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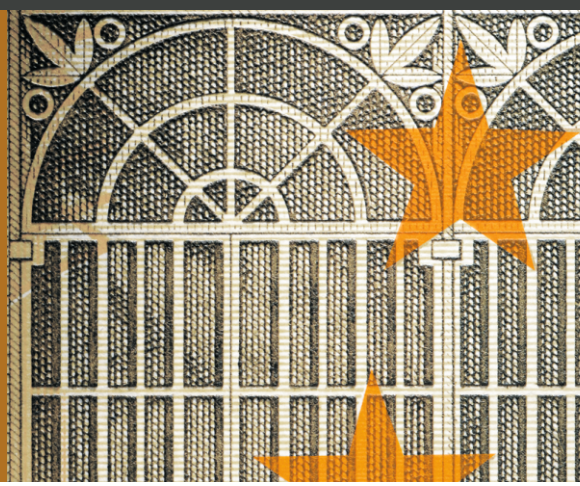

MIND THE GAP! THE RELATIVE WAGES OF IMMIGRANTS IN THE PORTUGUESE LABOUR MARKET

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Edition

Economics and Research Department

Lisbon, 2013

ISBN 978-989-678-166-8

ISSN 2182-0422 (online)

Legal Deposit no. 3664/83

Mind the gap! The relative wages of immigrants in the Portuguese labour market*

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Abstract

Using matched employer-employee data, we examine the wage gaps between immigrant and native workers in the Portuguese labour market in the 2002-2008 period. We use the relation between the Gelbach's and Oaxaca-Blinder's decompositions to split the unconditional average wage gap as the sum of a composition effect and a wage structure effect. Most of the wage gap is not due to worst endowments of the immigrants but to differences in the returns to those characteristics and to the immigrant status effect. In particular, education and foreign experience of the average immigrants are significantly less valued in the Portuguese labour market. Overall, the wages of immigrants do not fully converge to those of comparable natives as experience in the Portuguese labour market increases. The assimilation rates tend to be stronger in the first years after migration and for immigrants with higher levels of pre-immigration experience. Total immigrants are a heterogeneous group of different nationalities, with immigrants from the EU15 and China starring as the two extreme cases.

Keywords: Immigration, Wages, Assimilation, Matched employer-employee data, Oaxaca-Blinder decomposition, Portugal

JEL Codes: F22, J31, J61

*The authors thank Mário Centeno, Álvaro Novo, Manuel Coutinho Pereira and Pedro Portugal for their comments and suggestions. We also thank Lucena Vieira for excellent computational assistance. The opinions expressed in the paper are those of the authors and do not necessarily coincide with those of Banco de Portugal or the Eurosystem. Any errors and omissions are the sole responsibility of the authors. Address: Banco de Portugal, Economics and Research Department, R. Francisco Ribeiro 2, 1150-165 Lisboa - Portugal. E-mails: scabral@bportugal.pt and cfduarte@bportugal.pt

1 Introduction

Portugal has traditionally been a country of emigration and significant immigration flows began much more recently. The first important wave of large-scale immigration in Portugal was of a political nature, with the mass return of Portuguese citizens from the former colonies in Africa after the revolution of 1974. Until the mid-nineties, immigration in Portugal was relatively modest in international terms, comprising mainly nationals from Portuguese speaking countries. In the late nineties, immigration accelerated driven by high and unmet labour demand in construction and some services sectors. There was also a significant change in the nationality mix because a substantial part of these arrivals originated from Central and Eastern European countries, with no particular historical or cultural link with Portugal, and, more recently, from Brazil.

The rapid increase of immigration in Portugal, together with the change in its nationality composition, raises new questions regarding the economic performance of immigrants. Do they earn the same wages as natives upon arrival? If not, what accounts for the difference? Do the wages of these recent waves of immigrants tend to converge to those of natives as they acquire more labour experience? Are these results homogeneous across main immigrant nationalities? This paper aims at answering these questions using a matched employer-employee longitudinal database (*Quadros de Pessoal*) from 2002 to 2008.

It is commonly observed that immigrants earn less upon arrival than comparable native workers. The imperfect portability of human capital, in particular education and work experience, acquired in the origin country, as well as the lack of fluency in the destination language were found to be important determinants of this wage gap (see, for instance, Friedberg (2000) and Aydemir and Skuterud (2005)). Over time, immigrants' wages tend to catch up to natives' wages as they engage in a process of acquiring skills relevant for the destination country. The wage disadvantage of immigrants upon arrival tends to diminish as experience in the host country increases, but at a decreasing rate. In some some countries, however, the catching up of immigrants is never complete (see Izquierdo et al. (2009) for Spain and Dell'Aringa et al. (2012) for Italy).

The narrowing of the initial wage disadvantage of immigrants with time of residence in the destination country was recently named by Chiswick and Miller (2012) as "positive assimilation" but it has received much attention in the economic literature on immigration for several decades (see Borjas (1999) for a comprehensive discussion on the concept of economic assimilation). The pioneering work of Chiswick (1978) based on a cross-section of US immigrant men found that immigrants earned less than natives upon arrival but converged quite rapidly to the native wage level. Borjas (1985) questioned the empirical validity of this conclusion, as it was based on a pure cross-section regression model, which was used to assess the dynamics of the assimilation process of immigrants. Using a cross-section sample of

immigrants implicitly assumes that the composition of the successive cohorts of immigrants does not change significantly over time. Posteriorly, most of the literature used repeated cross-sections controlling for differences among immigrants cohorts when studying the economic assimilation of immigrants in different countries (see Baker and Benjamin (1994) or Antecol et al. (2006)). Cross-section estimates of the assimilation process can be biased by selective return migration. One solution is the use of longitudinal databases that follow the native and immigrant populations over time and, hence, estimate the assimilation profile of immigrants that stayed in the country for a given period (see Lubotsky (2007) or Hu (2000)).

In this paper, we examine the wages of recent immigrants in the Portuguese labour market identifying the major differences with native workers upon arrival and whether these differences decline (or not) as their experience in Portugal increases. In the line of Friedberg (2000), we investigate if education and work experience obtained in different countries are rewarded differently in the Portuguese labour market. Given the nature of recent immigration flows in Portugal, we also examine immigrants by main regions of origin, to see if the relative wage patterns are homogeneous across different immigrant groups.

The article is organised as follows. Section 2 presents the longitudinal database used (*Quadros de Pessoal*) and section 3 describes the main characteristics of immigrants relative to those of native workers. The estimation methodology is outlined in section 4. Section 5 presents the empirical results, accounting for the potential heterogeneity of immigrants by main origins. Finally, section 6 presents some concluding remarks.

2 Database and identification strategy

The database used in this paper is *Quadros de Pessoal* (QP), a longitudinal dataset matching workers and firms based in Portugal. This administrative data draws on an annual mandatory employment survey that covers virtually all establishments with wage earners in Portugal in a reference month (October), excluding the Public Administration and domestic work. Given that it is compulsory, it does not suffer from the non-response problems that often plague standard household and firm surveys. Besides the advantage of its comprehensive coverage, it is also generally recognised that this dataset is reliable by virtue of its public availability.

Reported data cover the establishment itself (establishment identifier, location, economic activity, employment, etc), the firm (firm identifier, location, economic activity, employment, sales, ownership, etc) and each of its workers (social security identifier, gender, age, education, skills, occupation, tenure, employment status, hours worked, earnings, etc). The information on earnings is very complete, including the base wage, regular and irregular wage benefits and overtime pay.

The worker-level data cover all years since 1986, except 1990 and 2001, but information on the nationality of the worker only starts in 2000, so our sample period starts in 2002 and ends in 2008. The exact nationality at the country level of the worker is the only information available that helps to identify immigrant workers in QP, as neither the place of birth nor the year of arrival in Portugal are recorded. Nevertheless, given the nature of recent immigration in Portugal and the low naturalisation rate, the sample of immigrants covered in QP database seems to be a good approximation of the target population. Because some workers do not report their nationality in every year considered, we further assumed that individuals that declare at least once to be foreign nationals are immigrants and maintain that nationality throughout the whole period (see D'Amuri et al. (2010) for a similar assumption).

Regarding data on formal education, the QP dataset has information on the highest level of education completed by each worker, but not on the country where that level of education was attained. So, we cannot differentiate between foreign and domestic schooling. However, recent immigrant flows in Portugal were linked with employment opportunities and, hence, it is reasonable to assume that most of these immigrants completed their education in the country of origin. We defined 6 education categories based on the International Standard Classification of Education (ISCED): illiterate (no formal education or below ISCED 1), 4 years completed (primary education) and 6 years completed (first stage of basic education) are both included in ISCED 1, 9 years completed refers to ISCED 2 (lower secondary education), 12 years completed refers to ISCED 3-4 (upper-secondary) and tertiary refers to ISCED 5-6.

The QP dataset does not cover domestic work. This fact can have some impact on the results because many foreign women in Portugal are linked to this sector. We tried to assess the extend of this phenomenon by checking its impact on an alternative, though less detailed, longitudinal database made available by *Instituto de Informática* (Portuguese social security data-processing office), which includes domestic work. The share of domestic work in total employment is around 0.01 per cent on average for both natives and immigrants in the 2002-2007 period, which suggests that most people in this sector work in the informal economy. This result highlights the fact that all workers in illegal and irregular situations are excluded from the analysis given the lack of information on these individuals in the QP database (and in all official databases), leading to an underestimation of immigrants in the Portuguese labour market.

The QP database has no information on the date of arrival in Portugal, hence we cannot directly obtain the traditional assimilation variable of the time spent in the destination country, commonly referred to as years since migration. However, we can obtain information on the date that each individual (native and immigrant) first entered private employment (legally) in Portugal. When this occurs, each worker is given an identification number that is unique and remains constant over time. We used this property of the data to trace back each worker

present in the 2002-2008 database to its first record. The database also has information on the date of admission of each worker in each firm. Because the QP database only starts in 1986, we used the minimum of the two records (year the worker first appears in the database and first year of admission in a firm) as the date of entry in the Portuguese labour market. This information is then used to compute a measure of effective labour market experience in Portugal, available for both natives and immigrants, and examined in section 3. In addition, for immigrants, the effective labour market experience is used as a proxy of the time spent in Portugal, i.e., years since migration, in our regression analysis. A caveat of our proxy of years since migration is that the date of entry of an immigrant in private employment does not necessarily coincides with the actual date of entry in Portugal, because a significant part of the recent immigration flows in Portugal were of illegal nature, as evinced by the series of regularisations that occurred since 2000 (see Marques and Góis (2007) for a description of recent Portuguese immigration policies).

We also computed the traditional education-corrected age or potential work experience as age minus 6 minus years of education for both natives and immigrants. The standard caveat of this proxy is that it assumes that the worker enters the labour market immediately after schooling and that the employment period is continuous with no episodes of unemployment or inactivity. In addition, using this information as a measure of the experience of natives in the Portuguese labour market has an additional caveat in our framework: possible periods of employment abroad of native workers due to emigration are assumed to have the same wage returns as employment in Portugal. The same reasoning applies to the using of potential experience in the measurement of foreign experience of immigrant workers, as it is implicitly assumed that experience was continuously accumulated in the country of origin of the immigrant.

All studies that distinguish foreign and domestic human capital of immigrants are subject to measurement error given the strong assumptions needed to estimate these separate returns using the standard databases available. Nevertheless, the results of Skuterud and Su (2012) suggest that the estimated returns to foreign and domestic sources of schooling and experience found in the literature do not appear to be driven by measurement errors in these variables. In addition, the detailed characteristics of the QP database still make it suitable to study the wage performance of immigrants in Portugal. At present, empirical evidence on the behaviour of immigrants in the Portuguese labour market is relatively scarce, probably reflecting the novelty of the phenomenon. Some exceptions are Carneiro et al. (2012) who examine the relative wages of immigrants in the Portuguese labour market in 2003-2008 and Cabral and Duarte (2010) that provide a comprehensive description of the main features of recent immigration flows in Portugal from 2002 to 2008, both using the QP database.

Some additional filters were imposed on the database to eliminate erroneous, inconsistent or missing reports. First, the analysis was restricted to individuals for whom there was

information available for a set of key variables, such as gender, age, nationality, sector of activity and tenure. Second, we further restricted our sample to workers aged between 15 and 80 years and with a job tenure below 65 years. Third, we focused our analysis on the full-time employees segment and we only considered those employees that reported a base wage of at least 80 per cent of the minimum legal wage.[1] Whenever a worker was present in more than one firm in a given year we kept the register corresponding to maximum earnings or maximum hours worked. Fourth, as we focus on wage assimilation, we use a regular wage measure that includes the base wage (monthly gross pay for normal hours of work) and the regular subsidies and premiums paid on a monthly basis like seniority payments.

As it is an employment survey, the QP database only covers individuals that are employed in the reference period. Therefore, we cannot assess the employment assimilation, as we do not have information on the individuals that are not employed. Moreover, we also cannot handle selective return migration by explicitly modelling out-migration like Hum and Simpson (2004) for Canada and Venturini and Villosio (2008) for Italy. If a given immigrant disappears from the database we do not know the reason: he can be unemployed or inactive; he may have left the country; or it can also be a reporting omission/error from the firm. Thus, using the QP database we can only estimate the assimilation profile of employed immigrants that stayed in Portugal for a certain period of time.

3 Exploratory analysis

Historically, Portugal has been a country of emigration, but in the late nineties immigration flows grew strongly driven by high labour demand. A significant share of this new immigration flows came from Central and Eastern European countries (CEEC), i.e., from countries with no evident cultural link with Portugal.[2] More recently, there was a very significant increase in immigrants from Brazil. Immigration from China, although growing strongly in the last decade, still represents a small share of total immigrant workers. At present, three major groups make up the bulk of immigration in Portugal, representing around 75 per cent of total: Brazil, Portuguese speaking countries in Africa (PALOP) and CEEC.[3]

Full-time employed immigrants in Portugal increased by 47 per cent in cumulative terms from 2002 to 2008, representing 6.4 per cent of the total employement in 2008. Table 1 reports the sample means of some relevant variables for natives and immigrants, as well as for the main nationalities of immigrant workers in Portugal.

[1] By law, workers formally classified as apprentices can receive a minimum wage that is, at least, 80 per cent of the full rate.

[2] CEEC (Central and Eastern European countries) in the QP database includes Slovakia, Poland, Czech Republic, Hungary, Estonia, Slovenia, Latvia, Lithuania, Romania, Russian Federation, Moldova, Ukraine and Serbia.

