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Decomposing immigrant wage assimilation
– the role of workplaces and occupations

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Decomposing immigrant wage assimilation - the role of workplaces and occupations

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Abstract

This article uses a matched employer-employee panel data of the Swedish labor market to study immigrant wage assimilation, decomposing the wage catch-up into parts which can be attributed to relative wage growth within and between workplaces and occupations. This study shows that failing to control for selection into employment when studying wage assimilation of immigrants is very likely to under-estimate wage catch-up. The results further show that both poorly and highly educated immigrants catch up through relative wage growth within workplaces and occupations, suggesting that employer-specific learning plays an important role for the wage catch-up. The highly educated suffers from not benefiting from occupational mobility as much as the natives do. This could be interpreted as a lack of access to the full range of occupations, possibly explained by difficulties in signaling specific skills.

Key words: Firm sorting, occupational mobility, wage assimilation, host country specific human capital, employer learning

JEL codes: D22, D31, J01, J31, J71

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1 Introduction

Due to growing evidence of poor labor market integration of recent immigrant cohorts, the economic integration of immigrants has become a cause of concern for policy makers in many western countries (for an overview, see Bauer, Lofstrom and Zimmerman (2000)). In the light of this an increasing focus has been directed towards understanding what mechanisms are at play in determining immigrants' outcomes in their host country. Contributing to this literature, this study decomposes wage catch-up into relative wage increases taking place within or between workplaces and occupations. This analysis gives indications of the mechanisms affecting immigrant wage catch-up. Furthermore it explores how controlling for individual unobserved heterogeneity affects wage assimilation estimates.

The paper uses a linked employer-employee dataset covering the majority of the Swedish labor market between 1995 and 2008. The longitudinal structure of the data makes it possible to study wage catch-up rates controlling for the composition of employed individuals, and the results indicate that estimates from repeated cross-sections might be biased. This study also shows that immigrants' relative wage growth mainly takes place within workplaces, which suggests that private employer learning is contributing to the wage catch-up of the immigrant group.

In many western countries immigration has gradually shifted from labor migrants towards refugees and family reunification immigration, and as an effect more recent immigrant cohorts have consisted of people from lower income source countries. This has likely contributed to lower entry wages for the group of immigrants, as labor migrants arrive with skills needed in the labor market, while the skills of the refugee immigrants are less often transferable to the host country labor market. Refugees are less likely to have acquired their education planning for a future in a new country, and an education from low income source countries is likely to be less comparable to the host country's educations (Borjas, 1992; Lalonde and Topel, 1992; Lubotsky, 2007; Bauer et al., 2000; Hammarstedt and Shukur, 2006).

Despite the fact that how to estimate immigrant's success in a host country has been subject to a debate among researchers for decades[1] the fact that estimates of earnings assimilation differs between studied immigrant groups is widely accepted. Western migrants have experienced high employment- and wage rates in most European labor markets, while this has not been the case for non-western immigrants. Many studies show evidence of slow earnings catch-up and a poor starting position

[1] See Lubotsky (2007); Sarvimäki (2011) for overviews of the debate.

for non-western immigrants, and this is also true for Sweden.[2] Le Grand and Szulkin (2002) uses a cross-sectional data and shows an 18 % wage gap for immigrant men from non-European countries after six years in Sweden. The gap decreases to about 12 % after 20 years.

A number of studies suggest that the immigrant-native wage gap is partly driven by ethnic segregation across both workplaces and occupations. For the US, with a long history of racial segregation, McTague et al. (2006) finds that racial segregation has decreased, but that it still explains a large part of racial wage differences.[3] Åslund and Skans (2010) show that immigrants in Sweden are overexposed to immigrant colleagues, something which is associated with lower average labor earnings. It has also been shown that the increased wage dispersion in the last 20 years has to a large extent been driven by increased wage dispersion among firms (Edin, Holmlund and Skans, 2007). This calls attention to understanding how sorting across firms acts as a possible mechanism of wage disparities between the groups. Aydemir and Skuterud (2008) and Pendakur and Woodcock (2010) show for Canada that recent immigrants are sorted into lower paying firms than non-recent immigrants.

Following these studies a strand of research has emerged which uses repeated cross-section or panel data to study the assimilation effect of sorting. The advantage of the repeated cross-sections is of course the ability to distinguish assimilation effects from cohort effects. Barth, Bratsberg and Raaum (2012) show that wage catch-up is slow in Norway, and that this could partly be explained by lack of access to workplaces with higher wage levels. Damas de Matos (2011) shows that immigrant workers in Portugal experience a closing of the wage gap of about 1% per year, and sorting across firms with higher wages can explain about one third of this wage catch-up. Similarly, Gotlibovski, Sauer and Weiss (2003) and Ekberg and Rooth (2006) study the role of occupational upgrading for increasing immigrant wages. Both studies find an initial occupational downgrading for immigrants, but Gotlibovski et al. (2003) find a larger subsequent occupational upgrading amongst immigrants in Israel than Ekberg and Rooth (2006) finds for immigrants in Sweden. Contributing to this literature I aim at decomposing wage catch-up for non-western immigrants in Sweden, studying sorting and mobility both between workplaces and

[2]See Hayfron (1998); Barth et al. (2012); Price and Shields (1998) for recent European estimates and Arai, Regnér and Schröder (2000); Hammarstedt and Shukur (2006); Edin, Lalonde and Åslund (2000) for Swedish estimates . Sarvimäki (2011) finds for Finland that most of the closing of the earnings gap can be attributed to increased employment rates among the immigrants, while Husted, Rosholm, Skyt Nielsen, and Smith (2002) attribute some of the relative earnings growth in Denmark to increasing relative wages.

[3]Ethnic occupational segregation is documented in US (Catanzarite, 2000), UK (Elliott and Lindley, 2008), as well as Sweden (Le Grand and Szulkin, 2002)

occupations.

Studying wage assimilation offers the methodological difficulty of how to deal with the fact that wage earners are a selected sample of individuals in the labor market (Husted et al., 2002). Workers need to be employed to earn wages. The employment rate is however low among recent immigrants in many OECD countries (Bauer et al., 2000), in particular among those from low income source countries (Hammarstedt and Shukur, 2006), and therefore selection into employment might be even more pronounced than it is for natives.[4] As employment rates increase, with time the individuals who have a job the first years in the host country are likely to differ in some unobservable dimension from those who find their first job several years later. For this reason estimates of wage assimilation will be biased unless the composition of individuals at work is properly accounted for.

Using a longitudinal data for the years 1995-2008 consisting of about 21 million observations I estimate a wage assimilation model controlling for individual unobserved heterogeneity. This study shows that the wage catch-up is underestimated if the selection into work is not accounted for, which has implications for how estimates from repeated cross-sectional data should be interpreted in settings where there is selection on unobservables into work. The immigrants experience a wage catch-up of between 5-10 percentage points over 30 years regardless of their education level, starting out from between -16 and -19 percentage point wage gap.

I furthermore decompose the wage catch-up by introducing workplace- and occupation -fixed effects respectively into the wage model, thereby accounting for mobility into high wage firms and/or occupations.[5] Furthermore, I control for the individual- workplace (or individual-occupational) match heterogeneity and study how the wage assimilation rate within given workplaces and occupations compare with the total wage catch-up rate. This yields novel insights as to how different aspects of worker mobility contributes to the wage catch-up of immigrants. Regardless of education most of the wage catch-up can be attributed to immigrants having higher within-workplace wage growth than natives. Neither cross-occupation nor cross-workplace mobility contributes to narrowing the wage gap. University-educated immigrants even fall behind natives in terms of benefiting from occupational mobility (i.e. their upward occupational mobility is slower), but experience a larger positive wage growth within occupations.

The high wage catch-up within given workplaces and occupations is in line with a

[4]See Lubotsky (2007) for a discussion on delayed earners.

[5] Damas de Matos (2011) focuses on the group of labor market migrants, who are likely to experience radically different wage growth patterns than non-western refugee immigrants.

private information employer learning model, where the employer is uncertain about the immigrant employee's productivity and therefore employs the immigrant on a lower entry wage than that of a comparable native. As the employer learns about the true productivity of the worker the wage increases. The wage growth is then larger than that for a native employee. The fact that highly educated immigrants experience a high within-occupation relative wage growth suggest that occupation-specific human capital becomes an important signal of skills in the host country. Altogether the results shows that the wage catch-up cannot solely be explained by acquisition of the host country-specific capital.

In the next section the potential mechanisms of wage catch-up is discussed. Section 3 and 4 describes the data and the variables of interest.The empirical specification is set up in section 5 and the results are presented in section 6. A robustness analysis is presented in section 7 and section 8 concludes the paper.

2 Country-specific human capital, information asymmetry and relative wage growth

The main barriers which immigrants face when entering a new labor market is the lack of host country specific skills and the difficulty of appropriately signaling skills and experiences. As these barriers are gradually overcome with time spent in the host country, they give rise to different patterns in relative wage growth, and therefore a decomposition analysis aimed at understanding where relative wage growth takes place can help us understand their relative importance for host country progress.

The traditional way of viewing the barriers which immigrants meet when entering the host country labor market is to focus on the lack of host country-specific human capital. If this is the main barrier it is likely that relative wages will increase through a gradual acquisition of such capital (Borjas, 1985). The most commonly considered specific human capital is language proficiency, and the extent to which fluency in the host country language affects the possibilities in the labor market is determined by the structure of the labor market and its need for communicative skills (Borjas, 1985; Lalonde and Topel, 1997). This suggests that the initial wage gap should be higher among the well-educated who might aspire towards parts of the labor market where communicative skills are particularly important. But it also means that the catch-up for this group should be more rapid as they acquire these skills.

A lack of language skills might also influence the initial workplace or occupa-

tion, as an immigrant-dense workplace might be easier to access if the host country language skills are poor. This acquisition of host country language skills is likely to improve labor market possibilities both within firms and across firms.

Another strand of the literature focuses on the uncertainty regarding the immigrants' productivity caused by the difficulty of correctly signaling skills. This can lead to statistical discrimination by employers who, due to imperfect knowledge, or perception, of individual immigrant workers' skills, could be inclined to hire a person based on knowledge of the group as a whole (Phelps, 1972). This reduces the number of jobs and workplaces that are available for immigrant job-seekers, and suggests that labor market sorting can, at least to some extent, be explained by a lack of information about the skills and experiences of the foreign-born population.

In a dynamic framework the statistical discrimination theory develops into a model of employer learning which emphasizes the fact that an initially low evaluation of worker productivity can be revised as the employer learns about the true productivity of the worker. Depending on the assumption regarding how labor market learning takes place the employer learning model will give different predictions for relative wage growth. In a public employer learning model all employers learns symmetrically about the productivity of the worker (Altonji and Pierret, 1997), and the increased information improves on outside options for immigrants. Thereby it leads to relative wage increases from both mobility in the labor market as well as from wage increases in the workplace. But if learning is instead assumed to be asymmetric, the current employer has the advantage of observing the productivity of the worker first hand (Oettinger, 1996) and then wage gains from revealed productivity primarily takes place within the workplace. This suggests that wages catch up mostly within firms where the employer has the chance to learn about the immigrant worker. A similar argument can be made about wage catch-up within given occupations, where acquiring experience in a specific occupation will reduce the uncertainty of the skills of the employee and therefore lead to higher within-occupation catch-up.

