Aggregate educational mismatches in the Portuguese labour market

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Abstract
This article assesses the evolution of educational mismatches in Portugal over the last two decades. There has been a consistent reduction in undereducation, as younger and more educated generations replace the older ones in the labour market. Higher undereducation in Portugal vis-à-vis European Union countries is currently mostly a problem of older employees. Overeducation remains contained even in recent years: the figures for Portugal stand below those for the majority of the European countries. Furthermore, there has been a large increase in the number of college graduates during this period, most of whom have been able to find highly-skilled occupations. (JEL: I21, J21, J24)

Introduction

The Portuguese labour force has been structurally characterized by low levels of education relatively to other European countries. Despite still lagging behind, over the last decades the labour market in Portugal has undergone important transformations, with a considerable rise in employees' education levels. Alongside this trend, production technologies have changed in most industries, increasing the demand by firms for more educated workers. What has been the result of this interplay between a larger demand and supply of more educated employees?

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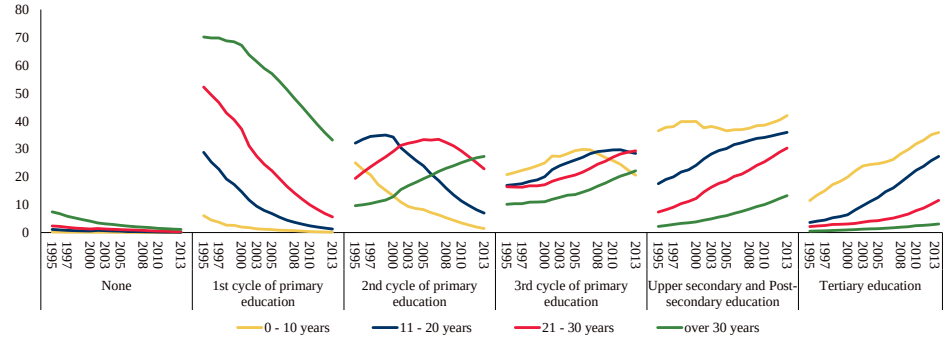


FIGURE 1: Employment structure by educational attainment within experience cohorts (in percentage).

Note: Lines represent the proportion of employees who, within a given experience cohort, have the indicated education level in that year. Details about the computation of breakdowns of education and experience are given in the text.
Source: Authors' calculations based on *Quadros de Pessoal*.

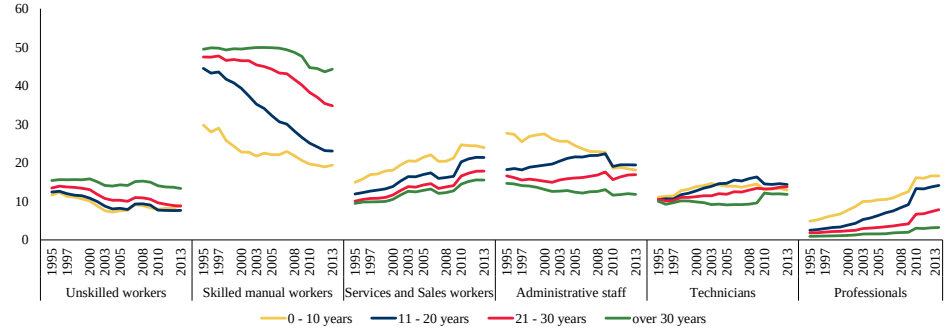


FIGURE 2: Employment structure by occupation within experience cohorts (in percentage).

Note: Lines represent the proportion of employees who, within a given experience cohort, have the indicated occupation in that year. Details about the computation of breakdowns of occupations and experience are given in the text.
Source: Authors' calculations based on *Quadros de Pessoal*.

Figures 1 and 2 present the evolution of employment structure, respectively, by education and occupation, 1995-2013, computed using microdata for the Portuguese labour market.[1] The upward trend in

1. The bulk of our results are based on *Quadros de Pessoal*, for which the last year available at the time of writing is 2013. Moreover, as further explained in the text, this article deals with secondary and tertiary market activity sectors.

educational attainment, along with a shift towards occupations requiring more skills, is rather evident in the charts for younger generations of workers. The purpose of this article is to explore the impact of such developments on educational mismatches, i.e. the lack or excess of education relatively to that required for workers to perform their jobs – labelled, respectively, as undereducation and overeducation. More specifically, we look at two main questions. First, to what extent undereducation is still an issue, given the catching up of the Portuguese workforce to higher education levels. Second, whether the growing number of highly educated workers, particularly college graduates, coming to the labour market has given rise to overeducation. This topic has been raised for developed economies by authors such as Hartog (2000) who considers that the strong expansion of participation in education has outpaced the increase in the demanded levels of education. In contrast to previous studies for Portugal – see below – that focused on the relationship between educational mismatches and earnings, our analysis focuses on the mismatches themselves (at an aggregate level), considering aspects such as breakdowns by occupations and experience cohorts, the relationship between overeducated college graduates and their fields of study and comparisons between Portugal and European Union countries.