[3] PALOP (*Países Africanos de Língua Oficial Portuguesa*) refers to the former Portuguese colonies in Africa (Angola, Cape Verde, Guinea Bissau, Mozambique, and São Tomé and Príncipe).

Table 1: Main characteristics of native and immigrant full-time workers in Portugal, average 2002-2008

	Natives	Immigrants					
		Total	EU15	PALOP	CEEC	Brazil	China
Levels in 2008	2,324,699	159,539	13,294	39,305	37,638	42,266	2,670
Share in total, 2008	93.6	6.4	8.3	24.6	23.6	26.5	1.7
Employment status (%)							
Permanent contract	77.6	45.2	66.3	49.6	35.4	35.9	44.0
Fixed-term contract	22.4	54.8	33.7	50.4	64.6	64.1	56.0
Age							
Average years	37.9	35.7	36.5	36.5	36.3	33.0	34.3
% workers aged less 35 years	43.4	50.5	51.1	45.7	47.5	62.4	53.9
Gender (%)							
Male	57.0	65.0	56.6	58.9	75.4	61.1	64.0
Female	43.0	35.0	43.4	41.1	24.6	38.9	36.0
Work experience in Portugal							
Average years	13.0	5.1	7.4	6.7	2.9	2.9	3.1
Educational attainment (%)							
Illiterate	1.2	4.1	0.5	4.8	6.3	1.7	15.4
4 years completed	24.0	23.2	7.9	34.1	20.6	16.7	38.8
6 years completed	22.1	17.0	11.7	16.9	16.9	18.5	15.0
9 years completed	21.6	24.3	19.9	21.8	26.7	27.9	20.0
12 years completed	20.0	23.0	29.7	16.7	23.7	29.3	7.6
Tertiary	11.0	8.5	30.2	5.8	5.9	5.8	3.2
Main sectors of activity (%)							
Manufacturing industry	28.4	15.7	20.6	8.8	22.0	10.7	1.4
Construction	11.4	23.7	8.2	28.5	31.9	19.2	0.6
Services, *of which*:	57.6	57.6	68.9	61.9	40.0	68.3	98.0
Wholesale and retail trade	20.0	13.5	19.9	11.1	9.1	15.8	49.9
Hotels and restaurants	6.2	15.3	11.5	14.6	10.6	23.5	45.1
Business services	9.6	15.5	12.8	23.6	10.7	15.2	1.1
Other sectors	2.6	3.0	2.3	0.8	6.1	1.9	0.1
Average real monthly wage							
In Euros	853.7	745.7	1463.4	681.2	609.3	723.7	456.1
Wage gap to natives							
Euros		-108.0	609.8	-172.4	-244.3	-129.9	-397.6
100 x log points (real hourly wages)		-15.0	33.2	-16.9	-24.3	-19.3	-49.5
% Minimum wage earners	8.0	12.6	6.8	8.4	13.3	16.7	57.3

Source: Quadros de Pessoal.

Notes: The shares of main immigrant groups are computed as a percentage of total immigrants. EU15 includes the initial 15 Member-States of European Union except Portugal. CEEC (Central and Eastern European countries) includes Slovakia, Poland, Czech Republic, Hungary, Estonia, Slovenia, Latvia, Lithuania, Romania, Russian Federation, Moldova, Ukraine and Serbia. PALOP (Países Africanos de Língua Oficial Portuguesa) refers to the former Portuguese colonies in Africa (Angola, Cape Verde, Guinea Bissau, Mozambique, and São Tomé and Príncipe). Illiterate refers to no formal education or below ISCED 1, 4 years completed (primary education) and 6 years completed (second stage of basic education) are both included in ISCED 1, 9 years completed refers to ISCED 2 (lower secondary education), 12 years completed refers to ISCED 3-4 (upper-secondary) and tertiary refers to ISCED 5-6. ISCED stands for International Standard Classification of Education. The percentage of minimum wage earners was computed considering workers with wage in the interval of +/- 1 euro centered on the minimum wage.

One of the most notable differences between immigrants and natives in the Portuguese labour market relates to the nature of the contract, i.e., permanent versus fixed-term. In the 2002-2008 period, more than half of immigrant workers had a fixed-term contract, compared to around 22 per cent for natives. Immigrants from Brazil and CEEC have the highest proportion of fixed-term contracts.

Immigrant workers are younger than natives. Workers with less than 35 years account for around 43 per cent of total natives but represent about 50 per cent of immigrants. This difference is higher in the case of workers from China and, especially, from Brazil.

The percentage of females in immigrant employment is lower than in native employment, but the exclusion of domestic work from the analysis tends to underestimate female migrant employment in Portugal. The share of female workers is higher in the case of the EU15 and PALOP (more than 40 per cent in both cases) and lower in the case of CEEC.[4]

As expected, given the recent nature of most immigrant flows in Portugal, the effective work experience of immigrants in Portugal is lower than that of natives. Within immigrants, experience in Portugal is higher for workers from the EU15 and, to a lesser extent, from the PALOP, which are the immigrant groups that have been longer in the country.

The differences in educational attainment between natives and immigrants as a whole are not substantial, even if the share of illiterates is higher for immigrants. However, there are important differences among the main immigrant groups. Immigrants from China stand out by their extremely low educational level, with around 15 per cent of illiterates and only around 3 per cent of workers with tertiary education. The proportion of workers with tertiary education is very similar in immigrants from the PALOP, CEEC and Brazil, but the Brazilians have a smaller share of individuals with very low education levels. In contrast, the educational attainment of immigrants from the EU15 is significantly higher than that of all other nationality groups, including the natives, with more than 30 per cent of them having tertiary education.

Immigrant employment in Portugal is concentrated in a few sectors, namely construction and some services activities. Construction is the main sector of immigrant employment in Portugal, accounting for almost 24 per cent of the total. The employment share of the services sector as a whole is similar for natives and immigrants but the breakdown within services is very different. Immigrants are especially concentrated in three sub-sectors: hotels and restaurants, real estate and business services, and wholesale and retail trade.

Regarding wages and not controlling for any differentiating factors, immigrants in Portugal are, on average, paid below the wages of native workers in the 2002-2008 period.[5] The average real hourly wage of immigrant workers is 15.0 log points or 13.9 per cent

[4] EU15 includes the initial 15 Member-States of European Union except Portugal.

[5] In the regression analysis of the next sections, real hourly wages are the dependent variable. We also included the real monthly wage in this descriptive analysis as it results in more intuitive values and the conclusions remain unaltered.

$(= 100(exp(-0.150) - 1))$ below the average wage of natives, but there are substantial differences among immigrants.[6] The average wage of workers from the EU15 is about twice as high as the average immigrant wage and substantially higher than the average native wage. In contrast, Chinese immigrants earn wages significantly lower than the other migrant groups.

The proportion of workers that are paid the minimum wage is higher for immigrants than for natives.[7] Immigrants from the EU15 have the lowest share of minimum wage earners, even lower than that of natives, while more than 57 per cent of Chinese workers are reported as earning the minimum wage in this period. These differences in the incidence of the minimum wage are in line with the disparities in the average educational attainment of these immigrant groups.

4 Estimation strategy

Following the seminal paper on immigrants' wage assimilation by Chiswick (1978), we start by estimating the following equation:

$$logW_{it} = \alpha + \beta_0 imi + \beta_1 ysm + \eta_1 ysm^2 + \beta_2 pexp + \eta_2 pexp^2 + \sum_{j=1}^{5} \beta_{3j} edu_j + \psi X_{it} + \varepsilon_{it}, \quad (1)$$

where $logW_{it}$ is the natural logarithm of the real hourly wage of individual i at time t, imi is a dummy variable for immigrant status, ysm is a proxy for years since migration, edu_j are the formal education categories described in section 2 (illiterate workers are the omitted category), $pexp$ is the traditional potential work experience, and ε_{it} is a conventional stochastic error term. We also included quadratic terms on years since migration and potential experience to account for the fact that wages tend to increase at a decreasing rate with years in the labour market. Other characteristics that potentially affect wages are included in the vector X_{it}. As we analyse both males and females, X_{it} has a variable on the worker's gender (the reference group being male). A dummy variable identifying fixed-term contracts is also included. Equation 1 also controls for sector, geographical and year-specific effects, which at first are assumed to have a common impact on the wages of natives and immigrants. The reference categories are 2002 for the time dummies, Lisbon for the geographical location and manufacturing industry for the sectoral classification. Appendix A describes all variables used in the analysis.

In equation 1, the coefficient β_0 measures the wage gap upon arrival between an immigrant and a comparable native, both illiterate and without any work experience. As denoted by this interpretation, the wage gap is computed throughout the text as the wage of immigrants

[6] Whenever we mention log points throughout the text we refer to 100 x log points.

[7] The percentage of minimum wage earners was computed considering workers with a monthly wage in the interval of +/- 1 euro centred on the minimum wage.

minus the wage of natives. The inclusion of quadratic terms on years since migration and potential experience makes the direct interpretation of the respective coefficients more difficult. Ignoring higher order polynomials for the sake of simplicity, the coefficient β_1 measures the difference between the returns to domestic work experience of immigrants and natives, i.e., it captures the rate at which the immigrant-native wage gap varies with time spent in Portugal. Because we are controlling for the impact on immigrant wages of time spent in the Portuguese labour market through the inclusion of the variable *ysm*, the coefficient β_2 has a different interpretation for immigrants and natives: for natives it represents the return to one additional year of domestic experience, while for immigrants is the return to one additional year of foreign experience. However, as these two returns to experience are constrained to be the same in equation 1, the β_2 coefficient can be seen as a weighted average of these two (potentially) different effects. Finally, the β_{3j} coefficients report the returns to the j education category compared to being illiterate (omitted category) for both natives and immigrants.

Though being a useful benchmark, equation 1 has several shortcomings. As discussed in Friedberg (2000), this equation implicitly imposes equality restrictions on most of the returns of human capital of native and immigrant workers. Literature suggests that this is a strong assumption. First, the imperfect portability of education and experience acquired in the country of origin tends to result in lower returns to foreign human capital of immigrants in comparison to natives' domestic human capital. Second, returns to experience and education obtained in the country of destination were also found to differ between natives and immigrants. Given the characteristics of our sample, we cannot completely differentiate returns to education of natives and immigrants because we have no information on the place where education was obtained. Nevertheless, we can allow for different returns to education for natives and immigrants irrespective of the place where the formal schooling grade was attained. As regards labour market experience, equation 1 assumes that the returns on foreign experience of immigrants are equal to the returns on domestic work experience of natives, as highlighted by the interpretation of the coefficient β_2. We can relax this equal-return restriction and allow these returns to differ.

For this purpose, we estimate an unrestricted version of equation 1:

$$\begin{aligned} logW_{it} &= \alpha + \beta_0 imi + \beta_1 ysm + \eta_1 ysm^2 + \beta_2 pexp + \eta_2 pexp^2 \\ &+ \gamma_2 imi * pexp + \eta_3 imi * pexp^2 + \sum_{j=1}^{5} \beta_{3j} edu_j + \sum_{j=1}^{5} \gamma_{3j} imi * edu_j \\ &+ \psi X_{it} + \varepsilon_{it} \end{aligned} \tag{2}$$

In equation 2, the coefficient β_0 measures the wage gap upon arrival between an immigrant and a comparable native, both illiterate and without any work experience. Again, ignoring higher order polynomials, the β_1 coefficient captures the difference between the returns to

domestic and foreign experience of immigrant workers and the γ_2 coefficient captures the difference between the returns to one year of work experience of an immigrant in his home country and one year of experience of a native worker in Portugal. The sum of β_1 and γ_2 captures the difference in the returns to experience of immigrants and natives in the Portuguese labour market. Using as concept of economic assimilation the rate of wage convergence between immigrants and natives in the host country (see Borjas (1999) for a discussion), this sum corresponds to the assimilation factor or assimilation rate.[8] The γ_{3j} coefficients measure the difference in the returns to education between immigrants and natives for the other 5 educational levels considered, with β_{3j} denoting the returns to the different education categories for natives.

More flexible versions of this equation were also estimated, allowing for the impact of other variables to vary between natives and immigrants (coefficients γ in equation 3), as follows

$$\begin{aligned} logW_{it} &= \alpha + \beta_0 imi + \beta_1 ysm + \eta_1 ysm^2 + \beta_2 pexp + \eta_2 pexp^2 \\ &+ \gamma_2 imi * pexp + \eta_3 imi * pexp^2 + \sum_{j=3}^{m} \beta_j x_j + \sum_{j=3}^{m} \gamma_j imi * x_j + \varepsilon_{it}, \end{aligned} \tag{3}$$

where *m* denotes the total number of covariates included in the model. When including interactions between all variables considered and the immigrant dummy this is equivalent to estimating separate regressions for native and immigrant workers.[9]

While the above specification permits the distinction between natives and immigrants, in the case of immigrants it assumes that the effects are homogeneous across different nationality groups. As described in section 3, immigrant workers in Portugal are not a homogeneous group and considering immigrants as a whole conceals important differences among nationalities. In an alternative specification, we augmented equation 3 by replacing the immigrant dummy variable with a set of indicators for the major immigrant groups in Portugal (Brazil, PALOP and CEEC) and also for the EU15 and China. Immigrants from the EU15 are quite different from the average immigrant worker, as they are much more qualified and earn much higher wages, on average. At the other extreme are the immigrants from China, which grew strongly in recent years: they are the least qualified and earn the lowest wages, on average. As our large sample size enables us to split our data according to the main nationality groups, we estimated separated regressions for each group, thus allowing all variables to have a differentiated impact across all groups.

All the above regressions were estimated by ordinary least squares (OLS), using a pooled dataset for the 2002-2008 period. As we observe each worker multiple times, throughout the

[8] In section 5.2, the wage assimilation of immigrants is examined using simulated wage profiles of native and immigrant workers, fully taking into account the effect of the quadratic polynomials.

[9] The coefficients estimated from the fully interacted model and from separate regressions are equivalent, but in the separate regressions framework the variance of natives and immigrants is allowed to differ.

years, there is most likely a violation of the assumption of independence among observations. We address this issue by using robust standard errors clustered at the individual level. This permits to adjust the errors to the lack of independence without having to explicitly model the correlation among individuals.

4.1 Decomposition analysis

Let us focus on the following questions: whether immigrants earn the same wages as natives upon arrival and, if not, how this wage gap is influenced by differences in endowments and returns to worker and firm characteristics. Instead of resorting to the sequential comparison across specifications of the coefficient of interest (in this case, the β_0 coefficient, denoting the wage gap upon arrival), we use the decomposition technique proposed by Gelbach (2010). The results obtained from the comparison of the estimates for different specifications are influenced by the sequence of specifications, but the Gelbach's procedure is path-independent and consistently delivers the individual contribution of each additional variable, conditional on all other regressors.