3 Data

In this project I use the Wage and Salary Structure Data from Statistics Sweden. This dataset covers all public sector workplaces and a stratified sample of private sector workplaces in the Swedish labor market, where stratification is based on the combination of firm size and industry. All employees of the sampled firms are included in the data. About 50 % of all employees in the private sector are included

in the data set, with an over-sampling of large firms.[6]

Wages are standardized into full-time monthly equivalence wages, so the wage is independent on the hours a person works in the observed month. Data also contains information on occupations, based on 3-digit ISCO coding. This dataset links individuals to workplaces through tax records on annual income. For individuals with multiple sampled jobs in the same year, the employment with the highest total income (by year) is used for the analysis. Individual data contains information such as age, sex, country of origin, year of entry to Sweden and highest level of education. Country of origin is used to classify whether an immigrant comes from a non-western country or not. This study will only focus on the labor market outcomes of the group of non-western immigrants, as this group is overlaps highly with the group of refugees who have not migrated for labor market reasons. This makes them a suitable group for studying labor market progress, reducing the risk of selective in-migration based on employment prospects. Unfortunately, the country of origin variable is not perfect and some countries share the same country code due to confidentiality reasons as the groups of immigrants from a specific country can be very small in certain years.[7] All future data description and analysis contains only immigrants from non-western countries as well as natives.

To further restrict the sample towards mainly including refugee immigrants, all immigrants arriving before 1975 are excluded. Furthermore, I exclude all child-immigrants from the sample, since the experiences from the host country differs substantially between those arriving as grown-ups and those migrating at a young age (see Friedberg (1992) for a discussion). Also workers who change educational status during the observed years are excluded from the baseline analysis, as this reduces the risk of measurement error.[8] A result of this restriction is that one avenue through which success in the labor market can be obtained is eliminated from this analysis.

After these sample selection restrictions are imposed the data contains about 21 million observations, more or less evenly distributed over 14 years. In total 136,856 non-western immigrants are observed in the data compared to 2,689,472 natives. The analysis includes natives between 18 and 65 and immigrants between 20 and 65. Over the whole 14 years the number of workplaces observed is 150,324, and

[6]The data collection is in November so everyone who is employed during that specific week is in the data. This means that seasonal workers are not included.

[7]See list in Appendix for countries which are classified as non-western in this analysis.

[8]The education variable represents the highest attained education level, so individuals changing status to a lower education are certain to be measurement errors. As it is not clear which observations are measurement errors when education status increases, just eliminating the observations with a declining education status would induce bias.

I follow 130 occupations.[9] Due to the sampling structure of the Wage and Salary Structure Data this dataset constitutes an unbalanced panel, with an undersampling of smaller firms. The sampling probability for an employed native is 52 % while it is 49.6 % for an employed immigrant, suggesting that the sampling probabilities are reasonably similar.

Since many firms in the data are very large (in the public sector for example every municipality is coded as a unique firm) and consists of several workplaces, firms are a potentially unsuitable unit for studying labor market sorting. Therefore the analysis will instead be performed on the level of the establishment/workplace. This implies that any estimates of mobility between workplaces also include mobility between workplaces within the same firm. As a sensitivity analysis, this choice of unit of analysis will be varied.

Linked-employer employee information is also available for the full labor market through the dataset RAMS (Register-Based Labor Market Statistics) from Statistics Sweden. The reason for not using this dataset of the full labor market is that it does not include information on monthly wages and occupational codes. I will use the monthly earnings data, which is available for all employed people, to perform a robustness analysis, constructing approximations of monthly wages from annual income records.

3.1 Descriptive statistics

Table 3.1 and 3.2 present some basic descriptive statistics in terms of mean values for the group of natives and non-western immigrants for the year 2002. Panel A of table 3.1 and 3.2 show descriptive statistics for data for which there is wage information. I refer to this dataset as the sampled firm data. For the decomposition analysis, the data has to be grouped to identify both individual and occupation or workplace effects (see discussion under empirical specification), and therefore the data used in the respective empirical analyses will differ slightly from this data I describe here. Panel B in the tables show the same descriptive statistics for the full labor market data.

There are slightly fewer men in the sampled firm data (since the full public sector is covered while only about half of employees in the private sector are sampled). The immigrants are slightly younger than the natives, which is mostly due to a small number of immigrants older than 55 and a large number of immigrants between 35

[9] See table A1 in the appendix for an overview of the different datasets used for the different analyses.

Table 3.1: Descriptive statistics - individual details - year 2002

	Sampled firm data		Full data (all residents)	
	Natives	Non-western born	Natives	Non-western born
Age	45.544	42.086	46.494	41.982
Male	0.452	0.487	0.519	0.513
<25 years	0.007	0.008	0.021	0.023
>25 years & <35 years	0.167	0.172	0.175	0.208
>35 years & <45 years	0.278	0.438	0.246	0.387
>45 years & <55 years	0.309	0.316	0.251	0.276
>55 years	0.239	0.066	0.277	0.098
Less than high school	0.143	0.195	0.229	0.289
More than high school	0.480	0.404	0.489	0.378
High school	0.377	0.401	0.282	0.333
Monthly wage (SEK)	23,042	19,266	23,042	19,266
Employment rate	0.989	0.956	0.783	0.534
Years since migration (Mean)		11.960		10.567
<5 years in Sweden		0.103		0.211
>5 years & <10 years in Sweden		0.328		0.292
<10 years & <20 years in Sweden		0.432		0.381
>20 years in Sweden		0.136		0.116
N	1,541,640	56,025	3,757,071	211,603

Note. Employment rate is based on register data, collected in November each year. A person is regarded as employed if she has worked at least one hour that week. For this reason not everyone who is sampled in the Firm Data will be regarded as employed, since they might not have worked that particular week. It is therefore a crude measurement of employment rate. The Wage information in the full data is only available for the observations of the firm data. Therefore the wages do not differ between the two panels.

and 45 years. The youngest age group is heavily under-represented, which has to do with the fact that those who change their educational status during the observation period are excluded from the baseline analysis. It is not surprising to see such a large proportion of the immigrants having more than high school education, as the immigrant group is heterogeneous, and recent cohorts of immigrants are highly educated (Eriksson, 2007). The immigrants who have been less than 5 years in Sweden are underrepresented in the firm data, but it seems that after 5 years they are starting to enter work on a larger scale. On average the immigrants earn 84 % of natives' wages, but the immigrants' employment rate is much lower than that of natives, about 68% of natives' employment rate.

Regarding how the two groups are distributed across workplaces, it is clear from table 3.2 that immigrants work in environments with more immigrant colleagues than do natives. More than 9 out of 10 natives work in workplaces with fewer than

10 % immigrant employees, while about half of the immigrants are employed in workplaces with more than 10 % immigrant employees. It is known that segregation is larger in small firms such as family businesses and immigrant entrepreneurs, which here are undersampled in the firm data. Therefore the description of workplace segregation might be underestimating segregation slightly. Immigrants are also slightlyunder represented in the public sector. In terms of segregation across occupations, the full data cannot provide any additional information from the sampled firm data, and here it is clear that more immigrants than natives work in occupations with more than 10 % foreign born.

Table 3.2: Descriptive statistics - firm details - year 2002

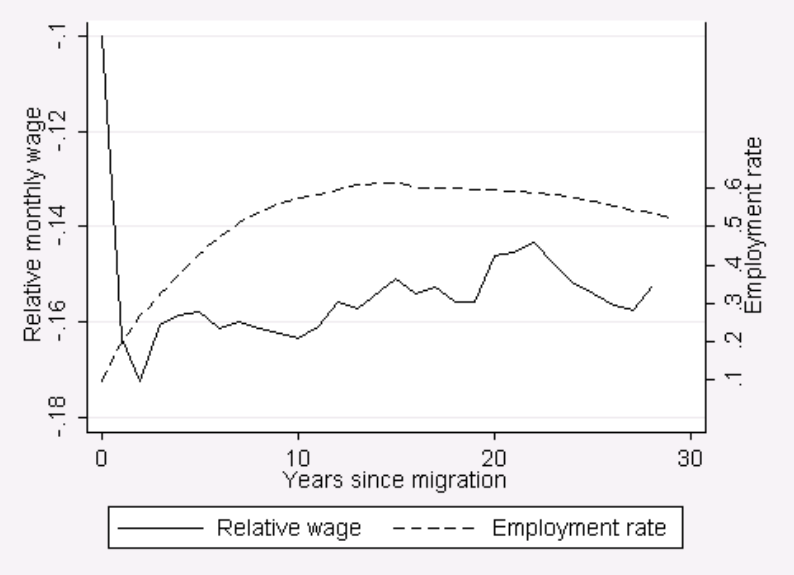
	Sampled firm data		All employed	
	Natives	Non-western born	Natives	Non-western born
Workplace segregation				
<10 % foreign-born	0.928	0.561	0.916	0.456
<25 % &>10 % foreign-born	0.056	0.234	0.062	0.218
<50 % &>25 % foreign-born	0.014	0.152	0.017	0.159
<75 % &>50 % foreign-born	0.002	0.044	0.003	0.069
>75 % foreign-born	0.005	0.012	0.063	0.168
Share in public sector	0.507	0.428	0.310	0.249
N	1,458,138	51,103	2,972,083	123,163
Occupation segregation				
<5 % foreign-born	0.844	0.543		
<10 % & >5 % foreign-born	0.1	0.21		
<20 % & >10 % foreign-born	0.057	0.248		
N	1,541,640	56,025		

Note. Sample sizes are here smaller than in table 3.1 due to missing values in workplace- or occupation identifiers

4 Describing relative wage growth

Figure 4.1 shows how the relative wage of the non-western immigrants compared to similar natives develops over Years Since Migration to Sweden (YSM) . Arrival

Figure 4.1: Relative wage



Note: Figures are plotted for the cohort arriving between 2005 and 2008. The relative wage of this cohort is the closest to the mean relative wage.