Educational mismatches have been considered costly for the economies, justifying a long-standing researchers' concern about them (Freeman 1976; Thurow 1975). In the case of overeducation, output is lower than it would be if the workers' qualifications were fully used, while undereducated workers are likely to have a deficit of skills impacting negatively on their performance. Most studies of educational mismatches have focused on wage returns, both in the literature for Portugal (see, for instance, Araújo and Carneiro 2017; Cerejeira *et al.* 2007; Santos and de Oliveira 2002; Kiker *et al.* 1997) and in the international literature (see, for instance, Di Pietro and Urwin 2006; Duncan and Hoffman 1981; Iriondo and Pérez-Amaral 2016; Bauer 2002; Frenette 2004). In general, findings indicate that the returns to required education exceed those to overeducation, while the returns to undereducation are negative. Therefore, educational mismatches may also indirectly impact on firm productivity through their effects on wages and, more generally, job satisfaction (Hartog 2000). Mahy *et al.* (2015) provide evidence on the relationship between educational mismatches and firm productivity across working environments. They concluded that higher levels of required education or overeducation (undereducation) impact positively (negatively) on productivity. Furthermore, the effect of overeducation on productivity is higher among firms with highly-skilled jobs, belonging to high-tech industries and operating in a more uncertain economic environment.

There is no single best definition of required education for a given occupation in the literature while, at the same time, the measured levels of under- and overeducation turn out to be rather sensitive to such a definition. As described below, our study uses two common measures of

required education. The first one is a standard correspondence between the International Standard Classification of Occupations (ISCO) and the International Standard Classification of Education (ISCED). This measure shows a consistent reduction of undereducation over time in Portugal, from around two thirds of the employees in 1995 to approximately one third in 2013. Moreover, undereducation shows a marked decreasing profile from upper to lower experience cohorts. At the end of the sample, undereducation was below 10% for employees with up to 10 years of experience, but still at 60% for their peers with more than 30 years of experience. This pattern essentially reflects the replacement in the labour market of older generations by newer, more educated ones. Overeducation assumes negligible values at the beginning of the sample, and remains confined to around 5% of the workforce at the end of it.

We compute an alternative indicator, internal to the characteristics of Portuguese labour force, which measures required education directly from the data, as the mode of the employees' educational attainment within occupations. Undereducation is much lower and overeducation is higher in this second indicator, which is less demanding in terms of workers' education than the ISCO-ISCED one, particularly at the beginning of the sample. Moreover, because modal educational attainment categories may change over time, this second indicator shows no clear trends, thus being less appropriate for assessing the evolution of mismatches.

Finally, we present cross-country comparisons, on the basis of the EU-SILC database (2007-2016) and using the ISCO-ISCED indicator, which is internationally comparable. As far as undereducation is concerned, Portugal remains at a disadvantage vis-à-vis the European Union countries, but this is largely confined to more experienced workers. Moreover, Portugal is among the countries with the lowest incidence of overeducation.

An important caveat for the methodologies as the ones followed in this article is that required qualifications are evaluated solely on the basis of formal education, while other skills coming from broad-based knowledge, on-the-job training and experience might be equally important for workers to adequately perform their jobs.

This article is organized as follows. The following section briefly summarizes the methodologies in the literature to measure required education for a given occupation. The third section describes the data used and the computation of mismatches. The fourth section presents the key findings, dealing particularly with overeducated college graduates. The fifth section compares educational mismatches in Portugal and European Union countries. The last section concludes.

Methods for identifying educational mismatches

The starting point for identifying educational mismatches is a measure of required education for each occupation. In the educational mismatches literature two major approaches have been used. In the first one, studies have considered mismatches between individuals available for work and available jobs (macroeconomic mismatch). In the second one, the literature has considered discrepancies between workers' qualifications and requirements for their job only for employed workers, at a micro level. Moreover, educational mismatches may encompass both vertical mismatches, measured in terms of over- and undereducation, and horizontal mismatches. The latter measure the extent to which workers, normally college graduates, are employed in occupations unrelated to their main field of study, on the basis of a subjective question or comparing fields of study with occupation codes. Our study takes a micro approach and focuses on vertical mismatches.