Consider as the base model the regression of $logW_{it}$ in a constant and a dummy variable for immigrant status (*imi*) and as the full model a more general version of this model, including additional covariates. The aim of this analysis is to have a better grasp on how β_0 is influenced by introducing additional covariates in the base model. Gelbach shows that the difference between the coefficient of interest in both models ($\beta_0^{base} - \beta_0^{full}$) can be additively decomposed into δ_i contributions, where i represents the regressors added to the full model and not included in the base model.[10] The contributions are calculated as

$$\delta = (X'_{base}X_{base})^{-1}X'_{base}X_{full}\beta^{full}, \tag{4}$$

where X_{base} denotes the covariates included in the base model - dummy variable for immigrant status -, X_{full} are the covariates included only in the full model and β^{full} are the coefficient in the full model associated with X_{full} variables. The δ_i contributions are the mean gaps between immigrants and natives over the i regressors scaled by the coefficient of these regressors in the full model.

Another way of seeing this is by saying that β_0^{base}, i.e., the unconditional average wage gap, is the sum of two terms - the composition effect and the wage structure effect. The composition effect represents the part of the unconditional wage gap that can be attributed to differences (relative to natives) in the average levels of the variables included in the model.[11] The wage

[10] Because this decomposition is additive, one can obtain δ_i contributions for groups of regressors, e.g. J sector dummies, as the sum of group-wise components $\delta_{sector} = \sum_{j=1}^{J} \delta_j$. Furthermore, robust standard errors clustered at the individual level are considered. For more details, see Gelbach (2010).

[11] The differences in the covariates are weighted by the coefficients of natives. This procedure resumes to building a counterfactual scenario where the returns to the covariates for immigrants are assumed to be the same as for natives, being exclusively assessed the impact

structure effect measures the part of the wage gap that reflects differences in the returns to the variables considered in the model and the unexplained part of the gap due to "group membership" (the immigrant dummy, that also captures all potential effects of differences in unobserved variables). Analytically,

$$\beta_0^{base} = \underbrace{(\overline{X}_{full}^{imi} - \overline{X}_{full}^{natives})\beta_{natives}^{full}}_{\text{Composition effect}} + \underbrace{\overline{X}_{full}^{imi}(\beta_{imi}^{full} - \beta_{natives}^{full}) + \beta_0^{full}}_{\text{Wage structure effect}}, \quad (5)$$

where $\overline{X}$ are the sample averages. This reasoning owes to the well-known strand of the literature on decompositions of mean wage differentials, namely the Oaxaca-Blinder decomposition (Oaxaca (1973) and Blinder (1973)).

Consider the model specified in equation 1 as the full model. In this case, the link between Gelbach's and Oaxaca-Blinder's decompositions is merely an approximation to give some intuition. The exact link would involve including interaction terms for all variables of the full model to allow for different returns between natives and immigrants. The composition effect accounts for the difference in means between immigrants and natives for the covariates included in equation 1. However, the wage structure effect underlying equation 1 only accounts for the effect associated with *ysm*, whose coefficient measures the difference in returns to an additional year of experience in the Portuguese labour market for immigrant and native workers, and the β_0^{full}, which is the unexplained portion of the gap.

Alternatively, take as the full model the model of equation 3, which includes interaction terms for all variables. The unconditional average wage gap (β_0^{base}) can be decomposed into the sum of a composition effect associated with the differences in the average magnitude of the variables included in the model (the same as in the previous framework) and a wage structure effect. Now, the wage structure effect is the sum of the contributions associated with *ysm* and with all the interaction variables (differences in the returns to the other covariates) and β_0^{full}.

As discussed in Fortin et al. (2011), to include categorical variables with more than two categories - in our case, educational attainment, sectors, regions and time effects - raises some difficulties in the interpretation of the results of the wage structure effect. In particular, the possibility of separating the differences in the returns of the omitted categories from the "true" unexplained component is hindered. Although the overall wage structure effect is independent of the omitted categories chosen, the differences in the returns to individual variables, as well as β_0^{full}, vary with this choice. One should bear in mind the fact that these individual effects are always conditional on the choice of the omitted categories and, thus, should be interpreted carefully.

of differences in the levels of the covariates.

4.2 Assimilation analysis

Typically, the literature on wage assimilation focuses on whether immigrants' wages grow faster over time than the wages of comparable natives, thus narrowing the wage disadvantage registered upon arrival in the destination country. As discussed in Chiswick and Miller (2012), this traditional model corresponds to the "positive assimilation" model. This model has the implicit assumption that immigrants have a set of skills acquired in their lower-income origin that are not perfectly transferable to the higher-income destination, implying that immigrant wages upon arrival will be lower than those of comparable natives. Afterwards, immigrants make investments both to increase the transferability of previously acquired skills and to acquire new destination-specific skills (e.g., language proficiency). With time spent in the destination country and as immigrants acquire this country-specific knowledge, their wages improve and immigrants' wages start to converge to the wages of comparable natives.

Conversely, the "negative assimilation" model applies to immigration flows between similar countries where worker' skills are highly transferable internationally (Chiswick and Miller (2011)). This model is characterised by higher wages upon arrival for immigrants than for comparable natives. With time spent in the destination country, immigrants' wage start to decline to those of comparable native workers reflecting the dissipation of the economic rent that motivated the initial migration.

These two assimilation models assume that the wage differences upon arrival narrow with time of residence in the host country and wage parity between immigrants and comparable natives is achieved over a reasonable time-span. The rate at which the immigrant-native wage difference narrows with years since migration is commonly referred to as the assimilation factor or assimilation rate. Nevertheless, there is empirical evidence suggesting that in some cases the wage of immigrants do not fully converge to those of comparable natives (see Dell'Aringa et al. (2012) for Italy, Izquierdo et al. (2009) for Spain, Barth et al. (2004) for Norway, Hum and Simpson (2004) for Canada and Eckstein and Weiss (2004) for Israel).

How can we assess the immigrants' wage assimilation within the regression framework outlined in equation 3? We can start by rewriting this equation isolating the wage difference between the wages of immigrants and natives in the left-hand side,

$$\begin{aligned} logW_{it}^{I} - logW_{it}^{N} &= \beta_0 imi + \beta_1 ysm + \eta_1 ysm^2 + \gamma_2 imi * pexp + \eta_3 imi * pexp^2 \\ &+ \sum_{j=3}^{m} \gamma_j imi * x_j + \zeta_{it}, \end{aligned} \tag{6}$$

where $logW_{it}^{I}$ corresponds to the wages of immigrants and $logW_{it}^{N}$ denotes the wages of natives. The evolution of the wage gap over years in the country of destination, i.e., the

assimilation rate, can be expressed as follows:

$$\frac{\partial(logW_{it}^{I} - logW_{it}^{N})}{\partial ysm} = \beta_1 + 2\eta_1 ysm + \gamma_2 \frac{\partial imi * pexp}{\partial ysm} + 2\eta_3 imi * pexp \frac{\partial imi * pexp}{\partial ysm} \quad (7)$$

Recall that immigrants' potential work experience ($imi * pexp$) can be written as the sum of foreign potential experience (exp_{orig}), which is constant over time for each immigrant, and years since migration (ysm). Replacing $imi * pexp$ in equation 7 and rearranging the terms we obtain:

$$\frac{\partial(logW_{it}^{I} - logW_{it}^{N})}{\partial ysm} = \underbrace{\beta_1 + \gamma_2}_{A} + \underbrace{2(\eta_1 + \eta_3)ysm}_{B} + \underbrace{2\eta_3 exp_{orig}}_{C} \quad (8)$$

To ease the interpretation of equation 8 assume that there are three main blocks of coefficients: block *A*, which accounts for the linear impact of an additional year of domestic experience on the wage difference between immigrants and natives; block *B*, which represents the quadratic effect of that additional year; and, finally, block *C* denoting the interaction between the returns to domestic and foreign work experience of immigrants.

Consider a situation where immigrant workers earn lower (higher) wages than comparable natives upon arrival. If the assimilation rate of equation 8 is positive (negative), then there is a positive (negative) assimilation process. This process may be partial or complete, depending on whether full parity of wages between immigrants and natives is attained. A partial process of wage assimilation may result from the combination of a high initial wage difference and a small rate of assimilation, so that the wage difference upon arrival never cancels out in a reasonable time span. Furthermore, the wage assimilation process may also be interrupted by a change in the sign of the impact of an additional year of domestic experience on the wage difference.[12]

5 Empirical results

We start by examining the wage differences upon arrival between immigrants and comparable native workers in section 5.1 using the database for the 2002-2008 period presented in section 2 and the estimation strategy outlined in section 4. We then address the question of immigrants' wage assimilation in section 5.2, presenting simulated wage profiles over time in the Portuguese labour market. In both cases, we provide further insights by looking into the heterogeneity of the results by main regions of origin of immigrants in sections 5.1.1 and 5.2.1, respectively.

[12] As we are assuming a quadratic polynomial, the change of sign can occur only once for a given immigrant.

5.1 Wage gap upon arrival

As shown in the first column of Table 2, the simple difference in means between log wages of immigrant and native workers amounts to -15.0 log points. The second column reports the estimation results of equation 1, which is similar to the most common specification in immigration studies *à la* Chiswick (1978). In this specification, the estimated coefficient of the immigrant dummy variable is -18.8 log points. This indicates that immigrants wages at the time of entry in the Portuguese labour market are 18.8 log points, or 17.1 per cent ($= 100(exp(-0.188) - 1)$), below the wages of natives with similar observable characteristics and returns to such characteristics. With time spent in Portugal, this wage gap diminishes but at a decreasing rate, given the significance of the quadratic term on years since migration (*ysm*). Other things the same, the wages of immigrants are 12.1 log points lower than those of natives after 5 years in the country and it takes around 20 years for the average immigrant to close the initial wage gap.

Controlling for the levels of the characteristics and for the difference in the returns to domestic work experience of natives and immigrants leads to an increase of 3.8 log points in the wage gap. What can explain this evolution? To answer this question, we use the decomposition technique proposed by Gelbach (2010) and described in section 4.1. The results of implementing this procedure are plotted in Figure 1.

The composition effect is -2.1 log points, meaning that if the average values across all characteristics were the same for immigrants and natives, the unconditional wage gap would be 2.1 log points lower. In contrast, controlling for the different returns of immigrant and natives to experience in the Portuguese labour market (*ysm*) leads to a wage gap that is 5.9 log points higher. The coefficient β_0 in the full model measures the wage gap upon arrival of immigrants to the host country, while in the base model we have the average wage gap across all immigrants. Because the wage gap decreases with years since migration, controlling for this effect increases significantly the wage gap.

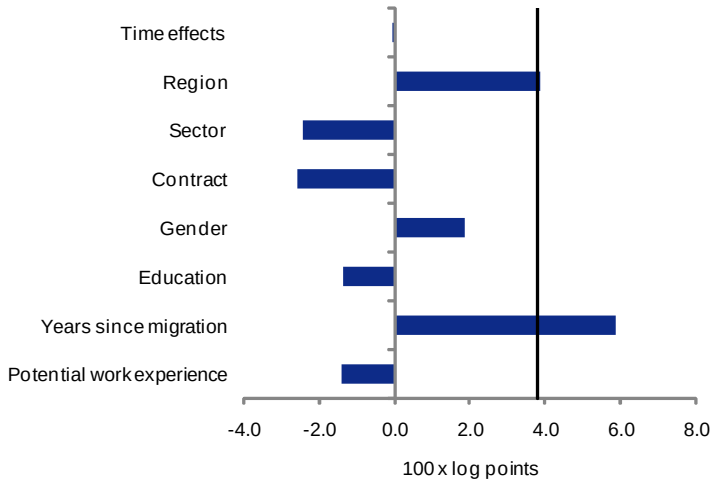
Regarding the covariates whose returns are assumed to be the same between immigrants and natives, controlling for gender and geographical location results in a larger immigrant-native wage gap in the full model. In contrast, the immigrant-native wage gap is smaller when we control for potential work experience, sectors, type of contract and educational attainment. Let us look into more detail to each contribution, starting with the characteristics whose differences in means favour the immigrants. Controlling for gender increases the wage gap, as in our database the share of female workers is smaller among immigrants and there is a wage penalty associated with female workers. If the share of female workers was the same for natives and immigrants, then the average wage gap would be 1.9 log points higher. Similarly, because immigrant workers are more concentrated in regions with higher wages, on average, and higher employment growth (see Cabral and Duarte (2010)), if the geographical

Table 2: Pooled OLS regression estimates, 2002-2008, dependent variable: log of real hourly wage

	(1)	(2)	(3)	(4)	(5)	(6)
imi	-0.150	-0.188	-0.022	0.362	0.311	0.205
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$pexp$		0.032	0.033	0.034	0.034	0.034
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$pexp^2$		-0.0004	-0.0004	-0.0004	-0.0004	-0.0004
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * pexp$			-0.012	-0.024	-0.023	-0.023
			[0.000]	[0.000]	[0.000]	[0.000]
$imi * pexp^2$			0.0001	0.0002	0.0002	0.0002
			[0.000]	[0.000]	[0.000]	[0.000]
ysm		0.015	0.020	0.026	0.026	0.025
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
ysm^2		-0.0003	-0.0003	-0.0004	-0.0004	-0.0004
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
gender		-0.234	-0.234	-0.234	-0.238	-0.237
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
imi*gender					0.072	0.049
					[0.000]	[0.000]
edu_1		0.052	0.046	0.070	0.070	0.070
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_2		0.167	0.161	0.192	0.192	0.192
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_3		0.346	0.340	0.379	0.379	0.379
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_4		0.581	0.575	0.623	0.624	0.623
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_5		1.239	1.233	1.282	1.282	1.281
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * edu_1$				-0.061	-0.063	-0.065
				[0.000]	[0.000]	[0.000]
$imi * edu_2$				-0.125	-0.126	-0.141
				[0.000]	[0.000]	[0.000]
$imi * edu_3$				-0.242	-0.245	-0.260
				[0.000]	[0.000]	[0.000]
$imi * edu_4$				-0.375	-0.380	-0.395
				[0.000]	[0.000]	[0.000]
$imi * edu_5$				-0.402	-0.406	-0.435
				[0.000]	[0.000]	[0.000]
contract		-0.079	-0.077	-0.076	-0.078	-0.078
		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
imi*contract					0.027	0.031
					[0.000]	[0.000]
Other controls	-No-	-Yes-	-Yes-	-Yes-	-Yes-	-Yes-
imi*Other controls	-No-	-No-	-No-	-No-	-No-	-Yes-
No. of observations	15,932,970	15,932,970	15,932,970	15,932,970	15,932,970	15,932,970
R^2	0.004	0.4471	0.4478	0.4500	0.4503	0.4515

Notes: p-values in brackets (implicit standard errors are worker-cluster robust). See the main text and Appendix A for a full description of all variables included.