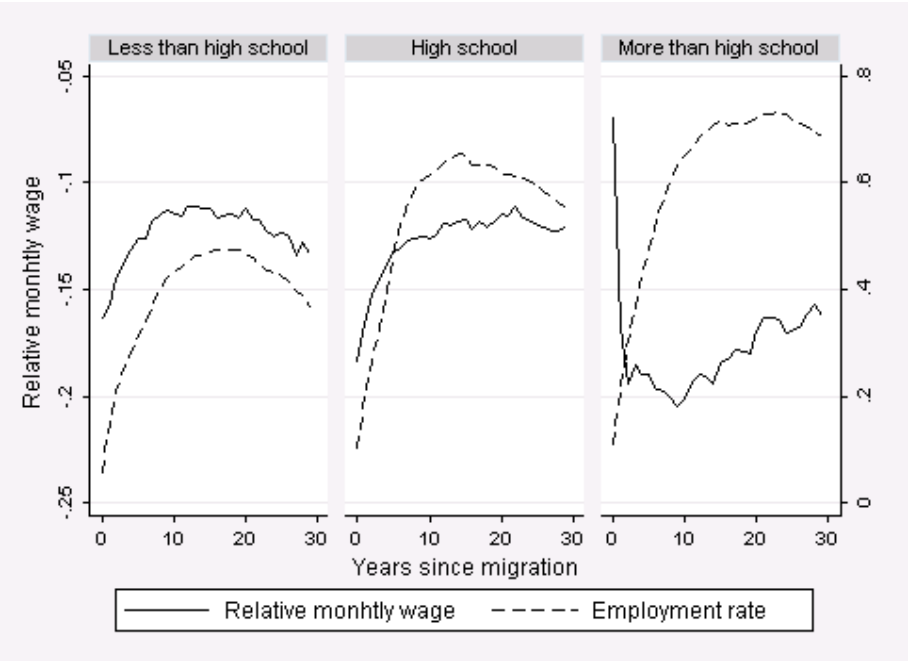
cohort is controlled for through 7 dummies covering the time span from 1975 to 2008. The relative wage increases from about -17% of natives to around -15% after 25 years in Sweden, which means that on an aggregate level the wage assimilation seems virtually non-existent. The dashed line in figure 1 also shows the employment rate of the immigrants over Years since migration. The very low employment rate for the first years in Sweden shows that the relative wage of the immigrant group these years is an average of fewer observations than later years.

Those who find a job early have a higher unobserved wage earning potential than those who find a job later on, which means that the first entrants in the labor market enter on higher wages than later entrants. This is also what we see, when in the first two years, relative wage is actually higher than in the succeeding years.[10]

Figure 4.2 shows the same description of the relative wage for the different education groups. Here it is evident that the pattern of high wage earners entering the labor market in the first years that we saw in the previous figure is driven by the group of highly educated individuals. They start out at -19% of comparable natives'

[10] One could worry that the early entrants into the labor market are labor migrants from developing countries and that a more fine distinction based on reason for immigration would eliminate this pattern. I have performed an analysis where I only study refugees arriving from former Jugoslavia during the years of 1993-94 when they experienced a war. The same pattern can be found for this group.

Figure 4.2: Relative wage over educational attainment



wages (first two years ignored) and from there on they increase their relative wage up to -16% after 30 years. The other education groups' relative wage curves are similar in shape, but the high school graduates have a larger relative wage increase, from -18% to -12% in the first 10 years. This same analysis is performed separately for women and men, and the results are presented in figures A.2 and A.3 in the appendix. The wage curve patterns are similar for both men and women, but the initial wages are higher for men. Also, it is clear that men start out on a lower relative wage than women do.

5 Empirical specifications

5.1 Estimating wage catch-up

In the basic synthetic panel data model (Borjas, 1985, 1999) immigrants' wages are estimated as a function of years since migration and age while the corresponding natives' wage growth is outlined as a function of age. Year of entry is also controlled for, given the evidence of cohort effects. A number of variations of the basic assimilation model have been used in the empirical literature, and the differences are most often due to the inclusion of fixed period effects and/or age at migration controls. Both these are important determinants of wage assimilation and should

be controlled for (Friedberg, 1992). The empirical problem is that including these controls introduces perfect linearities in the model, since the observation year equals the sum of the year of arrival and the years since migration (YSM) for the immigrants. Similarly age is a perfectly linear combination of years since arrival and age at migration:

$$\text{Year} \equiv \text{Arrival Year} + \text{YSM}$$

$$\text{Age} \equiv \text{Age at Migration} + \text{YSM}$$

Using a panel data it is possible to take both observed and unobserved individual heterogeneity in wage earning potential into account. Therefore my preferred specification includes controlling for individual fixed effects to eliminate the effect of all time-invariant unobservable characteristics of the individual. This reduces the identifying variation to within individual variation over time.

$$lnrealwage_{it} = \delta_{Imm} * Age_{it} + \theta_{Imm} * YSM_{it} + \mu_i + \varepsilon_i \tag{1}$$

$$lnrealwage_{it} = \delta_{Nat} * Age_{it} + \mu_i + \varepsilon_i \tag{2}$$

Here equation (1) estimates the log realwage for the individual i in year t, indicated as being an immigrant by the sub index Imm, and (2) the log realwage for individual i, indicated as being native by the sub index Nat. The wages of immigrants and natives are estimated simultaneously by interacting equation (1) and (2). The model allows for differential return to both age and years since migration for different education groups, but these interaction effects are excluded from the equations for notational purposes.

Individual fixed effects implicitly controls for age at migration, year of birth and year of entry (since these are time-invariant characteristics). This means that in addition to the previously mentioned co-linearities, when controlling for individual fixed effects, the effect of year of observation and age will be perfectly co-linear when implicitly controlling for year of birth (since Year $\equiv$ Age + Year of Birth). For this reason I do not include year fixed effects in the model (Borjas, 1999; Pischke, 1992).

Deflating the wage by CPI is a way to control for the trend in wages without controlling for year, which is why the log of real monthly wage is here used as the outcome variable.[11] Still, the coefficient for Age is constrained to be the same for natives and immigrants. Constraining the return to age to be equal for natives and immigrants in the labor market implies that the coefficient of interest, θ_{Imm} , should

[11] Here CPI for year 1990 is used as the reference year for deflating the monthly wages.

be interpreted as *the differential return to aging plus the return to spending time in the host country.* Henceforth this is what I will refer to as the wage catch-up parameter.

To more clearly study the part of this selection which is based on unobserved time-invariant characteristics I will contrast my individual fixed effect estimation results with results from a specification only controlling for observed characteristics.

6 Results

6.1 Is catch-up rate affected by selection into employment?

The most intuitive way of estimating wage assimilation would be to simply perform a regression of log wages on the time spent in the host country. But since the earlier description gave reason to suspect an initial positive selection into employment, the regular OLS results are likely to be downwardly biased. Before moving on to the results from the fixed effect estimations which controls for the composition of individuals at work I study whether or not time-invariant unobservable factors seems to matter for the wage catch-up rate. I do this by estimating the wage assimilation model controlling only for the observable parts of time-constant individual characteristics (ψ_{Immlt}). In practice this means that I replace the individual fixed effect μ_i with ψ_{Immlt} in equation (1) and (2). This variable is an index of all combinations of the observable time-invariant components of the individual fixes effect: immigrant status, year of birth and year of immigration (set to 0 for natives).

$$\psi_{Immlt} = \begin{bmatrix} \text{Origin}_{Imm} \\ \text{Year of Birth}_{l} \\ \text{Year of Immigration}_{t} \end{bmatrix}$$

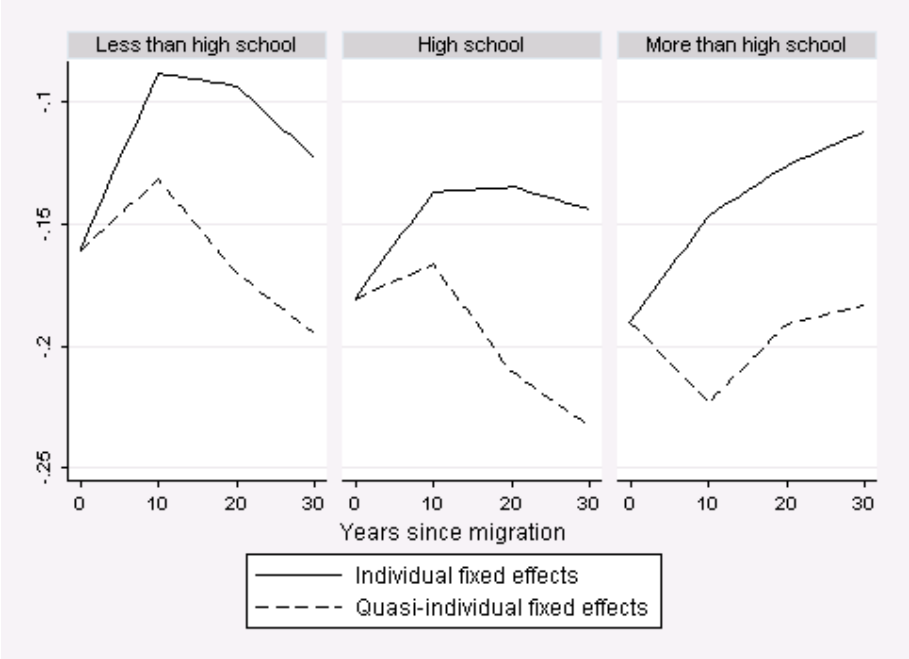
This means that the difference between $\theta_{Imm}^{Controls}$ and $\theta_{Imm}^{IndFixed}$ should be interpreted as the compositional bias of unobserved time-invariant individual characteristics on the wage catch-up rate.

The variable of interest is introduced as three splines, so linear estimates are allowed in three different intervals; (0-10, 10-20, 20-30 years since migration (YSM)). The reason for using a spline regression is that a polynomial functional form is driven by the distribution of observations over Years since migration and hence it is less precise at both low and high values of Years since migration (Husted et al., 2002).

These equations are primarily presented as figures, outlining the predicted wage

differences between native and immigrant workers at different years since migration (age for natives). Since this estimation controls for all time-invariant factors it is impossible to define a level of the immigrant native wage gap, but for illustrational purposes I impute the level of the initial wage gap using the description of figure 4.2.

Figure 6.1: Bias from selection into employment



Note: Predicted wages over the Years Since Migration (compared to a native of the same age). The initial gaps used are -16% (Less than High School), -18% (High School) and -19% (More than High School). Lines are drawn from estimates in column 1 and 2 in table A2 in the appendix.

Studying the fully drawn line which represents the wage catch-up controlling for individual fixed effects in Figure 6.1, the group of university educated immigrants experience the largest wage catch-up. Their relative wage increases by about 8 percentage points in 30 years (from an initial gap of about -19%). For the least educated, wage catch-up is high the first 10 years (about 7 percentage points) but then relative wage decreases again. The group of high school educated experience a rather small wage catch-up (about 4 percentage points) the first 10 years and then the relative wage remains relatively stable (at about -15% gap).

It is clear from figure 6.1 that when not controlling for the unobserved individual heterogeneity, wage catch-up appears lower than when it is controlled for, and the wage gap seems actually to be increasing with time in Sweden. The diverging relative wage when not controlling for individual fixed effects is in line with the

results from Norway where they do not control for the unobserved characteristics of the individuals in work at different points in time (Barth et al., 2012). But this pattern implies that the average wage of the *immigrant group* decreases over time as individuals with a lower earnings potential enter the labor market, and do so in lower paying positions. This pattern is most pronounced for the university educated, which is the group where there are a substantial number of workers entering on high wages during the first years. This analysis lends support to the hypothesis of an initially positive selection into employment, and highlights that it is crucial to account for individual fixed effects when estimating wage catch-up.