There are three methodologies to measuring the required education for a certain occupation: the job evaluation method, the empirical method and the subjective method. Each of them has advantages and shortcomings while findings tend to differ depending on the one being used (McGuinness *et al.* 2017; Mysíková 2016).

The job evaluation method relates educational attainment and job qualifications based on an external definition of education requirements by job analysts (see, for instance, Ortiz and Kucel 2008). This methodology is perceived as quite accurate because it is based on field expertise, but it does not take into account that occupational requirements can change rapidly over time. The first measure of required education we use – a correspondence between major occupations of ISCO and skill levels as defined in ISCED – belongs to this category (see the next section).

The empirical – or realized matches – method estimates the level of required education on the basis of a statistical indicator computed by occupation, such as average years of schooling within a range of one standard deviation, or the modal educational achievement category (see, for instance, Bauer 2002; Cerejeira *et al.* 2007; Verdugo and Verdugo 1989; Kiker *et al.* 1997; Rahona-López and Pérez-Esparrells 2013; Iriondo and Pérez-Amaral 2016). In practice, the mode is used more frequently than the mean, as it is less sensitive to the presence of outliers and provides a more accurate measure of adequate education (Santos and de Oliveira 2002). Furthermore, the number of years of schooling used to calculate the mean is frequently upwardly biased, and the one-standard-deviation range is arbitrary (see, for instance, Ortiz and Kucel 2008; Mysíková 2016).

The key advantages of the empirical method are that it can be applied to any micro datasets containing information about both educational attainment and occupations and it is sensitive to technological changes and labour market characteristics. Nevertheless, the fact that such indicator is tied

to a given point in time and country should be taken into account, in particular, when workers' education levels are changing substantially or heterogeneous countries are being compared. We also present results for educational mismatches in Portugal on the basis of this methodology in order to complement those from the job evaluation method.

The two methodologies just described are the so-called objective ones. It is worth mentioning the subjective method (not used in this article) that is based on the worker's self-assessment of the level of education required to perform her/his job, which is then compared to the highest education level completed by the worker (see, for instance, Allen and Van der Velden 2001; Capsada-Munsech 2015; Di Pietro and Urwin 2006; Duncan and Hoffman 1981; Hersch 1991). The main advantages of this self-declared approach is that it is relatively easy to apply and it is job-specific. Its drawbacks include the subjective bias arising from the workers' tendency to overestimate their own qualifications (Groot and Van Den Brink 2000).

Data and computation of educational mismatches

Data

Our analysis is mainly based on *Quadros de Pessoal*, a longitudinal matched employer-employee database collected every year by the Ministry of Labour and Social Solidarity. The design of *Quadros de Pessoal* allows the identification of required education only through the objective approaches: job evaluation and realized matches. This database provides detailed information about firms with at least one employee, establishments and their workers. The two key variables for this article are employee's occupation and education in a given year. Thus only employees for whom such an information was available were considered. We used data covering the 1995-2013 period (except 2001 for which no data exist), for the subsample of full-time employees aged between 16 and 65 years.[2] As far as activity sectors are concerned, we confined our sample to secondary and tertiary market activities: manufacturing industry,

2. According to BPLim (2017), full-time work corresponds to a weekly work period over 75% of the normal work period at the establishment or firm.

energy, utilities, construction and market services.[3] Our database contains 23,415,079 observations in total.[4]

Workers' occupations were reported in *Quadros de Pessoal* during our sample period according to two classifications: the 1994 National Classification of Occupations and the 2010 Portuguese Classification of Occupations. In order to analyse the evolution of educational mismatches over time, we had to harmonize and aggregate these two classifications. We developed a harmonized breakdown comprising 26 occupations, as well as a more aggregated one that comprises 6 occupations (Table 1). As explained below, this latter breakdown matches the major groups of ISCO. We dropped workers in managerial occupations from the analysis on the account that for this group formal education is a less suitable approximation of required qualifications, as other factors such as experience and managerial skills play a very important role along with purely technical skills.

In *Quadros de Pessoal*, employees' educational attainment is a categorical variable reporting the highest level completed. The categories of this variable changed in 1994, 2000 and 2006 to accommodate the evolution of the Portuguese education system. The 2006 classification incorporates, in particular, the implementation of Bologna Process.[5] Moreover, until 2006 the education level was censored at the level of *Bacharelato*, i.e. workers with *Bacharelato*, *Licenciatura* or above were allocated to the same category. In order to make all the information comparable, we considered 6 levels of education throughout the sample: (i) none; (ii) 1st cycle of primary education; (iii) 2nd cycle of primary education; (iv) 3rd cycle of primary education; (v) upper secondary and post-secondary education and (vi) tertiary education. Furthermore, the data provided by *Quadros de Pessoal* include the field of study for employees with tertiary education, an information also used in this study.