Figure 1: Decomposition of the variation of immigrant-native wage gap between the base and the full model *à la* Chiswick (1978) (contribution of regressors included in the full model)



Notes: This decomposition follows the technique proposed by Gelbach (2010). The vertical line is drawn at 3.8 log points, which is the estimated increase in the immigrant-native wage gap from the base to the full model.

concentration of immigrants and natives was the same, then the wage gap would be 3.9 log points higher.

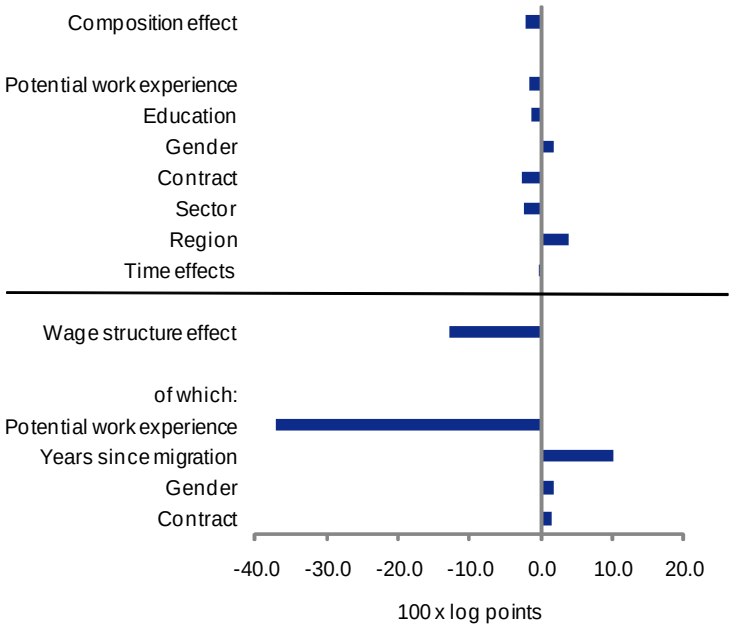
In turn, immigrants tend to be employed in sectors with below average wages, namely construction, hotels and restaurants and wholesale and retail trade, as shown in Table 1. Hence, part of the unconditional average wage disadvantage of immigrants is due to their sectoral concentration. Regarding the type of contract, there is a much higher proportion of immigrants with fixed-term contracts and there is an average wage penalty associated with these contracts, so controlling for this composition effect leads to a decline in the wage gap. A similar reasoning applies to the educational attainment. Finally, wages increase with potential experience and immigrants have, on average, lower values for this variable. If mean potential experience of immigrants was the same of natives, the wage gap would be 1.4 log points lower.

Up to this point, with the exception of *ysm*, the returns to human capital and other characteristics were assumed to be the same for immigrants and natives. The remaining columns of Table 2 show the results of progressively relaxing some of the restrictions implicitly imposed by equation 1. In the third column, we allow the returns to foreign work experience of immigrants and domestic experience of natives to differ and in the fourth column, we do the same for the returns to formal education. In the fifth column, we also allow the impact of gender and type of contract to differ between immigrants and natives. Finally, in the last column, we also interacted the time, geographical and sectoral dummies with the immigrant dummy, thus allowing the impact of all characteristics to vary between natives and immigrants. These results are equivalent to estimating separate equations for native and immigrant workers. The

full set of estimation results of the separate regressions of natives and immigrants, including all the dummy variables, is included in Appendix B.

Hence, how does controlling for the full set of variables explain the unconditional wage gap of -15.0 log points? Using the regression estimates included in the last column of Table 2, the coefficient of the immigrant dummy is 20.5 log points, meaning that the wage upon arrival of an immigrant whose characteristics match the omitted categories is 20.5 log points higher than the wage of a comparable native, both without any work experience. Recall that the omitted categories are: illiterate, male, manufacturing sector, Lisbon, permanent contract and 2002. To have a better grasp of the main drivers behind the unconditional average wage gap between immigrants and natives, and considering the model with all interactions as the full model, we apply Gelbach's procedure discussed in section 4.1. Figure 2 and the first column of Table 3 show the results of this decomposition. The total composition effect amounts to -2.1 log points (as in the previous decomposition) and the total wage structure effect is -12.9 log points. So, the majority of the wage gap is explained by differences in the returns of the covariates and by the "group membership" effect, and not by differences in endowments.

Figure 2: Decomposing the immigrant-native wage gap (Oaxaca-Blinder decomposition): Contribution of regressors included in full model with interactions



Note: This decomposition follows the technique proposed by Gelbach (2010).

The breakdown of the composition effect is essentially the same as the one obtained with the full model *à la* Chiswick (1978) described above. Regarding the breakdown of the wage structure effect, the difference in the returns to potential work experience has a strong negative contribution to the wage gap. If the returns to potential work experience were the same

Table 3: Decomposing the immigrant-native wage gap (Oaxaca-Blinder decomposition): Contribution of regressors included in full model with interactions, 100 x log points

Reference group:	Illiterate	12 years of education
Unconditional wage gap	-15.0	-15.0
Composition effect:	-2.1	-2.1
of which:		
Potential work experience	-1.5	-1.5
Gender	1.9	1.9
Contract	-2.5	-2.5
Sector	-2.4	-2.4
Region	3.9	3.9
Time effects	0.0	0.0
Education	-1.4	-1.4
Wage structure effect:	-12.9	-12.9
of which:		
Years since migration	10.1	10.1
Potential work experience	-37.1	-37.1
Gender	1.7	1.7
Contract	1.7	1.7
Sector	5.2	5.2
Region	7.2	7.2
Time effects	0.8	0.8
Education	-23.0	16.5
Immigrant dummy	20.5	-18.9

Notes: The immigrant dummy represents the unexplained part of the gap due to "group membership". The decomposition of the unconditional wage gap follows the strategy described in equation 5. Please refer to the text for more details. All coefficients reported are statistically significant at a level of significance of 1 per cent.

between natives and immigrants, the wage gap would be 37.1 log points lower. However, based on the standard errors of the Gelbach's decomposition procedure, the hypothesis of different returns is not rejected. Recall from the discussion in section 4 that the coefficients associated with the potential work experience have different interpretations for natives and immigrants in the full model regression. For natives, it captures the impact on wages of an additional year of experience in the Portuguese labour market. For immigrants, the coefficient associated with the interaction of the immigrant dummy with the variable potential work experience measures the difference between the returns of one year of work experience of an immigrant in his home country and one year of experience of a native in Portugal. This estimated difference is negative, meaning that pre-immigration work experience of immigrants is less valued than domestic experience of natives, supporting the idea that the

transferability of foreign experience to the destination country is limited. Ceteris paribus, one additional year of experience in the Portuguese labour market increases the average real hourly wages of native workers by 3.4 log points, while one additional year of foreign experience increases the real hourly wages of immigrants by 1.0 log points ($3.4 - 2.3$). So, foreign work experience of immigrants is rewarded by less than one third than domestic potential experience of natives. The estimated value of the linear marginal return to foreign work experience in the Portuguese labour market seems low but it is slightly higher than the one estimated by Sanromá et al. (2009) for Spain (0.7 log points) and compares favourably with the evidence of (close to) zero returns to foreign experience obtained for countries like Italy (Dell'Aringa et al. (2012)), Germany (Basilio and Bauer (2010)), Israel (Friedberg (2000)), Canada (Schaafsma and Sweetman (2001)) and the United States (Kossoudji (1989)).

For the sake of simplicity, the previous discussion ignored the quadratic terms. For a reasonable time span, this simplification does not affect the signal of the impacts, only their magnitude over time. For instance, when evaluated at 5 years of experience, an additional year of foreign experience of the immigrants increases their average wage by 0.8 log points, while the return of an additional year of domestic experience is 2.9 log points for a native. An additional year of foreign experience grants lower returns to immigrants than to natives ($\gamma_2 < 0$), but this penalty is progressively smaller ($\eta_3 > 0$), cancelling out with approximately 52 years of experience. Thus, for comparable workers with the same amount of potential experience, one additional year of potential experience deepens the wage gap upon arrival between immigrants and natives.

Years since migration (*ysm*) give a significant contribution to the increase of the wage gap, 10.1 log points, higher than in the previous specification illustrated in Figure 1 (5.9 log points). Recall that the explained gap attributed to *ysm* depends on two factors: the average level of the variable and its estimated return (β_1). In the previous decomposition of the full model *à la* Chiswick (1978), we were measuring the contribution of all other variables for the wage gap assuming that their returns were the same between natives and immigrants. Now, we relaxed this restriction allowing the returns of all variables to differ and this makes the interpretation and the estimated coefficient of *ysm* different in the two models. In the first case, included in column (2) of Table 2, the β_1 coefficient captures the difference between the returns to domestic experience of immigrant and native workers. In the second case, included in column (6) of Table 2, the β_1 coefficient captures the difference between the returns to domestic and foreign experience of immigrant workers. Because foreign experience of immigrant workers is less valued than domestic experience of native workers, the estimated β_1 coefficient is now higher, resulting in a larger contribution to the increase on the wage gap upon arrival. The difference between the returns to an additional year of domestic experience between immigrants and natives shows how the relative initial situation of immigrants changes with years of employment in Portugal (assimilation rate). Ignoring

the quadratic terms for the sake of simplicity, this difference in returns is only 0.2 log points ($2.5 - 2.3$), pointing to no substantial evolution of the wage gap of the average immigrant relative to comparable natives over time in the Portuguese labour market (section 5.2 goes into more detail on the assimilation of immigrants using simulated wage profiles over time).

The returns to gender and type of contract have similar positive (though small) contributions to the wage gap upon arrival. If returns to gender were the same between native and immigrant workers then the wage gap would increase by 1.7 log points. This evidence implies that the wage penalty associated with being a female worker is smaller in the case of immigrants. The same reasoning applies to the type of contract. If the penalty associated with having a fixed-term contract relative to a permanent contract was the same for natives and immigrants, the wage gap would be also 1.7 log points higher.

Recall that in the presence of categorical variables, the contributions of these variables to the wage structure effect are always conditional on the choice of the omitted categories. In addition, the immigrant status coefficient includes the average wage gap for the omitted categories, as well as the potential effect of unobserved variables. The comparison of the two columns of Table 3 illustrates this point, focusing on the educational attainment variable. The only difference between the two columns is the reference group, or omitted category, of the education variable, which is 12 years of schooling (upper-secondary education) in the second column.

Starting with the first column, conditional on the choice of illiterate, manufacturing, Lisbon and 2002 as omitted categories, the returns to education of immigrants are lower than those of natives for the other schooling levels. If the returns to an additional level of education relative to being illiterate were the same between immigrant and native workers, the wage gap would be 23.0 log points lower. However, this does not mean that the contribution of different returns to education is -23.0 log points because this value cannot be dissociated from the estimate obtained for the immigrant dummy (20.5 log points), which also includes the impact of the difference in returns for the omitted category of education (illiterate). Given that we have more than one categorical variable, this value also includes the implicit contribution of the difference in returns of the omitted categories of the sector, region and time effects.

Turning to the second column of Table 3, omitting the category of 12 years of education and keeping the rest constant, from the Gelbach's procedure we obtain a positive contribution of different returns to education to the respective wage gap (16.5 log points). If the returns to the other levels of education relative to having 12 years of schooling were the same for natives and immigrants, the wage gap would be 16.5 log points higher. Again this effect cannot be detached from the value estimated for the immigrant dummy: conditional on all other variables, an immigrant with 12 years of education would earn upon arrival less 18.9 log points than a comparable native. Note that the sum of the contribution of the difference in

returns to education and the immigrant dummy is the same in both columns: -2.4 log points.

Given the relevance of differences in returns to formal education in the literature on immigration and the magnitude of the estimated parameters in our regression, let us summarise the conditional wage gap upon arrival by educational attainment level. As these wage gaps are obtained by summing the coefficients associated with the immigrant status variable and the interaction of the different education levels with the estimated immigrant dummy, they are independent of the reference group chosen for the education variable, but still conditional on the omitted categories of the other variables. As can be seen in column (6) of Table 2, the estimated coefficients of the interaction of education and the immigrant status are all negative and the returns on completing one more educational level (compared to being illiterate) of immigrants relative to a comparable native worker are progressively lower as we move up the educational ladder.

The wage difference between an illiterate male immigrant worker in the manufacturing sector, in Lisbon, with a permanent contract, without work experience (foreign or in host country), in 2002 and a comparable native is positive and amounts to 20.5 log points, while the wage difference for similar individuals but with 4 years of schooling is 14.1 log points ($20.5 - 6.5$) and 6.4 log points ($20.5 - 14.1$) for comparable individuals with 6 years of education completed. This conditional wage differential of immigrants upon arrival becomes increasingly negative for the three higher educational grades: -5.4 log points ($20.5 - 26.0$) for workers with 9 years of schooling, -18.9 log points for those with 12 years of schooling ($20.5 - 39.5$) and, finally, -22.9 log points ($20.5 - 43.5$) for individuals with tertiary education. So, the wages of immigrants with more formal education are relatively more penalised upon arrival to the Portuguese labour market. This result supports the general idea of imperfect transferability of formal education and the notion that the transferability of education also depends on its grade found in other countries (see, for instance, Friedberg (2000) for Israel and Basilio and Bauer (2010) for Germany.)