This analysis is also done using the data set of the full labor market instead, and the result is robust. This means that the result is not driven by a selection into the part of the labor market sampled in the firm data. The results are also robust to inclusion of a 95 % confidence interval on the predicted wages (Shown in table A5 in appendix).

6.2 Decomposing wage catch-up

The second purpose of this study is to disentangle how movements between, and wage growth within, workplaces and occupations contribute to wage catch-up for the immigrant workers. This decomposition is performed by estimating a double fixed effect model, introducing workplace- and occupation fixed effects respectively in the individual fixed effect model, following Abowd, Kramarz and Margolis (2003). Decomposing wage catch-up over workplaces means estimating the interaction of equation(1) and (2) but including a workplace fixed effect (ψ_j) which is set equal for both immigrants and natives. Here the individual effects (μ_i) can be interpreted as the effect on wages of the innate human capital of the worker regardless of which workplace he or she might be working in. The fixed workplace effects (ψ_j) can be seen as the time-constant wage premium for workers who work in that specific workplace, regardless of their own ability, motivation or earnings potential (Abowd and Kramarz, 1999).

By introducing workplace fixed effects the sorting across workplaces with different wage levels is controlled for and the estimated wage catch-up can be interpreted as catch-up among workplaces with similar wage levels. This simultaneous identification of individual and workplace effects requires that there are workers who have changed employer, and that there are other employees in both workplaces to contrast the wage outcome with (Abowd, Creecy and Kramarz, 2002).[12]

[12]See table A1 in the appendix for mean number of workplaces and occupations of natives and

This decomposition outlined above will also be done in the exact same manner, studying the role of sorting over occupations instead, and the interpretation of the parameters will be the same, replacing workplace with occupation.

But there might be wage catch-up which is taking place due to mobility in the labor market which is not associated with moving to higher-paying workplace or occupation. The previous specification cannot distinguish the sorting effect from the mobility effect. Therefore I will also study the wage catch-up within given workplaces and occupations by controlling for the interaction between individual and workplace/occupation fixed effects. Controlling for this interaction reduces the identifying variation to the variation within each match of individual-workplace/occupation and therefore the estimated wage catch-up from this specification should be interpreted as wage catch-up within workplaces or occupations.

This decomposition model assumes that the workplace (occupational) fixed effects are the same for the immigrants and the natives employed in the same workplace (occupation). In sections 6.3.1 and 6.4.1 this assumption will be relaxed, which yields insights into whether or not sorting across workplaces (occupations) is related to the overall wage levels of the workplace (occupation) or the wage level for the immigrant group versus the wage level of the native group.

6.3 Wage catch-up within and between workplaces

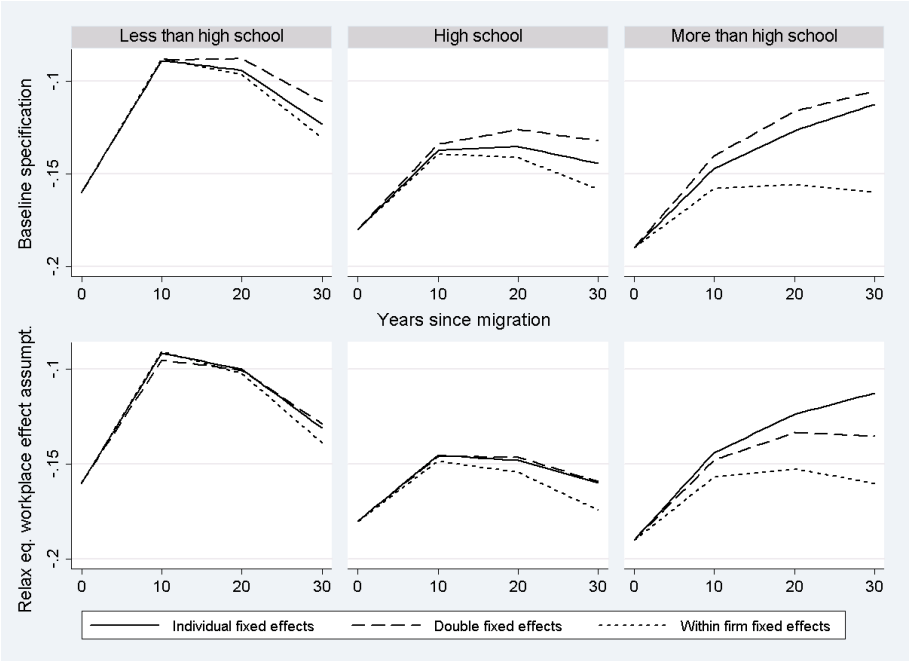
By decomposing where immigrant wage catch-up takes place this study offers insights into what mechanisms are at work in determining the immigrants' outcomes in the host country. Here the decomposition of the wage gap is performed through estimating equations (1) and (2) both without and with workplace effects. Each estimation here is outlined as one line in Panel A of figure 6.2.[13] The fully drawn line is the exact same fully drawn line as in the previous figure, and it shows the development of the predicted wage gap, controlling for individual heterogeneity. The dashed line shows the results of the specification controlling for both individual and workplace unobserved heterogeneity. The differences in the estimates between the two models should be seen as the part of wage catch-up which takes place because of sorting into workplaces which pay higher wage premiums. I also estimate the above model including the interaction of individual and workplace fixed effects. The estimates from this specification correspond to the dotted line in panel A of figure 6.2. The difference between the total wage catch-up and this catch-up can be seen

immigrants in the different data sets.

[13]Lines drawn from regression estimates in column 2-4 in table A2 in the appendix.

as catch-up due to workplace mobility.

Figure 6.2: Decomposing wage catch-up - workplaces



Note: The fully drawn line in the figures represent the estimates when including covariates and individual fixed effects. The dashed line is from a specification where also firm fixed effects are included alongside individual fixed effects. Finally, the dotted line is from the specification where instead the interaction of individual and firm effects is controlled for.

In terms of where the wage catch-up takes place, there are small differences in the specification with and without workplace effects (the confidence intervals of the predicted wages overlap each other, see table A5 in appendix). This means that wage catch-up mainly takes place either within the given workplace or from movements into workplaces of similar wage levels.[14]

For those with at most high school education the wage catch-up within workplaces is very similar to total wage catch-up. This means that neither mobility between workplaces nor sorting into higher-paying workplaces contributes to the relative wage growth for this group.[15] For the more highly educated, on the other

[14] As relative wages of immigrants and natives can also be affected by firm's wage setting behavior (as opposed to the workplace's), I have performed the same analysis as presented in figure 6.2 using the firm as the unit of analysis. There results are robust to the choice of unit.

[15] With the empirical set-up I am using, I cannot rule out that some firms offer better wage returns than others, and that immigrants are sorted into these firms. As a tentative test, I have limited the analysis to establishments which employ a fair number (at least five each) of both groups, finding an identical role for within-establishment catch-up, suggesting that differential wage growth within the same firms is a key element in the process which narrows the wage gap.

hand, the story is different. This group experiences a relative wage increase within workplaces which is much lower than their total wage catch-up. This implies that they increase their relative wage by changing workplaces. When studying the data for the full labor market this result changes. For this data there is no wage information, but approximate wage measures are constructed from annual incomes and months of work. This means that in the full labor market the highly skilled experience the same high within workplace catch-up which the low skilled show in the sampled firm data (see Appendix for details on this analysis). The decomposition results are similar for both men and women (results in figure A.4 in appendix).

6.3.1 Relaxing the assumption of equal workplace effects

The earlier analysis of how sorting over workplaces and occupations is affecting the wages of the immigrants assumes that the wage premium of entering a given firm or occupation is the same for natives and immigrants. But some workplaces may pay the groups differently, or employment within given occupations may be rewarded differently for the two groups. If this is the case then immigrants could over time sort into workplaces or occupations which pay on average higher wages for them as a group, even though we did not see this positive sorting effect when assuming that firm and occupation effects were equal for the groups.

The procedure for determining separate firm fixed effects for natives and immigrants is done in two steps. First, the double fixed effects model is estimated for natives, with controls only for age. This is the same as equation 2 estimated earlier in the interactive framework.

$$\log \text{realwage}_{it} = \delta_{Nat} * \text{Age}_{it} + \mu_i + \theta_j^{Nat} + \varepsilon_i \tag{3}$$

In the second step, the predicted values from this estimation will be subtracted from the wage level for the immigrants, thereby eliminating the part of the immigrant's wage which is due to age (still keeping the equal age effect assumption as in the baseline model). The revised wages for the immigrants will then be used as outcome variables in the double fixed effects model for the immigrants.

$$(\log \text{realwage} - \log \widehat{\text{realwage}}_{nat})_{it} = \theta_{Imm} * \text{YSM}_{it} + \mu_i + \theta_j^{Imm} + \varepsilon_i \tag{4}$$

This way the coefficient θ_{Imm} in equation 4 can be interpreted as wage catch-up controlling for the group-specific wage premium for entering a specific firm. For the 7,149 workplaces where I can identify both a native and immigrant workplace wage premium the correlation between these premiums is only 17%. The variance

of workplace premiums for the immigrants is larger than the variance for natives, and for almost all the workplaces the wage premium for immigrants is larger. As there are fewer immigrant observations the higher workplace premium variance and the low correlations between the workplace premiums for natives and immigrants can be interpreted as a low precision in the estimation of the workplace fixed effects for the immigrants.

The results from the regressions allowing differential firm effects for the natives and the immigrants are shown in Panel B of figure 6.2. Qualitatively the results do not change much, but the catch-up among workplaces of similar wage levels is now lower than in Panel A.