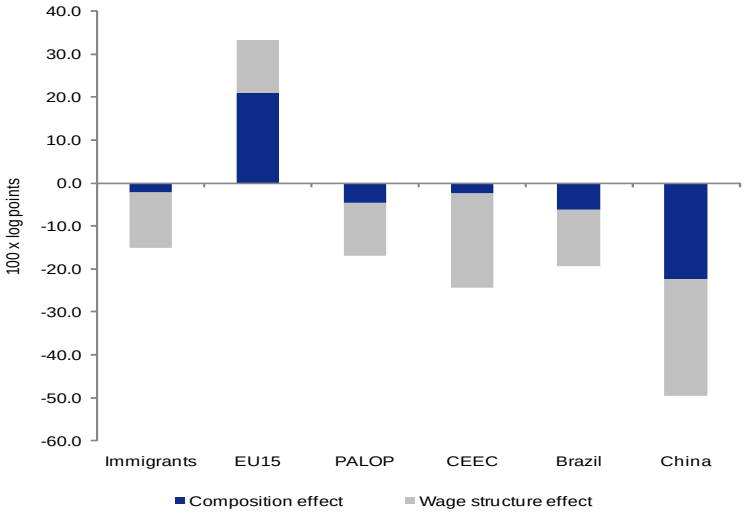
5.1.1 Accounting for heterogeneity in the wage gap upon arrival by immigrant origin

In this section, we examine the heterogeneity of the wage gap upon arrival of immigrants in the Portuguese labour market by main nationality groups. We individualise immigrants from the EU15, PALOP, CEEC, Brazil and China. We allow all the coefficients to vary between immigrants and natives and among immigrant groups, which is equivalent to estimating separate regressions for each nationality group. The full set of results of these individual regressions is included in Appendix B. In this section, we focus on the main results by nationality, highlighting the key contrast points among immigrant groups. Table 4 includes a selection of the main results of replacing the immigrant dummy variable by a set of indicators for each of the main nationalities considered. Throughout this section, we also report the results for the

average immigrant worker discussed in the previous section to facilitate the comparisons.

As described in section 3, we find a negative unconditional wage differential between the main groups of immigrants and natives, except in the case of immigrants from the EU15. How are these wage differences affected when we control for the characteristics of individuals and firms? As before, we use Gelbach's technique for implementing the Oaxaca-Blinder decomposition. All the gains and caveats of using this decomposition technique discussed above remain valid. Figure 3 shows the general results of this decomposition for each immigrant group, dividing the differential in average wages relative to natives into two terms, a composition effect and a wage structure effect.

Figure 3: Decomposing the immigrant-native wage gap (Oaxaca-Blinder decomposition) for the main immigrant groups, 100 x log points



Note: This decomposition follows the technique proposed by Gelbach (2010) and described in section 4.1.

Immigrants from the EU15 have very distinct results from the other immigrant groups examined. These immigrants earn, on average, more 33.2 log points than natives, reflecting a positive wage structure effects and, especially, a significant positive composition effect. The relative difference in the magnitudes of the wage determinants included in the regression largely favours immigrants from the EU15, a result that is in sharp contrast with the other immigrant groups considered. If the average level of the variables included was the same for immigrants from the EU15 and natives, then the wage difference would be 20.9 log points lower. Moreover, if there were no differences in the gains/penalties associated with each variable and no unexplained component, then the wage difference would be 12.3 log points lower. Hence, EU15 immigrants not only have better endowments but also tend to earn better returns on those variables.

The results of the composition and wage structure effects of Chinese immigrants are quite the opposite. Both effects are negative and substantial, contributing almost evenly to the relative wage disadvantage of these immigrants. From the -49.5 log points of unconditional

Table 4: Pooled OLS regression estimates, 2002-2008, dependent variable: log of real hourly wage - breakdown by nationality group

	Immigrants	EU15	PALOP	CEEC	Brazil	China
imi	0.205	0.073	0.221	0.254	0.274	0.255
	[0.000]	[0.121]	[0.000]	[0.000]	[0.000]	[0.000]
$pexp$	0.034	0.034	0.034	0.034	0.034	0.034
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$pexp^2$	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * pexp$	-0.023	0.012	-0.022	-0.030	-0.027	-0.033
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * pexp^2$	0.0002	-0.0002	0.0002	0.0003	0.0003	0.0004
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
ysm	0.025	-0.009	0.020	0.025	0.038	0.012
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
ysm^2	-0.0004	0.0004	-0.0002	-0.0002	-0.0007	0.0000
	[0.000]	[0.000]	[0.000]	[0.003]	[0.000]	[0.985]
gender	-0.237	-0.237	-0.237	-0.237	-0.237	-0.237
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
imi*gender	0.049	-0.055	0.059	0.068	0.062	0.219
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_1	0.070	0.070	0.070	0.070	0.070	0.070
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_2	0.192	0.192	0.192	0.192	0.192	0.192
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_3	0.379	0.379	0.379	0.379	0.379	0.379
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_4	0.623	0.623	0.623	0.623	0.623	0.623
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
edu_5	1.281	1.281	1.281	1.281	1.281	1.281
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * edu_1$	-0.065	-0.031	-0.053	-0.054	-0.054	-0.068
	[0.000]	[0.492]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * edu_2$	-0.141	-0.024	-0.140	-0.170	-0.151	-0.188
	[0.000]	[0.583]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * edu_3$	-0.260	0.028	-0.256	-0.339	-0.294	-0.356
	[0.000]	[0.537]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * edu_4$	-0.395	0.051	-0.375	-0.571	-0.456	-0.572
	[0.000]	[0.253]	[0.000]	[0.000]	[0.000]	[0.000]
$imi * edu_5$	-0.435	0.112	-0.391	-1.059	-0.582	-0.941
	[0.000]	[0.014]	[0.000]	[0.000]	[0.000]	[0.000]
contract	-0.078	-0.078	-0.078	-0.078	-0.078	-0.078
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
imi*contract	0.031	-0.034	0.040	0.087	0.058	0.043
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Other controls	-Yes-	-Yes-	-Yes-	-Yes-	-Yes-	-Yes-
No. of observations	15,932,970	15,060,001	15,215,980	15,247,469	15,174,975	14,990,179
R^2	0.4515	0.4588	0.4576	0.4571	0.4567	0.4585

Notes: p-values in brackets (implicit standard errors are worker-cluster robust). See the main text and Appendix A for a full description of all variables included.

wage gap to natives, -22.3 log points result from level differences in wage determinants and -27.2 log points reflect differences in the returns of the variables compared to natives and the immigrant status effect. Chinese immigrants have distinct features from the other immigrant groups that can help explain this result. Besides their very low educational attainment, two low-skill sectors (wholesale and retail trade, and hotels and restaurants) account for 95 per cent of total Chinese employment (see Table 1). In addition, Chinese workers tend to be more concentrated by firm than other immigrant groups. The average proportion of Chinese workers per firm is around 66 per cent, compared to around 30 per cent for the average immigrant.

With the exception of these two extreme cases, the results of the other immigrants groups are broadly in line with those obtained for the average immigrant: both effects contribute to the unconditional wage gap but the wage structure effect clearly dominates. That is, most of the wage gap is not due to worst endowments of the immigrants compared to natives but to differences in the returns of the covariates and to the "group membership" effect.

Table 5 depicts the detailed breakdown for the different immigrant groups. Starting again with immigrants from the EU15, the main contribution to the positive composition effect is associated with the education variable. This highly positive contribution results from the fact that the educational attainment of immigrants from the EU15 is significantly higher than that of natives (see Table 1). In contrast, potential work experience gives a negative contribution, as average potential work experience among immigrants from the EU15 is lower than for natives. As the share of male and female workers is very similar between these immigrants and natives, the composition effect associated with gender is not statistically significant.

Turning to the positive wage structure effect, the contribution of allowing for different returns on potential work experience between natives and immigrants from the EU15 is positive, which contrasts sharply with the results for the other immigrant groups. The foreign work experience of immigrants from the EU15 is better rewarded than the domestic experience of natives, as can be seen from the positive coefficient associated with the interaction of the EU15 immigrant dummy and the potential work experience variable in Table 4. Ignoring the quadratic terms for the sake of simplicity, one additional year of foreign work experience of these immigrants results in a wage increase of 4.6 log points ($3.4 + 1.2$), while in the case of natives the increase amounts to 3.4 log points.

In contrast to the average immigrant, for which the wage penalty associated with female and fixed-term workers is smaller than for natives, female and fixed-term workers from the EU15 have a higher wage penalty than similar natives. In addition, their positive wage differential compared to natives declines (although at a decreasing rate) with years since migration (see section 5.2.1 below for more details). So, controlling for this effect increases the positive wage difference between immigrants from the EU15 and natives.

The breakdown of the composition and wage structure effects for Chinese immigrants is, to some extent, symmetric to the one just described for the EU15 immigrants, as least regarding the major contributions to each effect. Firstly, the extremely low educational attainment of Chinese workers contributes strongly to the negative composition effect. Secondly, the negative difference between returns to pre-immigration work experience of Chinese immigrants and to domestic experience of natives is the main element behind the negative wage structure effect. In fact, the lowest returns to foreign experience are estimated for Chinese immigrants, while labour market experience abroad of workers from the PALOP is more valued than in the case of workers from the CEEC and Brazil. Using the regression estimates of Table 4 and ignoring quadratic terms, an additional year of labour market experience abroad increases mean wages of Chinese workers by only 0.1 log points ($3.4 - 3.3$). In addition, the separate regressions estimated of each immigrant group and included in Appendix B show that this value is not statistically different from zero, which means that work experience acquired in China has no significant wage value in the Portuguese labour market.

Regarding the other wage determinants, the individual contributions for decomposing the wage gap upon arrival obtained for main groups of immigrants, excluding the EU15, are qualitatively similar to the ones obtained for total immigrants, though with differences in magnitudes. Gender has a positive contribution both in the composition and wage structure effect. This result indicates that for these groups of immigrants the share of females is smaller than for natives and the wage penalty associated with female workers is smaller in the case of immigrants. However, female immigrants from China earn wages that are only 1.8 log points ($-23.7 + 21.9$) below their male counterparts, the smallest penalty estimated for all nationalities, which compares to a penalty of 23.7 log points for native workers and 18.8 log points ($-23.7 + 4.9$) for the average immigrant.

The contribution of the type of contract associated with the composition effect is negative, while the contribution associated with the wage structure effect is positive. Hence, immigrant workers from these origins tend to have proportionally more fixed-term links to the labour market but their wage penalty associated with that link is smaller than for natives. However, in contrast with a penalty of 7.8 log points for natives and 4.7 log points ($-7.8 + 3.1$) for the average immigrant, immigrants from the CEEC working under a fixed-term contract have wages that are slightly above the ones of their compatriots with a permanent contract (0.9 log points).

In spite of an overall similarity among main immigrant groups excluding the EU15, there are a few differences that are worth noting. Firstly, the composition effect associated with educational attainment of Brazilian immigrants is on the margin of statistical significance, which implies that their distribution over schooling levels is very similar to the one of natives. Secondly, the contribution of potential work experience associated with the composition effect is positive for immigrants from the PALOP, China and CEEC, though quite small in

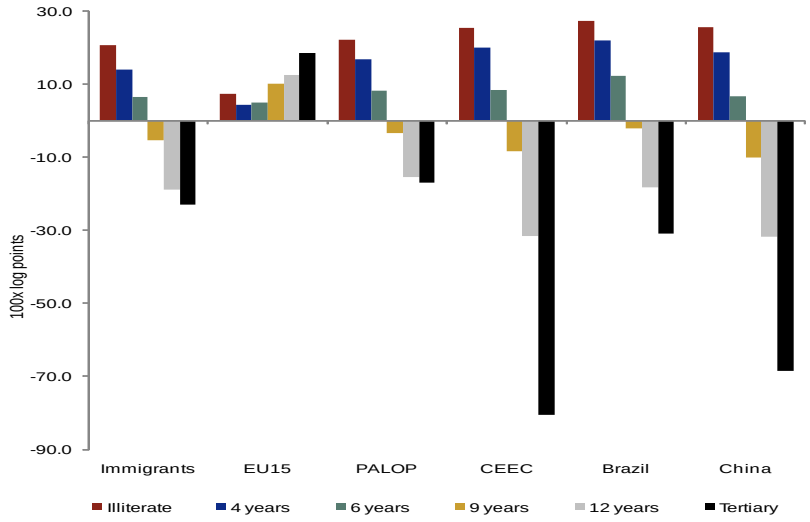
the last case. Average potential work experience is lower for all immigrant groups than for natives, but in these three cases the difference is rather small. So, the negative contribution from the linear term on potential work experience is outweighed by the contribution of its quadratic term (with a negative estimated coefficient) resulting in a combined contribution with a positive sign.

As it was done for the average immigrant in the previous section, let us finalise by examining the wage gap upon arrival for the different immigrant groups by educational attainment level. The regression estimates included in Table 4 show that, with the exception of immigrants from the EU15, the returns to education (in comparison to an illiterate worker) of the various immigrant groups are always lower than those of native workers across all educational levels. This result confirms the idea of imperfect transferability of education across borders, but there are important differences among immigrant groups. The highest difference in the returns to education compared to natives is obtained for workers from the CEEC and China, especially in the highest educational level. An average immigrant from the CEEC with tertiary education earns only more 22.2 log points (128.1 – 105.9) than a comparable illiterate worker of the same nationality, compared to 128.1 log points for a native worker and 84.6 log points for the average immigrant. The returns to tertiary education for an average Chinese worker (34.0 log points) are also significantly lower than those of the average immigrant. In addition, for Chinese workers, there are no significant wage returns of having 4 and 6 years of schooling compared to being illiterate.

Because immigrants' schooling is progressively less valued than natives, the wage gaps upon arrival of the various immigrant groups (excluding the EU15) become negative for the top-three educational levels (Figure 4). Taking the case of Brazil as an example, an illiterate male Brazilian worker in the manufacturing sector in 2002, in Lisbon, with a permanent contract and without any work experience has an average wage that is 27.4 log points higher than a comparable native. This positive wage difference vanishes as the educational attainment increases and becomes negative for the top three educational levels: -2.1 log points (27.4 – 29.4) for 9 years of education completed, -18.2 log points (27.4 – 45.6) for 12 years and -30.8 log points (27.4 – 58.2) for tertiary education. For workers with tertiary education, the wage gap upon arrival compared to natives is especially high for immigrants from the CEEC (-80.5 log points) and China (-68.6 log points). In the case of CEEC, this result is in line with anecdotal evidence that the degree of overqualification is high for these immigrants. In the 2002-2008 period, 18.1 per cent of CEEC immigrants with tertiary education are employed in the Portuguese construction sector, compared to a proportion of 6.3 per cent for natives and 9.4 per cent for the average immigrant.