For the poorly educated, there is no significant difference between the total predicted catch-up and the wage catch-up conditional on group-specific workplace fixed effect (see table A5 in appendix for confidence intervals). This, however, is not the case for those with more than high school education, who are increasing their relative wage by moving into workplaces with higher immigrant premiums.[16]

6.4 Wage catch-up within and between occupations

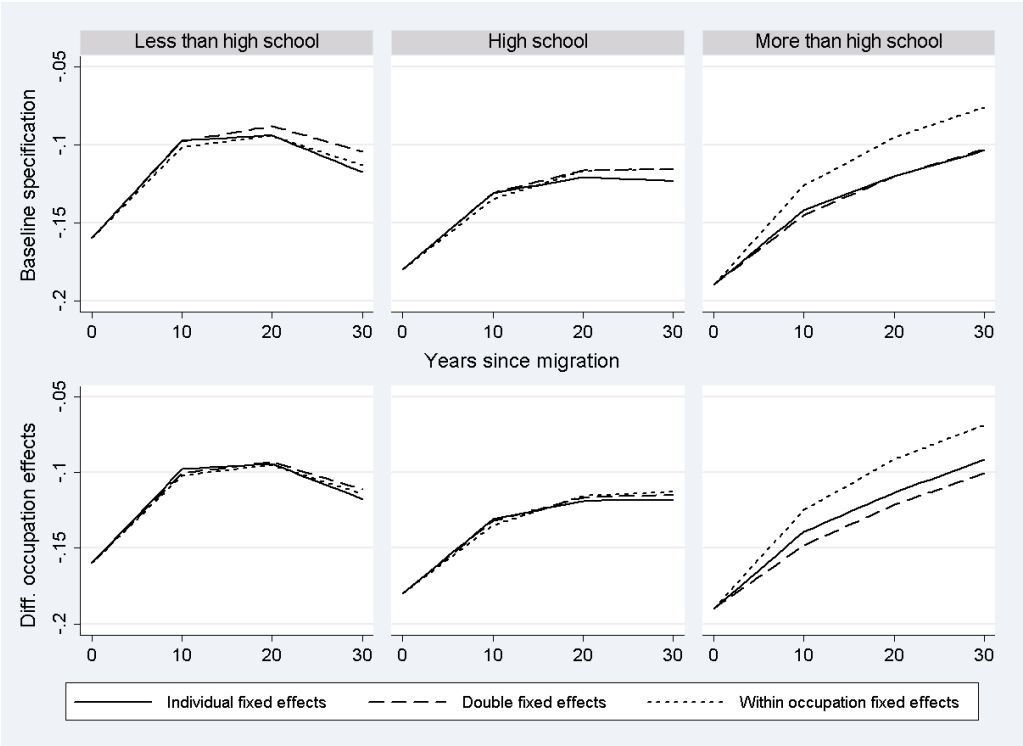
By studying how relative wages grow within occupations and from mobility between them we will reach a better understanding of how skills are utilized and signaled in the host country labor market. The same analysis as above is performed here, employing occupation dummies instead of firm fixed effects. Panel A of figure 6.3 shows the results when assuming equal occupation effect for natives and immigrants. Again, total wage catch-up is represented by the fully drawn line and is the same as we have seen in the previous figures.[17] Regardless of education level, the assimilation rate within occupations of similar wage levels is very similar to the total assimilation rate, indicating that sorting into higher-paying occupations does not contribute to wage catch-up (they lie within the confidence interval, see table A5 in appendix). What is evident from figure 6.3 is that the highly educated are experiencing a high within occupation wage catch-up, which also means that wage assimilation for this group would have been substantially larger had immigrants gained as much from

[16] Due to the identification requirements for both individual- and workplace fixed effects in the same model the whole sample of workplaces cannot be included in this analysis. The sample used here for the analysis will be the workplaces for which I can identify a separate workplace effect for natives, and in the second step I will use the workplaces for which I can estimate workplace effects for the immigrants (these workplaces does not necessarily have to be the same workplaces).

[17] They might differ slightly due to missing values in either workplace of occupation identifiers, as well as due to grouping which has altered the observations used. Also, only the years 1996-2008 are used here as 1995 does not have the same occupation codes.

occupational mobility as do the highly skilled natives. The decomposition results are similar for both men and women (results in figure A.5 in appendix).

Figure 6.3: Decomposing wage catch-up - occupations



Note: The fully drawn line in the figures represent the estimates when including covariates and individual fixed effects. The dashed line is from a specification where also occupation fixed effects are included, alongside individual fixed effects. Finally, the dotted line is from the specification where instead the interaction of individual and occupation effects is controlled for.

6.4.1 Relaxing the assumption of equal occupation effects

Results from relaxing the assumption of the equal occupation effect are outlined in Panel B of figure 6.3. Here it is clear that the wage gain from sorting is no different when assuming equal or differential occupation effects for the poorly educated. But as with the workplace analysis there is a slightly higher total catch-up than the catch-up within occupations of similar wage levels for the highly educated. This means that sorting into occupations which are better paying for immigrants contributes to narrowing the wage gap for this group.

The correlation between wage levels in different occupations for natives and immigrants is 72%, and there are about as many occupations for which the wage premium is higher for immigrants than for natives as occupations where the opposite

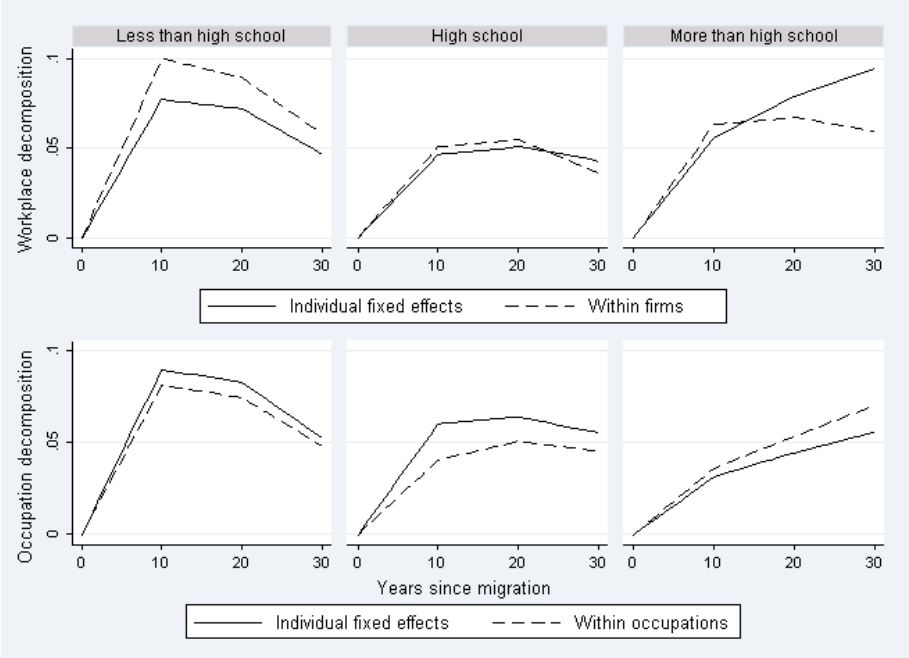
holds.

7 Robustness checks

7.1 Low mobility bias

The immigrants change employers as well as occupations less often than do the natives in the data. This is also true in the data for the full labor market. About 50 % of the immigrants do not change either workplace or occupation while the number is a little bit smaller for natives. For this group, the within workplace catch-up will be the same as total catch-up, which of course suggests that the small difference between within-workplace (and within-occupation) catch-up and total catch-up rate could be driven by this low mobility.

Figure 7.1: Low mobility bias?



Note: Predicted wage gap over the Years Since Migration (compared to a native of the same age).

Here results are presented from regressions excluding those individuals who do not change employer or occupation. Within-workplace catch-up is even larger for the poorly educated than we saw earlier, further reinforcing the result that within workplace wage growth is a main contributor to catch-up even for those who change employer. Regarding occupations within occupation catch-up is slightly lower for

all groups when excluding those who never change occupation. This means that the higher within occupation wage catch-up we saw earlier is driven by both wage catch-up within occupations for non-movers and for movers.

8 Conclusions

This study shows that wages of immigrants catch up mainly within workplaces and occupations and that neither workplace nor occupational mobility contributes to raising the relative wage for immigrants in Sweden. Secondly, it shows that estimates of wage catch-up will be biased if the initial positive selection into employment is not taken into account. Barth et al. (2012) estimate an increasing immigrant-native wage gap with time spent in Norway without controlling for individual fixed effects, and this is in line with the wage assimilation rate estimated here when not taking the selection into employment into account.

The total wage catch-up is highest for the best educated, for whom catch-up it is about 8 percentage points after 30 years. The other groups have a higher early catch-up which stops after about 10 years, but for the more poorly educated we see a decline in the relative wage after some years, possibly due to a diminishing return to human capital acquisition with time. The higher catch-up for the more highly educated could be explained by the greater importance of gaining the human capital needed to succeed in the part of the labor market which the highly educated enter.

The decomposition of the wage catch-up into wage catch-up within workplaces and from mobility between workplaces shows that immigrants' wages grow relative to the natives almost entirely because of higher wage growth within their workplaces. The higher within workplace wage growth for the immigrants could imply that the immigrants are initially hired on wages lower than their productivity and that once they are employed in a firm their wage growth is larger than that of natives. The fact that there is no wage catch-up from mobility in the labor market indicates that as the current employer learns about the true productivity of the workers, other employers are not learning as much. This also indicates that language acquisition is not the sole mechanism behind wage catch-up, in which case we would have seen wage catch-up also from mobility in the labor market.

This analysis also suggests that wage catch-up for the high skilled would have been substantially larger, had they gained as much from occupational mobility as do the natives. This implies that experience within a given occupation is more valuable for this group than it is for the natives, possibly due to a low transferability of human capital and home country experiences. The highly educated immigrants

experiences positive relative wage growth from sorting into workplaces and occupations with higher wage levels for the immigrants as a group. But these effects are very small compared to the relative wage increases taking place within workplaces and occupations.

The sorting results contradict the estimates of Damas de Matos (2011) who shows that sorting into more high paying firms can explain about one third of the closing of the wage gap among labor market migrant workers in Portugal. This can possibly be explained by the studied group of workers, since Damas de Matos (2011) only studies low-skilled labor migrant workers in the private sector and follows them for up to 10 years. The decomposition results of this study are more in line with the Norwegian estimates, where the lack of wage catch-up is to a large extent explained by a lack of sorting into high paying workplaces (Barth et al., 2012). The low catch-up from occupational mobility for the highly educated immigrants is in line with the results of Ekberg and Rooth (2006) who show that there is a low upward occupational mobility for the group of highly educated immigrants in Sweden.

This has been a first step in trying to decompose the wage assimilations for non-western immigrants, who as a group has proven to experience difficulties in many western labor markets, and it sheds light on the different barriers which poorly and highly educated non-western immigrants meet. This study gives us some answers as to why wages for the non-western immigrants do not catch up fully with natives even after many years in the labor market, but it also raises new questions. Why is the catch-up not larger? What is the role of the initial labor market attachment for subsequent wage growth? How does initial segregation translate into further economic outcomes? I leave this for further research.

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A Appendix

A.1 Data and variable description

Full data- RAMS (Register based labor market statistics)

Consists of LOUISE- Individual register data, FTGAST-Firm register data, and ANST-Connections between firms and individuals. Available for the years 1995-2008. Includes individuals between the age of 16 and 64 for the years 1995-2000, and between 16 and 74 for the years 2001-2007.

Firm data - wage and salary structure data

A stratified sample of firms and their employees, for 1995-2008. Contains all firms in the public sector, and a sample of firms in private sector. Firms with more than 500 employees have sampling probability equal to 1. In total, about 50 % of employees in the private sector are covered.

Variables

Wage Monthly wage (full time equivalents) - Registered wages from Firm Data.

Log real wage Total monthly wage deflated by CPI, 1990 being the reference year. Based on Monthly Wage (above).

Log real approximated wage Annual income divided my number of months in employment for a specific firm-individual match. Deflated by CPI, 1990 being the reference year.

Education Less than High School=Up to 10 years of schooling; High school=11-12 years of schooling; Post High School Education=At least some tertiary education, includes vocational training as well as university education.

Years since migration Years since the year of residence permit in Sweden. Based on calender year.