The estimates of returns to education for immigrants from the EU15 are very different from the other immigrant groups. Although results in Figure 4 show a positive wage differential upon arrival for all educational levels, the positive gap for illiterate workers is not statistically significant and the same occurs in most differences in returns to education compared to natives. The differences in the returns to tertiary education of the EU15 immigrants, which are higher and statistically significant at a 5 per cent level, are the exception. The idea that the returns to education are similar between natives and immigrants from the EU15 was already evinced in the fact that the contribution of the educational variables to the wage structure effect was not statistically significant for these immigrants.[13] The fact that formal education acquired in EU15 countries is more easily transferable to Portugal is not surprising and is in line with evidence found for other countries of higher international portability of education between developed countries (see, for instance, , Chiswick and Miller (1985) for Australia, Schoeni (1997) and Bratsberg and Ragan Jr. (2002) for the US, Ferrer and Riddell (2008) for Canada, Sanromá et al. (2009) for Spain and Basilio and Bauer (2010) for Germany).

Figure 4: Wage gap upon arrival between immigrants and natives by educational level (wage difference relative to a comparable native worker in 100 x log points)



Note: See the main text and Appendix A for a detailed description of the different educational levels.

[13]Recall, however, that this contribution to the wage structure effect is conditional on the reference group chosen for the categorical variable. We replicated the calculations using 12 years of education as the reference category and the contribution of the education variables to the wage structure effect continued to lack statistical significance for the EU15 immigrants.

Table 5: Decomposing the immigrant-native wage gap (Oaxaca-Blinder decomposition) for the main immigrant groups: Contribution of regressors included in the full model with interactions, 100 x log points

	Immigrants	EU15	PALOP	CEEC	Brazil	China
Unconditional wage gap	-15.0	33.2	-16.9	-24.3	-19.3	-49.5
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Composition effect:	-2.1	20.9	-4.6	-2.5	-6.2	-22.3
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
of which:						
Potential work experience	-1.5	-5.8	1.1	0.2	-6.3	0.9
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gender	1.9	-0.1	0.5	4.3	1.0	1.7
	[0.000]	[0.281]	[0.000]	[0.000]	[0.000]	[0.000]
Contract	-2.5	-0.9	-2.2	-3.3	-3.2	-2.6
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sector	-2.4	-1.0	-2.6	-2.2	-3.1	-5.9
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Region	3.9	1.9	7.8	2.0	5.3	2.6
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time effects	0.0	0.0	-0.1	0.1	-0.2	-0.1
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Education	-1.4	26.8	-9.0	-3.6	0.3	-18.7
	[0.000]	[0.000]	[0.000]	[0.000]	[0.029]	[0.000]
Wage structure effect:	-12.9	12.3	-12.4	-21.8	-13.1	-27.2
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
of which:						
Years since migration	10.1	-2.8	11.5	7.0	9.5	3.6
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Potential work experience	-37.1	11.0	-38.5	-48.0	-37.3	-51.3
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Gender	1.7	-2.4	2.4	1.7	2.4	7.9
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Contract	1.7	-1.1	2.0	5.6	3.7	2.4
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sector	5.2	-0.3	1.7	6.0	4.3	-7.8
	[0.000]	[0.728]	[0.001]	[0.000]	[0.000]	[0.213]
Region	7.2	-3.1	5.2	9.4	7.1	10.6
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time effects	0.8	-1.2	-0.5	3.8	-1.5	1.7
	[0.000]	[0.018]	[0.008]	[0.000]	[0.000]	[0.007]
Education	-23.0	4.9	-18.3	-32.8	-28.7	-19.9
	[0.000]	[0.262]	[0.000]	[0.000]	[0.000]	[0.000]
Immigrant dummy	20.5	7.3	22.1	25.4	27.4	25.5
	[0.000]	[0.121]	[0.000]	[0.000]	[0.000]	[0.000]

Notes: p-values in brackets (implicit standard errors are worker-cluster robust). See the main text and Appendix A for a full description of all variables included.

5.2 Simulated wage profiles over time

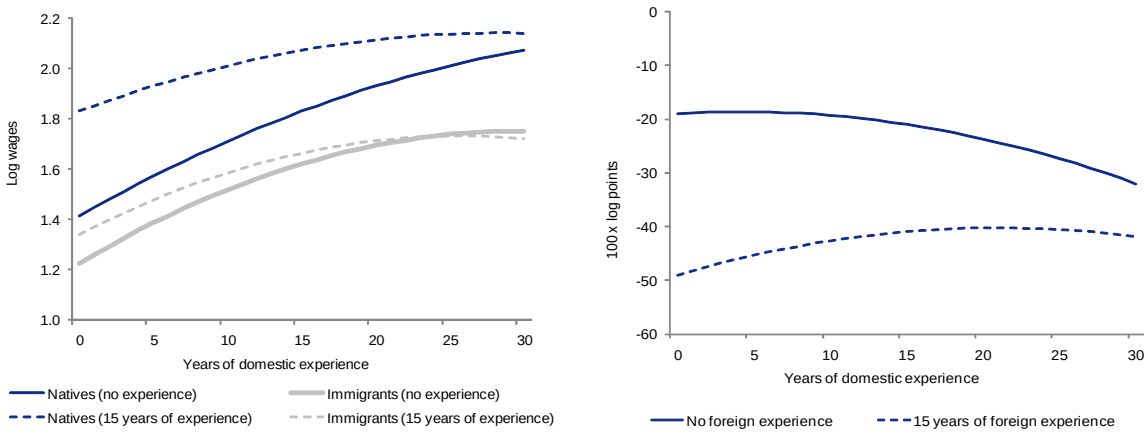
So far, our analysis focused on wage differences at the time of arrival at the destination country between comparable immigrant and native workers, i.e., wage differences before any assimilation. But is there a convergence between immigrants' and natives' wages over time? Do the wage differences upon arrival dwindle away? Essentially, we want to assess whether and how the initial wage situation of immigrants relative to natives changes with years of employment in Portugal.

Within the framework outlined in section 4.2, the coefficients associated with the linear returns to experience and used for assessing wage assimilation of immigrants are: the β_1 coefficient, which represents the difference between the returns to domestic and foreign experience of immigrant workers; and the γ_2 coefficient, which captures the difference between the returns of one year of work experience of an immigrant in his home country and one year of experience of a native worker in Portugal. From column (6) in Table 2, we can see that β_1 equals 2.5 log points, meaning that additional years of work experience in Portugal have a greater impact in immigrants' wages than additional years of experience in their country of origin. Moreover, γ_2 equals -2.3 log points, meaning that returns to pre-immigration experience of immigrants are smaller than the returns to domestic experience of natives.

Taking into account only the linear returns to experience, the wage assimilation rate is given by the sum of β_1 and γ_2, i.e., block *A* of equation 8. This difference in the returns to domestic experience amounts to 0.2 log points and passes the Wald test of statistical significance. This result implies that one year of work experience in Portugal is better rewarded for immigrants than for comparable natives but the extra gain is small. Thus, in case of large wage gaps upon arrival, immigrant workers are unlikely to reach parity with the wages of comparable natives during their stay in Portugal. However, this analysis of assimilation ignores the quadratic terms on years since migration and potential experience, which render more difficult the direct interpretation of the coefficients. In the remaining of this section, we compare simulated wage profiles of immigrants and natives, using the parameter estimates from equation 3 included in the last column of Table 2.

Let us define a male individual with 12 years of schooling, in the manufacturing industry, with a permanent contract, in Lisbon and in 2002 as the reference worker. Figure 5 plots the simulated wage profiles over a time span of 30 years for immigrants and natives with these characteristics but with two different starting points in terms of work experience: individuals entering the Portuguese labour market with no previous work experience (foreign or domestic) and individuals with 15 years of previous experience (foreign for the immigrant and domestic for the native). As the average level of work experience of immigrants upon arrival was found to be around 15 years, we chose this level as the starting point of one of the simulated wage profiles.

Figure 5: Simulated wage profiles for immigrant and native workers, real hourly wages



(a) Wage profiles

(b) Wage gaps

Notes: The simulated wage profiles use the parameter estimates from equation 3 included in the last column of Table 2. All profiles are evaluated for male workers with 12 years of schooling, in the manufacturing industry, with a permanent contract, in Lisbon and in 2002. The first panel depicts the simulated wage profiles for immigrants and natives with two different starting points in terms of work experience: individuals with no previous work experience (foreign or domestic) and individuals with 15 years of previous work experience (foreign for the immigrant and domestic for the native). The second panel includes the respective immigrant-native wage gaps over time.

As already discussed in section 5.1, foreign experience of the average immigrant is less valued in the Portuguese labour market than the domestic experience of natives. The differences in terms of the initial wages of the reference workers included in Figure 5 highlight this fact. The initial average wage of a native with 15 years of previous work experience is 41.6 log points higher than that of a native with no experience, while that difference for immigrants is only 11.5 log points. In addition, after 20 years in the Portuguese labour market there is no significant wage differential between these two average immigrants.

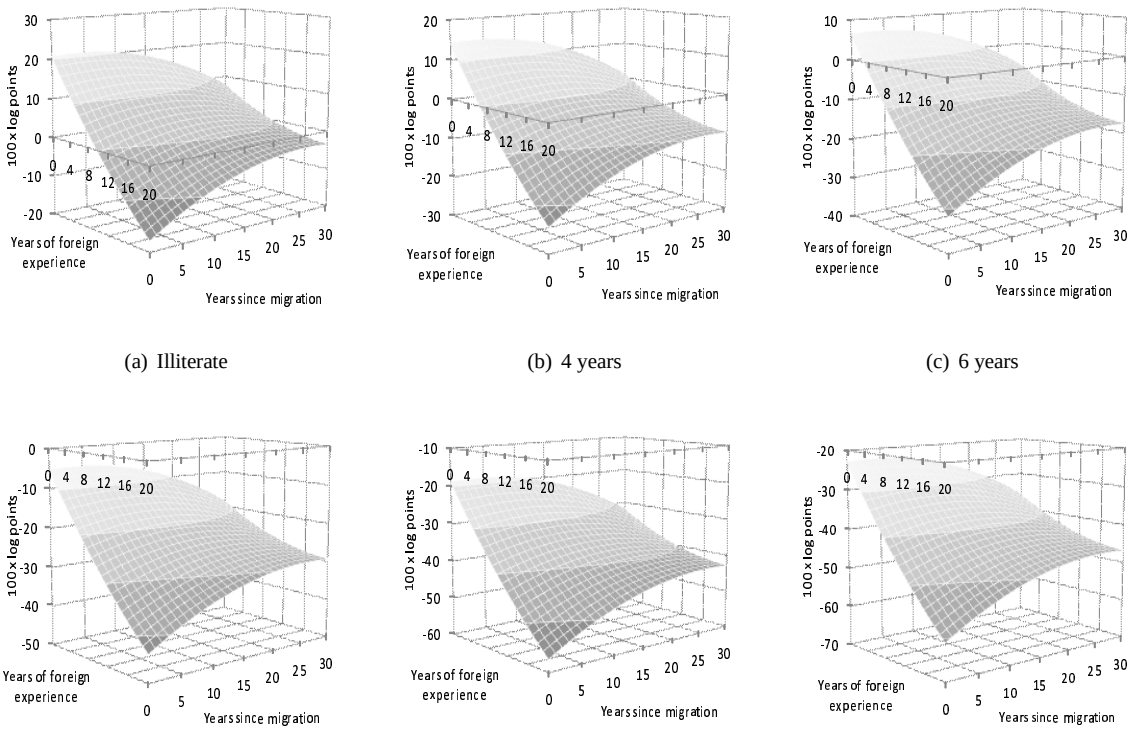
It is also evident from Figure 5 that natives' wages are always higher than those of immigrants. Starting with individuals with no previous experience, a reference immigrant worker will earn 18.9 log points less than a comparable native upon entry in Portuguese labour market. The first year of work experience in Portugal delivers a return that is 0.1 log points higher for immigrants than for natives. Nevertheless, when evaluated at 6 years of domestic experience, this difference in returns to an additional year of domestic experience is -0.1 per cent, thus not favouring the immigrants. Hence, after an initial period of four years in which immigrants' wages grow slightly above than those of natives, the process is reverted: the smallest wage gap of 18.6 log points occurs in the fourth year after migration and the wage gap after 30 years of experience in Portugal is 32 log points.

In the case of immigrants with 15 years of foreign experience, the wage convergence is higher but the remaining gap is still greater given the much lower starting point. The wage gap upon arrival in Portuguese labour market of an immigrant with 15 years of foreign experience relative to a reference native with 15 years of domestic experience amounts to 49.0 log points. The first year of domestic work experience of this average immigrant has a return that is 0.8

log points higher than that of a comparable native and the period of wage convergence lasts for around 20 years. However, after 30 years in the Portuguese labour market, the wage of a reference immigrant with 15 years of foreign experience is still 41.9 log points lower than that of a comparable native with 45 years of total experience.

In order to provide a more complete picture on how relative wages change with work experience, Figure 6 shows the simulated wage gaps for different levels of pre-immigration and domestic experience. Similarly to what was done in section 5.1, we present the results for the different levels of formal education. So, Figure 6 has six panels, where we trace out the implicit wage differences associated with one more year of domestic and/or foreign experience between the reference immigrant and native workers. In each panel, the y-axis measures the immigrant-native wage difference in log points, the x-axis has years since migration, i.e., work experience in Portugal, ranging from 0 to 30 years, and the z-axis (the depth axis) includes the years of foreign experience of immigrants, ranging from 0 to 20 years.

Figure 6: Patterns of post-arrival wage adjustment for immigrants in Portugal by education level
Wage differences between immigrants and natives, 100 x log points



(a) Illiterate (b) 4 years (c) 6 years

(d) 9 years (e) 12 years (f) Tertiary

Notes: The simulated wage gaps use the parameters estimates from equation 3 included in the last column of Table 2. The gaps are evaluated for male workers in the manufacturing industry, with a permanent contract, in Lisbon and in 2002.

Recall from equation 8 that only the differences in returns to work experience affect the evolution of relative wages over time, because the returns to both foreign and domestic work experience of immigrants are different from the returns to experience of natives. The values

of the other control variables, which are constant for each worker, only affect the wage gap upon arrival. Hence, all panels in Figure 6 show similar wage patterns over time, but different levels of the wage gap depending on the relative returns to education.

The first conclusion that can be drawn from Figure 6 is that, for each level of years since migration, higher foreign work experience affects negatively the wage difference between immigrants and natives. As the returns to foreign experience are significantly penalised vis-à-vis the returns to domestic experience of natives, higher levels of foreign experience drag down the relative wages of immigrants. However, as total work experience (domestic plus foreign) increases, this penalty is mitigated at a rate of 0.04 log points ($2\eta_3$). For instance, the (negative) slope of the wage gap is more pronounced upon arrival than 30 years after the arrival. As mentioned in section 5.1, this negative slope is reversed after approximately 52 years of total experience.