Immigrant The variable is defined from the information of country of origin. It takes on the value 1 if the individual origins from any of the non-European states, with the exceptions listed here:

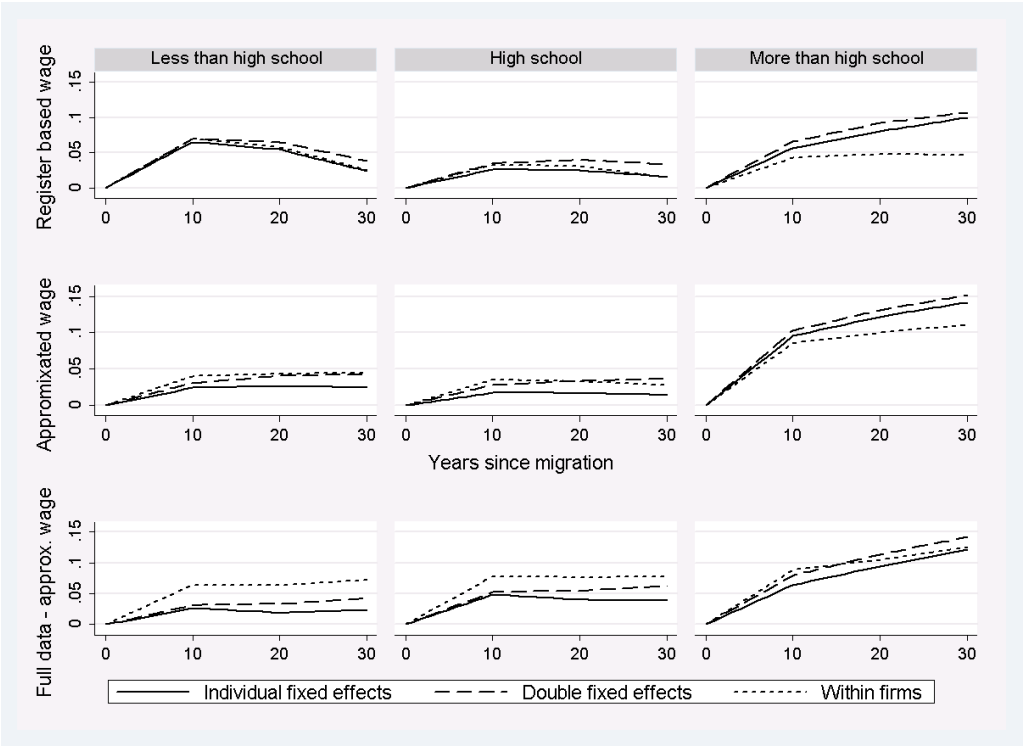
- European countries coded as non-Western countries: Yugoslavia, Croatia, Macedonia, Slovenia, Bosnia-Herzegovina, Albania, Bulgaria, Romania, Russia, Ukraine, Belarus.
- Non-European countries not coded as Western countries: USA, Canada, Australia, New Zealand and other countries in Oceanic region, Japan, China, South Korea, Hong Kong.

Firm Identifiers for the firm. Large organizational units can be coded as one firm, in the public sector all municipal workplaces belong to the same firm

Establishment Identification numbers for the actual workplace

Occupation 3-digit ISCO coding for occupation

Figure A.1: Wage catch-up in the full data



Note: The fully drawn line in the figures represent the estimates when including covariates and individual fixed effects. The dashed line is from a specification where also firm fixed effects are included. Finally, the dotted line is from the specification where instead the interaction of individual and firm effects is controlled for.

A.2 Using the full data - approximate wage measure

Using the full data set, I construct approximate measures of monthly wages from the annual income variable standardized by the number of months in this specific employment. The data does not contain information on hours of work so I exclude all individuals with a approximate wage below 75% of the mean wage for a publicly employed janitor (see Edin et al. (2007)). This cut-off is chosen since it can be seen as a minimum wage for a full-time employed person. This approximate wage measure has an 87% correlation with the register-based wage. This variable is used to perform a similar decomposition of the wage catch-up along the lines of sorting across workplaces as has been done above and the results are presented in figure A.1.

To understand the difference between this baseline analysis and the same analysis on the full data set, presented in panel C of figure A.1, it is important to disentangle differences driven by the new data and differences driven by the use of the approximate wage measures. Therefore I have performed an analysis where I decompose the wage catch-up with the register-based wage variable and with the approximated wage measure

using the exact same data. These are presented here in panel A and Panel B of figure A.1.[18] From figure A.1 it is clear that the level differences in wage catch-up between the estimations in the firm data and in the full data can be attributed to using another wage measure in the full data. But it is also clear that the higher within workplace wage catch-up is not explained by the choice of wage variable, but should rather be seen as higher with workplace wage catch-up when studying the full labor market.

[18]Panel A in figure 6.1 and figure A.1 differ only due to the data restrictions. Here I can only include observations where the approximate wage is non-missing. See table A1 in appendix for comparison of data

A.3 Analysis divided by sex

Figure A.2: Relative wage growth - women

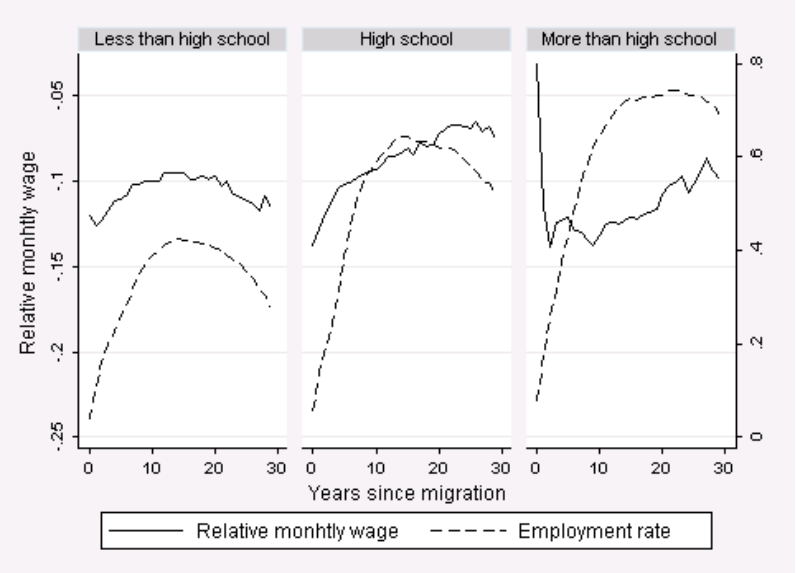


Figure A.3: Relative wage growth - men

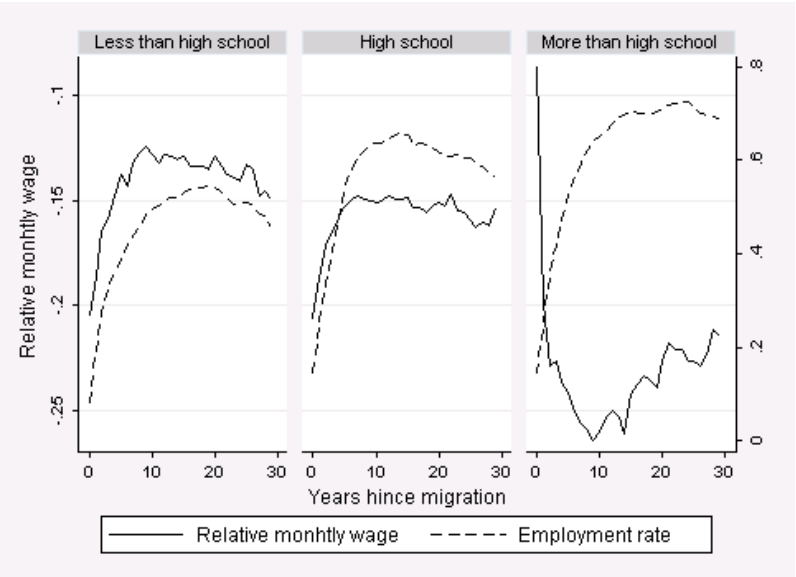


Figure A.4: Men and women - workplace decomp

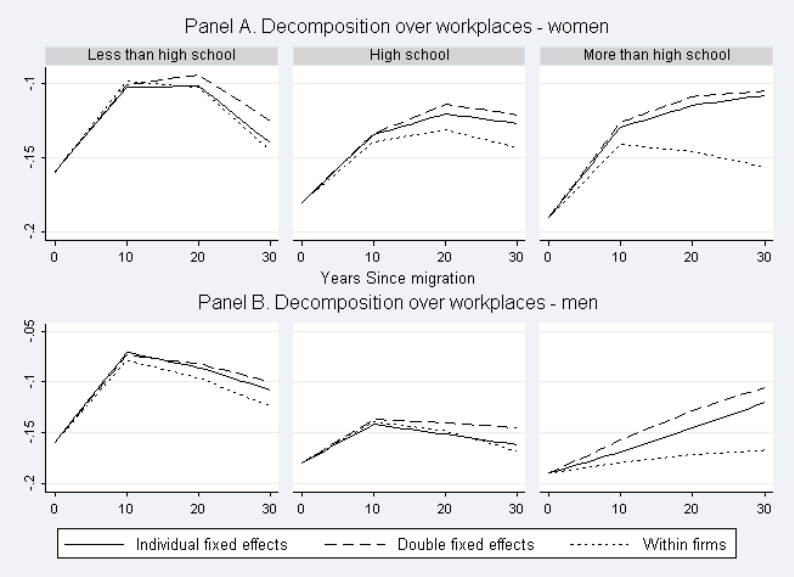


Figure A.5: Men and women - occupational decomp

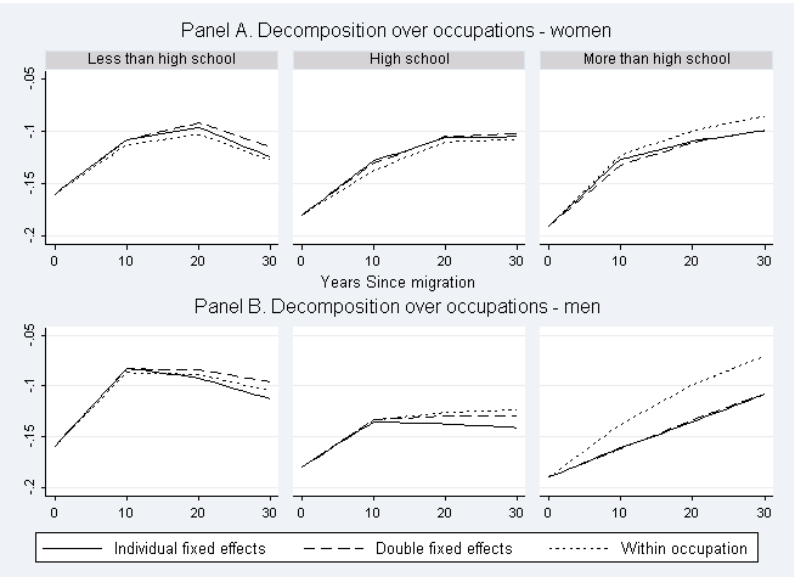


Table A.1: Description of data sets

Used for regression	Column 1-4 of table A2	Column 1-3 of table A3	Column 5-8 of table A2	Column 4-6 of table A3	Column 1-6 in table A4	Column 7-9 in table A4
Shown in figure	Panel A of figure 6.2	Panel B of figure 6.2 (immigrants)	Panel A of figure 6.3	Panel B of figure 6.3 (immigrants)	Panel A and B of figure A.1	Panel C of figure A.1
# individuals	2,706,959	110,613	2,760,730	134,683	2,448,671	3,232,513
# natives	2,580,665		2,626,280		2,344,930	3,078,126
# immigrants	126,294	110,613	134,450	134,683	103,7410	154,387
# Workplaces	126,273	15,942	143,609	36,301	118,457	275,541
# occupations	130	125	124	124	130	130
# workplaces /native (mean)	1.949758		1.953678		1.859354	2.333669
# occupations /native (mean)	2.010204		1.635184		1.915435	2.142445
# workplaces /imm(mean)	1.756726	1.703733	1.802402	1.805499	1.649762	1.89205
# occupations /imm(mean)	1.582553	1.555522	1.420476	1.423431	1.522349	1.754455