Second, for each level of foreign experience, longer stays in the host country are associated, at first, with slightly higher relative wages of immigrants compared to natives, but this premium decreases with domestic experience. Furthermore, immigrants' wage premium from accumulating domestic work experience increases with the level of pre-immigration experience (η_3 is positive). To see how this works let us look again at Figure 6. If one cuts vertical slices of the plotted surface along the foreign experience axis one can see that the wage differences between immigrants and natives are positively sloped on years since migration, up to a peak. Then, the negative quadratic effect dominates and one additional year of domestic experience has a negative effect on the relative wage of immigrants.

This result means that, if any, assimilation effects will be stronger in the first years of residence and will then fade away. The timing of the peak depends on the foreign experience of immigrants, with immigrants with less foreign experience reaching the peak sooner. Hence, on the one hand, immigrants' relative wages upon arrival are dragged down by the lower returns to foreign experience. On the other hand, immigrants with more foreign work experience have higher returns to domestic experience than natives during longer periods of time. This pattern may reflect the fact that more experienced immigrant workers whose skills are not easily transferable initially are better equipped to acquire country-specific human capital and have more incentives to make such investments in the country of destination. This result is in line with predictions of the immigrant human-capital investment model of Duleep and Regets (1999, 2002), who also found evidence of a systematic inverse relation between immigrant wages upon arrival and subsequent wage growth over time in the US. However, it contrasts with evidence found in other countries like Canada where additional foreign work experience lowers the subsequent returns to domestic work experience (see Skuterud and Su (2012)). The initial strong penalty on the valuation of foreign experience in the Portuguese labour market is, however, never fully compensated in a reasonable time span, as the wage differences are always negatively sloped on foreign experience.

Third, what about wage assimilation? Is it a partial or complete process? For education levels from 9 years of schooling to tertiary education, the wage gaps upon arrival are reduced initially but there is never a full convergence of immigrants' wages towards the wages of comparable natives. For the bottom-three education levels, in some cases there are positive wage differences upon arrival between immigrants and natives; in other cases the differences are negative. However, over a horizon of 30 years of domestic experience, for around 80 per cent of the different levels of pre-immigration experience considered, the initial situation does not change over time, i.e., if an immigrant earns less (more) than a native upon arrival, the same immigrant will still earn a lower (higher) wage than a comparable native after 30 years in Portugal. Thus, in general, we find no evidence in favour of the complete wage assimilation of the average immigrant over time spent in Portuguese labour market.

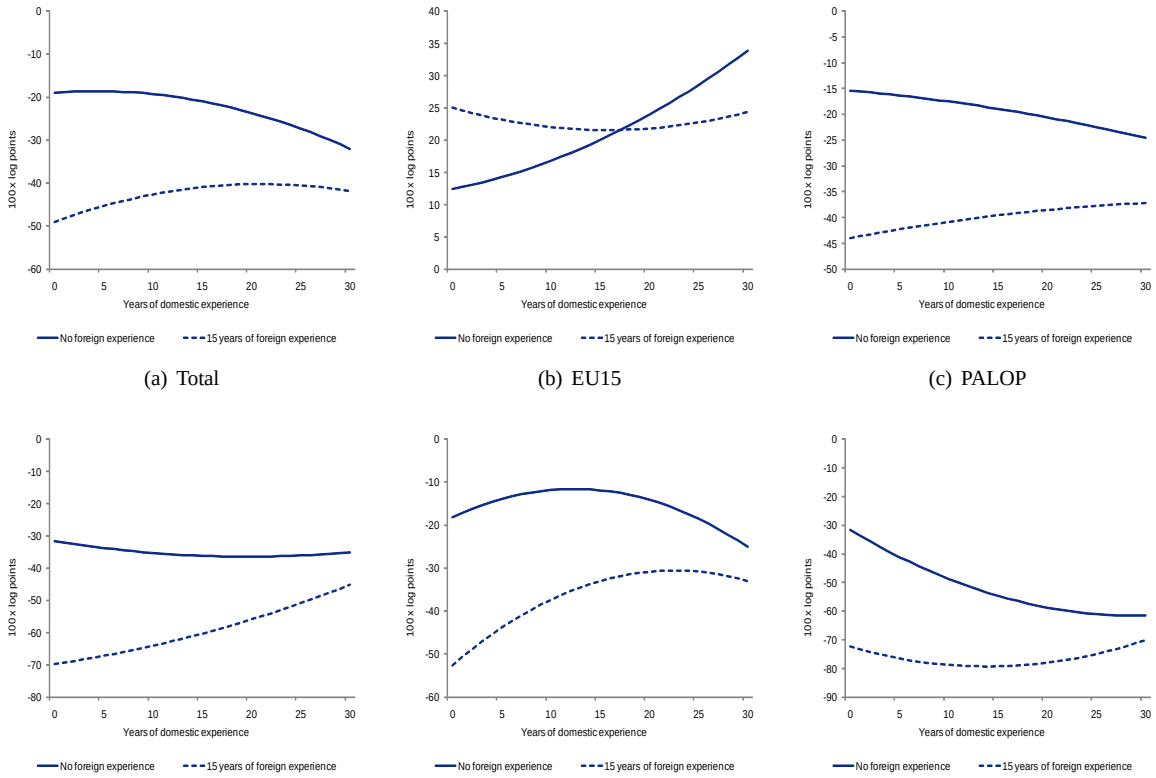
5.2.1 Accounting for heterogeneity in wage assimilation by immigrant origin

The returns to work experience, accumulated in the country of origin or in Portugal, have important differences among the main immigrant nationalities. Consider again a male worker with 12 years of schooling, in the manufacturing industry, with a permanent contract, in Lisbon and in 2002 as the reference worker. Following what was done in the previous section, Figure 7 plots the simulated wage gaps between the different immigrant groups and natives with these characteristics over a period of 30 years of domestic experience with two initial levels work experience: no previous work experience (foreign or domestic) and 15 years of work experience (foreign for the immigrant and domestic for the native). Figure 8 generalises these simulated wage differences considering several years of foreign experience of the immigrants (in the z-axis) ranging from 0 to 20 years.

Again let us start with the evolution of wage differences over foreign experience using Figure 8. For all immigrant groups except the EU15 workers, there is a negative linear impact of pre-immigration work experience on the relative wages of immigrants for each level of years since migration. The linear returns to foreign work experience, ranging from 0.1 log points for Chinese workers to 1.2 log points for PALOP workers, are all significantly lower than the linear returns to natives' domestic experience (3.4 log points). However, this penalty is mitigated as total work experience increases, at a rate that varies from 0.04 log points for PALOP immigrants to 0.07 log points for workers from China. Hence, the negative slope associated with foreign experience is reversed sooner for Chinese immigrants, followed by workers from Brazil, CEEC and, finally, PALOP (about 45, 46, 48 and 61 years of total experience, respectively).

The results for the EU15 immigrants are very different. As already mentioned in section 5.1.1, the linear returns to foreign experience of the EU15 workers are 1.2 log points higher than the linear returns to domestic experience of natives. Nevertheless, this premium in

Figure 7: Patterns of post-arrival wage adjustment for immigrants in Portugal by region of origin
Wage differences between immigrants and natives, 100 x log points



(a) Total (b) EU15 (c) PALOP

(d) CEEC (e) Brazil (f) China

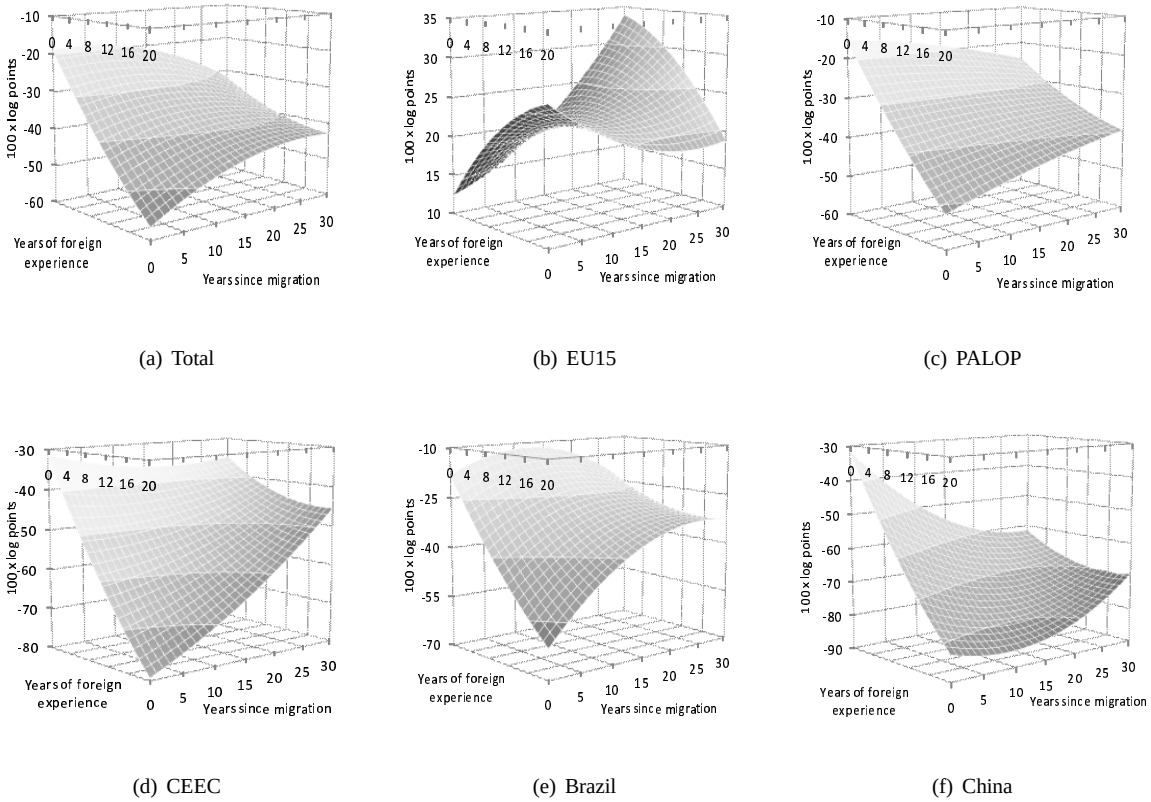
Notes: The simulated wage gaps use the parameter estimates from equation 3 for each immigrant group included in Table 4. The gaps are evaluated for male workers with 12 years of schooling, in the manufacturing industry, with a permanent contract, in Lisboa and in 2002.

returns to experience decreases as total experience increases, at a rate of 0.05 log points, resulting in a turning point at about 25 years of total experience. The combination of these two factors results in a mixed pattern of wage differences over total work experience, as plotted in Figure 8. While for recent immigrants the wage premium relative to natives increases with the amount of foreign experience, for immigrants living in Portugal for 20 years, the wage premium starts decreasing for immigrant workers who brought more than 5 years of foreign experience.

Now let us focus on the evolution of the wage differences of the main immigrant groups over time spent in the Portuguese labour market. Table 6 sums up the relevant blocks of coefficients for assessing the changes in the relative wages of immigrants over time (assimilation rate) as defined in equation 8, as well as their significance level.

Firstly, the results of immigrants from the EU15 are again in sharp contrast with those of the other immigrant groups. The difference in first-order returns to domestic experience between the EU15 and native workers is not statistically significant (block *A*), meaning that the linear returns to domestic experience of the EU15 and native workers are similar. However,

Figure 8: Patterns of post-arrival wage adjustment for immigrants in Portugal by region of origin
Wage differences between immigrants and natives, 100 x log points



(a) Total (b) EU15 (c) PALOP

(d) CEEC (e) Brazil (f) China

Notes: The simulated wage gaps use the parameter estimates from equation 3 for each immigrant group included in Table 4. The gaps are evaluated for male workers with 12 years of schooling, in the manufacturing industry, with a permanent contract, in Lisboa and in 2002.

over time, the wage differences upon arrival increase with domestic experience at a rate of 0.03 log points (block *B*), so the relative wages of the EU15 workers tend to diverge over time. This wage divergence is especially strong for immigrants without pre-immigration experience as depicted in Figure 7. For workers who bring more pre-immigration experience, this wage divergence is restrained reflecting the decreasing returns to high levels of foreign experience mentioned above. However, the relative wage advantage of the EU15 immigrants upon arrival is never reversed over time spent in the Portuguese labour market, i.e., there is not a full negative wage assimilation. This is true not only for workers with 12 years of schooling but also for all the other schooling levels considered.[14]

Secondly, for the other main immigrant groups, the results plotted in Figures 7 and 8 for the reference workers show that there is not a full positive assimilation process for any of them. Moreover, in some cases not even a partial assimilation process occurs, as the wage gap observed upon arrival increases with time spent in Portugal. i.e., immigrants' wages

[14]All detailed results are available from the authors upon request.

Table 6: Relevant coefficients for assessing the evolution of the immigrant-native wage differences over time (wage assimilation rate), log points

Blocks of coefficients	Immigrants	EU15	PALOP	CEEC	Brazil	China
A: $\gamma_2 + \beta_1$	0.0016	0.0030	-0.0017	-0.0049	0.0107	-0.0207
	[0.001]	[0.072]	[0.024]	[0.000]	[0.000]	[0.000]
B: $2(\eta_1 + \eta_3)$	-0.0004	0.0003	-0.0001	0.0002	-0.0009	0.0007
	[0.000]	[0.014]	[0.117]	[0.048]	[0.000]	[0.000]
C: $2(\eta_3)$	0.0004	-0.0005	0.0004	0.0006	0.0006	0.0007
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Notes: p-values in brackets (implicit standard errors are worker-cluster robust). The coefficients displayed in this table are defined in equation 8. Block *A* accounts for the linear impact of an additional year of domestic experience; block *B* represents the quadratic effect of that additional year; and block *C* measures the interaction between returns to domestic and foreign experience of immigrants.

diverge from natives' wages. Using the results depicted in Figure 7, it is clear that the wage gaps upon arrival of immigrants from the PALOP and, more markedly, from China with no pre-immigration work experience increase with years in the Portuguese labour market.