A.4 Detailed regression results

Table A.2: Decomposition over workplaces and occupations

	Workplace decomposition Corresponds to lines in Figure 6.1 and Panel A in Figure 6.2				Occupation decomposition Corresponds to lines in Panel A in Figure 6.3			
	(1) Quasi-fixed effect	(2) Individual-fixed effect	(3) Within firm-fixed effect	(4) Double fixed effect	(5) Quasi-fixed effect	(6) Individual-fixed effect	(7) Within occupation-fixed effect	(8) Double fixed effect
Male	0.199***				0.203***			
	(0.000330)				(0.000325)			
High school	-0.166***				-0.124***			
	(0.0135)				(0.0135)			
More than high school	-1.390***				-1.362***			
	(0.0168)				(0.0175)			
Refugee* less than high school	0.0604***				0.0834***			
	(0.00447)				(0.00412)			
Refugee* high school	0.0505***				0.0641***			
	(0.00377)				(0.00356)			
Less than high school* age	0.0387***	0.0596***	0.0549***	.0577173***	0.0349***	0.0611***	0.0545***	.0590924***
	(0.000863)	(0.000787)	(0.00102)	(.0004599)	(0.000848)	(0.000759)	(0.000831)	(.000552)
Less than high school* age2	-5.72e-05***	-0.000704***	-0.000611***	-.0006537***	-1.83e-06	-0.000763***	-0.000637***	-.0007235***
	(2.02e-05)	(1.75e-05)	(2.22e-05)	(9.91e-06)	(1.98e-05)	(1.68e-05)	(1.83e-05)	(.0000118)
Less than high school* age3	-1.37e-06***	4.18e-06***	3.58e-06***	3.80e-06***	-1.73e-06***	4.59e-06***	3.83e-06***	4.36e-06***
	(1.51e-07)	(1.26e-07)	(1.58e-07)	(7.06e-08)	(1.48e-07)	(1.21e-07)	(1.31e-07)	(8.19e-08)
High school* age	0.0533***	0.0653***	0.0584***	.0611871***	0.0468***	0.0593***	0.0535***	.0576173***
	(0.000544)	(0.000437)	(0.000542)	(.0002532)	(0.000566)	(0.000440)	(0.000448)	(.0002982)
High school* age2	-0.000392***	-0.000743***	-0.000629***	-.0006564***	-0.000279***	-0.000642***	-0.000565***	-.0006232***
	(1.31e-05)	(1.00e-05)	(1.22e-05)	(5.77e-06)	(1.35e-05)	(1.00e-05)	(1.02e-05)	(6.99e-06)
High school* age3	1.32e-06***	4.13e-06***	3.53e-06***	3.53e-06***	5.15e-07***	3.45e-06***	3.14e-06***	3.41e-06***
	(1.01e-07)	(7.41e-08)	(8.92e-08)	(4.25e-08)	(1.04e-07)	(7.39e-08)	(7.45e-08)	(5.21e-08)
More than high school* age	0.139***	0.121***	0.109***	.1109294***	0.134***	0.116***	0.104***	.1129714***

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Table A.2: Continued

	(0.000825)	(0.000669)	(0.000880)	(.0002796)	(0.000888)	(0.000683)	(0.000704)	(.0003112)
More than high school* age2	-0.00205***	-0.00145***	-0.00128***	-.0012754***	-0.00196***	-0.00139***	-0.00121***	-.0013635***
	(1.93e-05)	(1.48e-05)	(1.89e-05)	(6.17e-06)	(2.07e-05)	(1.50e-05)	(1.53e-05)	(6.75e-06)
More than high school* age3	1.20e-05***	7.02e-06***	6.16e-06***	5.98e-06***	1.13e-05***	6.69e-06***	5.87e-06***	6.70e-06***
	(1.46e-07)	(1.06e-07)	(1.32e-07)	(4.50e-08)	(1.55e-07)	(1.07e-07)	(1.09e-07)	(4.84e-08)
Less than high school* YSM1	0.00147***	0.00286***	0.00318***	.0025401***	0.000344	0.00136***	0.00134**	.0013047***
	(0.000497)	(0.000533)	(0.000676)	(.000331)	(0.000458)	(0.000488)	(0.000534)	(.0002685)
Less than high school* YSM2	0.000614*	-0.000743**	-0.000697*	-.0007178***	0.000919***	-0.000664**	-0.00109***	-.0004716**
	(0.000354)	(0.000317)	(0.000416)	(.0002062)	(0.000343)	(0.000299)	(0.000324)	(.0002136)
Less than high school* YSM3	-0.000309	-0.00200***	-0.00172***	-.0017213***	-0.000575	-0.00215***	-0.00201***	-.0016956***
	(0.000658)	(0.000468)	(0.000618)	(.0002748)	(0.000653)	(0.000443)	(0.000495)	(.0002794)
High school* YSM1	0.00141***	0.00427***	0.00407***	.0046033***	0.00203***	0.00491***	0.00451***	.0049152***
	(0.000309)	(0.000297)	(0.000385)	(.0001978)	(0.000297)	(0.000280)	(0.000307)	(.0001855)
High school* YSM2	-0.00440***	0.000210	-0.000181	.0008031***	-0.00400***	0.000992***	0.00181***	.001446***
	(0.000233)	(0.000190)	(0.000250)	(.0001348)	(0.000230)	(0.000182)	(0.000190)	(.0001216)
High school* YSM3	-0.00221***	-0.000923***	-0.00171***	-.0006117***	-0.00166***	-0.000222	0.000113	.0000564
	(0.000409)	(0.000281)	(0.000368)	(.000152)	(0.000407)	(0.000269)	(0.000280)	(.000141)
More than high school* YSM1	-0.00473***	1.33e-05	-0.000856	.0003738	-0.00414***	-9.41e-05	0.00187***	-.0004357
	(0.000475)	(0.000488)	(0.000613)	(.0002744)	(0.000458)	(0.000468)	(0.000552)	(.0003252)
More than high school* YSM2	0.00760***	0.00184***	0.000388	.001597***	0.00761***	0.00116***	0.00127***	.0010466***
	(0.000427)	(0.000325)	(0.000418)	(.0002278)	(0.000423)	(0.000312)	(0.000345)	(.0002158)
More than high school* YSM3	0.00299***	0.00234***	0.00132**	.0017179***	0.00269***	0.00190***	0.00183***	.0016775***
	(0.000821)	(0.000489)	(0.000618)	(.0002728)	(0.000817)	(0.000463)	(0.000493)	(.000267)
Observations	19,751,843	19,751,843	19,751,843	19,751,843	19,347,446	19,347,446	19,347,446	19,347,446
R-squared	0.411	0.922	0.957	0.931	0.401	0.925	0.951	0.9279

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Standard errors in double fixed effects estimations (column 5 and 9) are obtained through bootstrapping with 30 repetitions.

Table A.3: Allowing for differential firm and occupation effects

	Differential workplace effect Corresponds to lines in Panel B in Figure 6.2			Differential occupation effect Corresponds to lines in Panel B in Figure 6.3		
	(1) Fixed effect	(2) Within firm	(3) Double fixed effect	(4) Fixed effect	(5) Within occupation effect	(6) Double fixed effect
Less than high school* YSM1	0.00337***	0.00378***	.0030807***	0.00131***	0.00129***	.0011603***
	(0.000386)	(0.000443)	(.0005217)	(0.000332)	(0.000355)	(.0003926)
Less than high school* YSM2	-0.000546***	-0.000571**	-.0004878**	-0.000871***	-0.00126***	-.0008181***
	(0.000208)	(0.000239)	(.0002364)	(0.000186)	(0.000200)	(.0001412)
Less than high school* YSM3	-0.00196***	-0.00166***	-.0015564***	-0.00238***	-0.00215***	-.0019745***
	(0.000335)	(0.000370)	(.0003861)	(0.000301)	(0.000324)	(.0002174)
High school* YSM1	0.00349***	0.00318***	.0034074***	0.00491***	0.00450***	.0047884***
	(0.000195)	(0.000224)	(.000268)	(0.000168)	(0.000183)	(.000198)
High school* YSM2	-0.000295**	-0.000590***	-.0000475	0.00121***	0.00195***	.0015503
	(0.000123)	(0.000142)	(.0001476)	(0.000108)	(0.000114)	(.0001358)
High school* YSM3	-0.00115***	-0.00199***	-.0012744***	5.97e-05	0.000254	.0001669
	(0.000198)	(0.000232)	(.0002136)	(0.000173)	(0.000182)	(.0001429)
More than high school* YSM1	0.00113***	0.000165	.0008069**	0.000158	0.00202***	-.0006115**
	(0.000260)	(0.000307)	(.0003814)	(0.000225)	(0.000247)	(.0003077)
More than high school* YSM2	0.00232***	0.00101***	.0014904***	0.00139***	0.00139***	.0011257***
	(0.000173)	(0.000204)	(.0002234)	(0.000152)	(0.000162)	(.0002188)
More than high school* YSM3	0.00227***	0.00123***	.0010817	0.00210***	0.00201***	.0019152
	(0.000288)	(0.000341)	(.0002991)	(0.000251)	(0.000263)	(.0002285)
Observations	524,539	524,539	524,539	655,359	655,359	655,359
R-squared	0.981	0.987	0.981	0.981	0.983	0.981

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Standard errors in Double fixed effects estimations (column3 and 6) are obtained through bootstrapping with 30 repetitions.