Let us now look into more detail to each of the remaining four nationality groups, starting with immigrants from Brazil whose patterns of post-arrival relative wages are more similar to those of the average immigrant. In contrast with all the other immigrant groups, there is a positive and significant first-order impact of an additional year of domestic experience in the relative wages of Brazilian immigrants of about 1 log point. As can be seen in Figure 7, this fact implies some convergence of the relative wages of Brazilian workers in the first years after migration. This return premium for accumulating domestic experience is stronger for workers with more foreign experience (block *C* is positive) but it is decreasing with domestic experience (block *B* is negative). In some cases, wages of Brazilian immigrants reach parity with those of comparable native workers. For example, all illiterate workers with a negative wage gap upon arrival and with foreign experience between 12 and 20 years see their wages fully converge to those of natives over time. Nevertheless, the estimated rate of assimilation is not enough to ensure the same evolution for workers with 12 years of schooling (Figure 8) or tertiary education, whose wage convergence process is never completed.

At first glance, these results suggest that speaking the language of the host country may play a role on immigrant wage assimilation. However, language proficiency does not seem to be a sufficient condition. The linear returns to domestic experience of PALOP workers are about 0.2 log points lower than those of natives and the quadratic effect is not statistically significant (Table 6). However, this penalty in returns to domestic experience phases out

for immigrants with higher levels of foreign experience. The wage gap upon arrival of a reference PALOP immigrant with no foreign experience increases with domestic experience but the opposite happens for a similar immigrant with 15 years of foreign experience (Figure 7). Overall, we find no evidence of substantial wage convergence for immigrants from the PALOP. For immigrants with 9 years of schooling or more, the wage gap upon arrival never cancels out, deepening further with the stay in Portugal for less experienced workers. For immigrants with up to 6 years of schooling, the initial relative wage situation does not change over a horizon of 30 years for more than 85 per cent of the levels of pre-immigration experience considered.

For immigrants from the CEEC, there is a penalty in the linear returns to domestic experience relative to natives of 0.5 log points, but this penalty is reduced for immigrants with more foreign experience at a rate of 0.06 log points. As shown in Figure 7, the wage gap upon arrival for a reference CEEC immigrant without any foreign experience remains almost unchanged over time, but there is some wage convergence for immigrants with 15 years of foreign experience. However, in most cases, no full wage assimilation is attained. In particular, the wage gap upon arrival of CEEC immigrants with 9 years or more of formal education never disappears and for the bottom-three educational levels full wage parity with the natives is only obtained in around 45 per cent of the different years of foreign experience examined.

The highest penalty in the linear returns to domestic experience compared to natives is estimated for immigrants from China (2 log points). This penalty is mitigated with time spent in the host country at a rate of 0.07 log points (block *B*). As in the case of CEEC immigrants, the negative effect of the returns to domestic experience is reduced for immigrants with more foreign experience. As domestic experience is accumulated, the wage of a reference Chinese immigrant with no foreign experience diverges markedly from that of a comparable native worker, while in the case of immigrants with 15 years of previous experience that pattern is more muted and there is a slight convergence (Figure 7). Again, wage parity with comparable native workers is never reached for Chinese immigrants in the top-three educational grades over a horizon of 30 years in the Portuguese labour market. For immigrants with up to 6 years of schooling, wage parity with the natives is attained in the cases where there was a relative wage advantage of the Chinese immigrants upon arrival (30 per cent of the levels of foreign experience considered).

6 Conclusions

The increase in immigration flows in the late nineties and the substantial change in its nationality mix makes it relevant to analyse the relative wage performance of immigrant workers in Portugal. A large strand of the empirical research on immigration in the last decades focused on several aspects of labour market adjustment of immigrants. Most of this research is based on the "positive assimilation" model of Chiswick (1978) and assumes that the pre-migration skills are not perfectly transferable when immigrants move from a lower to a higher income area. As a result, immigrants face a wage disadvantage upon arrival, but this penalty narrows with time of residence in the destination country. Empirical evidence shows that immigrants' wages overtake comparable natives' wages within 10 to 20 years in some countries, but in other countries the initial wage gap never closes completely.

In this paper, we use a longitudinal matched employer-employee database (*Quadros de Pessoal*) in the 2002-2008 period to analyse the wages of immigrants in the Portuguese labour market, identifying the major differences against native workers upon arrival and tracking whether these differences fade away as their work experience in Portugal rises. In this period, the simple difference in means between wages of immigrant and native workers amounts to -15.0 log points, or -13.9 per cent.

We apply the decomposition procedure proposed by Gelbach (2010) to disentangle the main drivers of the wage differences upon arrival. We exploit the relation between Gelbach's decomposition and the Oaxaca-Blinder decomposition (Oaxaca (1973) and Blinder (1973)), describing the unconditional average wage gap as the sum of a composition effect - associated with differences in the average magnitude of variables included in the model - and a wage structure effect - differences in the returns to the variables considered in the model and the unexplained part of the gap due to the immigrant status.

The wage gap upon arrival between comparable immigrant and native workers is mainly associated with the wage structure effect and not with differences in endowments. In particular, foreign work experience of immigrants is rewarded by less than one third of natives' domestic experience. Moreover, the estimated returns to education (compared to being illiterate) of immigrants relative to natives are lower for all educational levels and become progressively lower as we move up the educational ladder. So, on average, the wages of immigrants with more formal education are relatively more penalised in the Portuguese labour market. Both of these results support the idea of imperfect portability of human capital across countries of Friedberg (2000).

We also assess the wage gap upon arrival by main nationality groups of immigrants - EU15, PALOP, CEEC, Brazil and China. There are significant differences among these nationalities and we find that treating immigrants as a homogeneous group conceals distinct results across

nationalities. The average wage of workers from the EU15 is substantially higher than the average native wage, while Chinese immigrants earn wages significantly lower than other migrant groups. Our decomposition results show that the EU15 immigrants not only have better endowments but also tend to earn better returns to those characteristics. In particular, their educational attainment is significantly higher than that of natives and their foreign work experience is better rewarded than the domestic experience of natives. The results for Chinese workers are strikingly different: both the composition and wage structure effects are negative and substantial, contributing almost evenly to the relative wage disadvantage of these immigrants. In particular, they have an extremely low educational attainment and their pre-immigration work experience is not significantly valued in the Portuguese labour market. With the exception of these two extreme cases, the results of the other groups are broadly in line with those obtained for the average immigrant: most of the wage gap is not due to worst endowments of the immigrants compared to natives but to differences in the returns of the covariates and to the immigrant status effect.

Overall, the wages of immigrants do not fully converge to those of comparable natives as experience in the Portuguese labour market increases. Hence, the initial wage differences never disappear completely in most cases, implying that a wage penalty (premium) upon arrival, though varying in magnitude, persists over time spent in the Portugal. When there is a convergence of relative wages, the assimilation rate tends to be stronger in the first years since migration. Higher levels of pre-immigration work experience are also associated with higher returns to domestic experience but the initial strong penalty on foreign experience is not fully compensated in a reasonable time span in most cases. Again, the results for the EU15 immigrants are very different from the other immigrant groups, as their wage premium upon arrival tends to increase over time. On the other extreme, the wage penalty upon arrival of Chinese immigrants is not reverted and, in some cases, even increases with domestic experience. In general, we find no substantial assimilation effects for immigrants from the PALOP and CEEC, specially for workers who arrive with low levels of foreign work experience. The highest assimilation rate is estimated for immigrants from Brazil, whose wages catch-up more with those of comparable native workers than the other nationalities, though not completely in most cases.

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Appendix

A Definition of variables

Dependent variable	Description
$logW_{it}$	Natural logarithm of the real hourly wage of individual i at time t.

Explanatory variables	Description
imi	Dummy variable for immigrant status. Equals 1 if worker is immigrant.
pexp	Age - 6 - years of education.
ysm	Proxy of years since migration. Only for immigrant workers (equals zero for native workers). Based on the date that each worker first entered private employment (legally) in Portugal. Using QP records, it is possible to trace back each worker to its first record and also to obtain the first year of admission in a firm. This proxy corresponds to the difference between the reference year t and the minimum of these two dates.
Educational attainment	These variables record total years of education reported by the worker. The categories used are based on the International Standard Classification of Education (ISCED).
edu_0	Illiterate, meaning no formal education or below ISCED 1.
edu_1	4 years completed (primary education). Included in ISCED 1.
edu_2	6 years completed (second stage of basic education). Included in ISCED 1.
edu_3	9 years completed (lower secondary education). Refers to ISCED 2.
edu_4	12 years completed (upper-secondary education), Refers to ISCED 3-4.
edu_5	Tertiary education. Refers to ISCED 5-6.
Variables included in X_{it}	
Gender	Dummy variable for gender. Equals 1 if worker is female.
Contract	Dummy variable for distinguishing permanent from fixed-term contracts. Equals 1 in case of fixed-term contracts.
Sector	Dummy variables for different industries, namely agriculture, mining and quarrying, manufacturing, construction, wholesale and retail trade, hotels and restaurants, transportation, financial services, real estate and business services, public administration, education and health, and other services. The reference group is manufacturing industry.
Region	Dummy variables for different geographical locations, namely Aveiro, Braga, Faro, Leiria, Lisboa, Porto, Santarém, Setúbal and other regions. The reference group is Lisboa.
Time effects	Year-specific fixed effects. The reference year is 2002.

B Full results of the regressions

Table B.1: Pooled OLS regression estimates, 2002-2008, dependent variable: log of real hourly wage

	Natives	Immigrants	EU15	PALOP	CEEC	Brazil	China
constant	0.792	0.997	0.865	1.013	1.046	1.065	1.047
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
pexp	0.034	0.010	0.046	0.012	0.003	0.006	0.001
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,567]
$pexp^2$	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,446]
ysm		0.025	-0.009	0.020	0.025	0.038	0.012
		[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
ysm^2		0.000	0.000	0.000	0.000	-0.001	0.000
		[0,000]	[0,000]	[0,000]	[0,003]	[0,000]	[0,985]
gender	-0.237	-0.188	-0.292	-0.178	-0.168	-0.174	-0.018
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,007]
edu_1	0.070	0.005	0.039	0.016	0.016	0.016	0.002
	[0,000]	[0,101]	[0,381]	[0,002]	[0,000]	[0,078]	[0,775]
edu_2	0.192	0.051	0.168	0.052	0.022	0.041	0.004
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,592]
edu_3	0.379	0.119	0.406	0.123	0.040	0.085	0.022
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,014]
edu_4	0.623	0.228	0.674	0.248	0.052	0.167	0.051
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,004]
edu_5	1.281	0.846	1.393	0.890	0.222	0.699	0.340
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
contract	-0.078	-0.047	-0.112	-0.038	0.009	-0.020	-0.035
	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]	[0,000]
2003	-0.015	-0.019	-0.023	-0.024	-0.009	-0.026	-0.015
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.016]
2004	0.003	-0.006	-0.018	-0.014	0.015	-0.023	-0.006
	[0.000]	[0.000]	[0.004]	[0.000]	[0.000]	[0.000]	[0.429]
2005	0.002	-0.001	-0.015	-0.014	0.028	-0.020	0.005
	[0.000]	[0.502]	[0.022]	[0.000]	[0.000]	[0.000]	[0.502]
2006	-0.018	-0.007	-0.041	-0.022	0.032	-0.030	-0.008
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.316]
2007	-0.025	0.004	-0.032	-0.018	0.066	-0.031	0.004
	[0.000]	[0.013]	[0.000]	[0.000]	[0.000]	[0.000]	[0.635]
2008	-0.029	-0.007	-0.034	-0.028	0.054	-0.049	0.034
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Aveiro	-0.190	-0.089	-0.196	-0.066	-0.075	-0.025	0.022
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.017]	[0.310]
Braga	-0.261	-0.069	-0.295	0.161	-0.053	0.034	-0.025

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Table B.1 – *Continued from previous page*

	Natives	Immigrants	EU15	PALOP	CEEC	Brazil	China
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.024]	[0.051]
Faro	-0.112	0.004	-0.209	0.025	-0.018	0.001	0.038
	[0.000]	[0.080]	[0.000]	[0.000]	[0.000]	[0.862]	[0.000]
Leiria	-0.147	-0.042	-0.258	-0.017	-0.024	0.000	-0.015
	[0.000]	[0.000]	[0.000]	[0.116]	[0.000]	[0.983]	[0.331]
Porto	-0.188	-0.040	-0.169	-0.006	0.000	0.033	0.024
	[0.000]	[0.000]	[0.000]	[0.307]	[0.927]	[0.000]	[0.013]
Santarém	-0.164	-0.047	-0.248	0.006	-0.022	-0.020	-0.023
	[0.000]	[0.000]	[0.000]	[0.587]	[0.000]	[0.013]	[0.024]
Setúbal	-0.107	-0.041	-0.188	-0.019	-0.024	-0.058	-0.020
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.044]
Other regions	-0.206	-0.012	-0.224	0.030	-0.001	-0.008	-0.013
	[0.000]	[0.000]	[0.000]	[0.000]	[0.890]	[0.156]	[0.166]
Agriculture	-0.157	-0.092	-0.074	-0.130	-0.083	-0.104	-0.117
	[0.000]	[0.000]	[0.022]	[0.000]	[0.000]	[0.000]	[0.342]
Mining and quarrying	0.111	0.013	0.108	0.052	0.069	0.060	-
	[0.000]	[0.260]	[0.048]	[0.111]	[0.000]	[0.049]	-
Construction	-0.055	-0.044	-0.089	-0.076	-0.025	-0.030	0.232
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.048]
Wholesale and retail trade	-0.051	-0.027	-0.098	-0.053	-0.031	-0.052	-0.173
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.006]
Hotels and restaurants	-0.109	-0.020	-0.044	-0.032	0.040	-0.052	-0.175
	[0.000]	[0.000]	[0.004]	[0.000]	[0.000]	[0.000]	[0.005]
Transportation	0.133	0.236	0.107	0.191	0.268	0.157	0.622
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.003]
Financial services	0.227	0.434	0.137	0.386	0.382	0.296	0.752
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Real estate	-0.034	0.052	-0.064	-0.015	0.103	0.055	0.360
	[0.000]	[0.000]	[0.000]	[0.014]	[0.000]	[0.000]	[0.001]
Public administration	-0.030	0.096	0.003	0.007	0.183	-0.022	0.355
	[0.000]	[0.000]	[0.854]	[0.408]	[0.000]	[0.017]	[0.027]
Other services	-0.028	0.141	0.053	0.015	0.126	0.154	0.375
	[0.000]	[0.000]	[0.026]	[0.264]	[0.000]	[0.000]	[0.005]
No. of observations	14,976,145	956,825	83,856	239,835	271,324	198,830	14,034
R^2	0.458	0.286	0.428	0.337	0.134	0.225	0.309

Notes: p-values in brackets (implicit standard errors are worker-cluster robust). See the main text and Appendix A for a full description of all variables included.

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