Table A.4: Decomposition in the full data set

	Baseline regression Corresponds to lines in Panel A in figure A.1			Baseline with approx wages Corresponds to lines in Panel B in figure A.1			Approx wages in fulldData Corresponds to lines in Panel C in figure A.1		
	(1) Individual-fixed effect	(2) Double fixed effect	(3) Within firm effect	(4) Fixed effect	(5) Double fixed effect	(6) Within firm effect	(7) Fixed effect	(8) Double fixed effect	(9) Within firm effect
Less than high school* age	0.0525***	.0527029***	0.0507***	0.0334***	.0331806***	0.0321***	0.0620***	.065575***	0.0767***
	(0.001)	(.0005792)	(0.001)	(0.001)	(.0006775)	(0.001)	(0.001)	(.0004097)	(0.001)
Less than high school* age2	-0.0005***	-.0005368***	-0.0005***	-0.0000	.0000117	0.0000	-0.0007***	-.0007137***	-0.0010***
	(0.000)	(.0000128)	(0.000)	(0.000)	(.0000147)	(0.000)	(0.000)	(8.78e-06)	(0.000)
Less than high school* age3	0.0000***	2.95e-06***	0.0000***	-0.0000***	-1.82e-06***	-0.0000***	0.0000***	.3.65e-06***	0.0000***
	(0.000)	(9.05e-08)	(0.000)	(0.000)	(1.05e-07)	(0.000)	(0.000)	(6.37e-08)	(0.000)
High school* age	0.0657***	.062642***	0.0586***	0.0127***	.0093695***	0.0071***	0.0418***	.0384646***	0.0441***
	(0.001)	(.0002748)	(0.001)	(0.001)	(.0004316)	(0.001)	(0.000)	(.0002854)	(0.001)
High school* age2	-0.0007***	-.000673***	-0.0006***	0.0005***	.0006343***	0.0007***	-0.0001***	.0000114*	-0.0001***
	(0.000)	(6.17e-06)	(0.000)	(0.000)	(9.83e-06)	(0.000)	(0.000)	(6.43e-06)	(0.000)
High school* age3	0.0000***	3.61e-06***	0.0000***	-0.0000***	-6.64e-06***	-0.0000***	-0.0000***	-2.20e-06***	-0.0000***
	(0.000)	(4.46e-08)	(0.000)	(0.000)	(7.25e-08)	(0.000)	(0.000)	(4.62e-08)	(0.000)
More than high school* age	0.1301***	.1188175***	0.1186***	0.0107***	.0009735*	-0.0008	0.0367***	.0233123***	0.0167***
	(0.001)	(.0003605)	(0.001)	(0.001)	(.0005566)	(0.001)	(0.001)	(.0003907)	(0.001)
More than high school* age2	-0.0016***	-.0014475***	-0.0015***	0.0011***	.0012566***	0.0013***	0.0006***	.0008414***	0.0009***
	(0.000)	(7.98e-06)	(0.000)	(0.000)	(.0000124)	(0.000)	(0.000)	(9.00e-06)	(0.000)
More than high school* age3	0.0000***	7.20e-06***	0.0000***	-0.0000***	-.0000132***	-0.0000***	-0.0000***	-.0000108***	-0.0000***
	(0.000)	(5.75e-08)	(0.000)	(0.000)	(9.05e-08)	(0.000)	(0.000)	(6.94e-08)	(0.000)
Less than high school* YSM1	0.0039***	.0034683	0.0037***	0.0007	.0002889	0.0005	-0.0023***	-.0021566***	-0.0014
	(0.001)	(.0003666)	(0.001)	(0.001)	(.0008287)	(0.001)	(0.001)	(.0003253)	(0.001)
Less than high school* YSM2	-0.0009**	-.0009644***	-0.0010**	0.0003	.0003887	0.0005	0.0002	9.95e-06	0.0001
	(0.000)	(.0002234)	(0.000)	(0.000)	(.000285)	(0.001)	(0.000)	(.0002434)	(0.001)
Less than high school* YSM3	-0.0021***	-.0019615***	-0.0016**	0.0001	-.0000516	0.0007	0.0006	.0001786	0.0007
	(0.001)	(.0002428)	(0.001)	(0.001)	(.0003348)	(0.001)	(0.001)	(.0003393)	(0.001)
YSM2	0.0026***	.0034735***	0.0033***	0.0017***	.0028057***	0.0035***	0.0049***	.0052936***	0.0078***

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Table A.4: Continued

	(0.000)	(.0002098)	(0.000)	(0.000)	(.0003549)	(0.001)	(0.000)	(.000226)	(0.000)
YSM2	-0.0001	.0005061***	-0.0002	-0.0000	.0005632***	-0.0002	-0.0009***	.0001865	-0.0002
	(0.000)	(.0001173)	(0.000)	(0.000)	(.0001701)	(0.000)	(0.000)	(.0001413)	(0.000)
YSM3	-0.0009***	-.00066***	-0.0016***	-0.0003	.0002702	-0.0005	-0.0002	.0007102***	0.0001
	(0.000)	(.0001557)	(0.000)	(0.000)	(.0002337)	(0.001)	(0.000)	(.00023)	(0.001)
More than high school* YSM1	0.0031***	.0031031***	0.0010	0.0078***	.0075098***	0.0050***	0.0016***	.0026598***	0.0011
	(0.001)	(.0004308)	(0.001)	(0.001)	(.0004405)	(0.001)	(0.001)	(.0003348)	(0.001)
More than high school* YSM2	0.0025***	.0021186***	0.0007	0.0027***	.0022765***	0.0016***	0.0039***	.0032366***	0.0018***
	(0.000)	(.0002121)	(0.000)	(0.000)	(.0002251)	(0.001)	(0.000)	(.0002086)	(0.000)
More than high school* YSM3	0.0029***	.0021606***	0.0016**	0.0023***	.0017464***	0.0017*	0.0029***	.0021128***	0.0019**
	(0.001)	(.0002059)	(0.001)	(0.001)	(.0004011)	(0.001)	(0.001)	(.0003499)	(0.001)
Observations	16,974,416	16,974,416	16,974,416	16,974,416	16,974,416	16,974,416	28,999,854	28,999,854	28,999,854
R-squared	0.922	0.931	0.955	0.884	0.892	0.927	0.810	0.83	0.891

Robust standard errors in parentheses. Standard Errors for Double Fixed Effects Model obtained through bootstrapping with 30 repetitions for column 3 and 6 and 15 repetitions for column 9.
*** p<0.01, ** p<0.05, * p<0.1

Table A.5: Confidence intervals of wage gaps

	Wage gap with confidence intervals - panel A of figure 6.2							
	Quasi-ind. fixed effects		Ind. fixed effects		Double fixed effects		Within fixed effects	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Less than high school								
10 years	-0.127	-0.138	-0.087	-0.090	-0.089	-0.088	-0.086	-0.089
20 years	-0.164	-0.177	-0.093	-0.095	-0.088	-0.088	-0.095	-0.098
30 years	-0.184	-0.206	-0.121	-0.126	-0.112	-0.110	-0.127	-0.134
High school								
10 years	-0.161	-0.172	-0.136	-0.139	-0.135	-0.133	-0.138	-0.141
20 years	-0.204	-0.217	-0.134	-0.137	-0.126	-0.126	-0.139	-0.143
30 years	-0.223	-0.242	-0.142	-0.147	-0.133	-0.131	-0.155	-0.162
More than high school								
10 years	-0.217	-0.230	-0.145	-0.149	-0.143	-0.138	-0.156	-0.160
20 years	-0.184	-0.198	-0.124	-0.129	-0.119	-0.113	-0.153	-0.158
30 years	-0.171	-0.196	-0.109	-0.116	-0.109	-0.101	-0.155	-0.165
	Wage gap with confidence intervals - differential workplace effect - panel B of figure 6.2							
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Less than high school								
10 years			-0.097	-0.086	-0.097	-0.086	-0.084	-0.097
20 years			-0.106	-0.094	-0.106	-0.094	-0.095	-0.109
30 years			-0.139	-0.124	-0.139	-0.124	-0.130	-0.147
High school								
10 years			-0.158	-0.152	-0.158	-0.152	-0.155	-0.162
20 years			-0.161	-0.155	-0.161	-0.155	-0.161	-0.168
30 years			-0.174	-0.165	-0.174	-0.165	-0.179	-0.190
More than high school								
10 years			-0.147	-0.141	-0.147	-0.141	-0.153	-0.160
20 years			-0.127	-0.121	-0.127	-0.121	-0.149	-0.156
30 years			-0.117	-0.108	-0.117	-0.108	-0.154	-0.166
	Wage gap with confidence intervals - panel A of figure 6.3							
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Less than high school								
10 years	-0.142	-0.132	-0.098	-0.096	-0.097	-0.098	-0.100	-0.103
20 years	-0.174	-0.161	-0.095	-0.093	-0.088	-0.088	-0.093	-0.096
30 years	-0.201	-0.179	-0.120	-0.115	-0.104	-0.105	-0.111	-0.116
High school								
10 years	-0.175	-0.165	-0.142	-0.140	-0.141	-0.141	-0.143	-0.146
20 years	-0.216	-0.204	-0.132	-0.130	-0.127	-0.126	-0.125	-0.128
30 years	-0.236	-0.217	-0.136	-0.131	-0.127	-0.125	-0.123	-0.128
More than high school								
10 years	-0.217	-0.205	-0.143	-0.140	-0.145	-0.145	-0.124	-0.128
20 years	-0.182	-0.168	-0.122	-0.118	-0.120	-0.120	-0.093	-0.098
30 years	-0.177	-0.153	-0.107	-0.100	-0.104	-0.101	-0.071	-0.080

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Table A.5: Continued

	Wage gap with confidence intervals - panel B of figure 6.3							
	Quasi-ind. fixed effects		Ind. fixed effects		Double fixed effects		Within fixed effects	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Less than high school								
10 years			-0.144	-0.138	-0.138	-0.146	-0.142	-0.148
20 years			-0.132	-0.126	-0.123	-0.131	-0.122	-0.129
30 years			-0.132	-0.124	-0.120	-0.130	-0.119	-0.127
High school								
10 years			-0.144	-0.138	-0.138	-0.146	-0.142	-0.148
20 years			-0.132	-0.126	-0.123	-0.131	-0.122	-0.129
30 years			-0.132	-0.124	-0.120	-0.130	-0.119	-0.127
More than high school								
10 years			-0.142	-0.137	-0.153	-0.144	-0.122	-0.128
20 years			-0.116	-0.111	-0.127	-0.116	-0.088	-0.094
30 years			-0.096	-0.088	-0.108	-0.094	-0.064	-0.073
	Wage gap with confidence intervals - panel C of figure A.1 in Appendix							
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Less than high school								
ten years	-0.147	-0.158	-0.131	-0.137	-0.159	-0.161	-0.092	-0.099
twenty years	-0.169	-0.183	-0.138	-0.144	-0.160	-0.160	-0.093	-0.100
thirty years	-0.145	-0.170	-0.132	-0.142	-0.162	-0.158	-0.082	-0.094
High school								
ten years	-0.146	-0.157	-0.130	-0.133	-0.179	-0.181	-0.100	-0.104
twenty years	-0.176	-0.189	-0.138	-0.142	-0.180	-0.180	-0.101	-0.106
thirty years	-0.177	-0.198	-0.138	-0.146	-0.181	-0.179	-0.097	-0.107
More than high school								
ten years	-0.193	-0.205	-0.124	-0.128	-0.192	-0.188	-0.099	-0.103
twenty years	-0.137	-0.151	-0.093	-0.098	-0.189	-0.191	-0.082	-0.088
thirty years	-0.111	-0.137	-0.063	-0.073	-0.189	-0.191	-0.059	-0.071

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