Finally, using a common procedure in the literature, we calculated experience as the difference between age (derived from date of birth) of the employee and the number of years of schooling[6], minus 6. This variable

3. More specifically, our analysis includes firms whose main economic activity (NACE) is: (i) manufacturing; (ii) electricity, gas, steam, cold and hot water and cold air; (iii) water collection, treatment and distribution, sewerage, waste management and remediation activities; (iv) construction; (v) wholesale and retail trade, repair of motor vehicles and motorcycles; (vi) transportation and storage; (vii) accommodation and food service activities; (viii) information and communication activities; (ix) financial and insurance activities; (x) real estate activities; (xi) consultancy, scientific and technical activities and (xii) administrative and support service.

4. Given the aggregate nature of the analysis, we considered a sequence of cross-sections. Nevertheless, we took advantage of the longitudinal nature of the dataset to correct some inconsistencies in the data, such as in employees' educational attainment and date of birth.

5. For more information, see Decree-Law n. 74/2006 of March 24.

6. We assumed the minimum number of school years required to complete the highest educational level reported.

6-occupation breakdown	26-occupation breakdown
Unskilled workers	Agricultural and fishing workers Unskilled workers in other sectors
Skilled manual workers	Machinery and transport operators Skilled manual workers (except agriculture)
Services and Sales workers	Personal service workers Sellers
Administrative staff	Administrative staff
Technicians	Intermediate technicians for research and industry Intermediate technicians of electronics and computer science Intermediate life and health technicians Intermediate management and administration technicians Intermediate technicians for other services
Professionals	Experts in physics, chemistry and similar Experts in mathematics and statistics Computer experts Engineering experts Experts in life sciences Doctors Nurses University professors Teachers and childhood educators Management and administration Jurists Economists Journalists Specialists in social and human sciences

TABLE 1. Breakdowns of occupations used in the analysis.

corresponds therefore to *potential* labour market experience. We excluded from the sample workers having more than 55 years of potential experience.

We also carry out a comparison of educational mismatches for Portugal vis-à-vis other European Union countries and, in this instance, we use data from the Survey of Income and Living Conditions (EU-SILC). This last dataset is described in the corresponding section.

Computation of educational mismatches

ISCO provides a framework for the production of internationally comparable occupational data. The first method we employ for the calculation of under- and overeducation indicators is based on a standard correspondence between the eight ISCO-08 major groups relevant for our analysis and formal education levels of UNESCO's ISCED-97, given in Table 2, which was developed by the International Labour Organization (ILO 2012). Note that ISCO-08 has two additional major groups that are not relevant for us: Managers, excluded from the analysis for the reasons given above, and Armed forces, as we only deal with market activities. The 6-occupation breakdown presented in Table 1 above is a slightly aggregated version of those eight ISCO-08 major groups, as detailed in Table 3.

ISCO-08	Required education (ISCED-97)
Elementary Occupations Skilled Agricultural, Forestry and Fishery Workers	1st, 2nd or 3rd cycle of primary education or Upper secondary and Post-secondary education
Services and Sales Workers Craft and Related Trades Workers Plant and Machine Operators and Assemblers Clerical Support Workers	3rd cycle of primary education or Upper secondary and Post-secondary education
Technicians and Associate Professionals Professionals	Tertiary Education

TABLE 2. Mapping of ISCO-08 major groups to levels of education of ISCED-97.

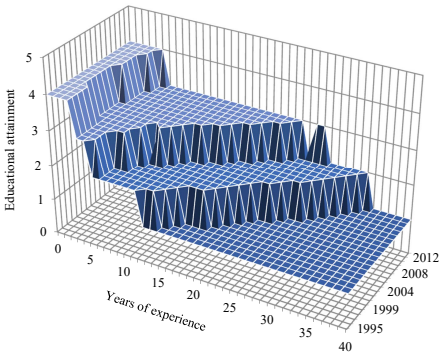
6-occupation breakdown	ISCO-08
Unskilled workers	Elementary Occupations Skilled Agricultural, Forestry and Fishery Workers
Services and Sales Workers	Services and Sales Workers
Skilled manual workers	Craft and Related Trades Workers Plant and Machine Operators and Assemblers
Administrative staff Technicians Professionals	Clerical Support Workers Technicians and Associate Professionals Professionals

TABLE 3. Mapping of the 6-occupation breakdown to ISCO-08 major groups.

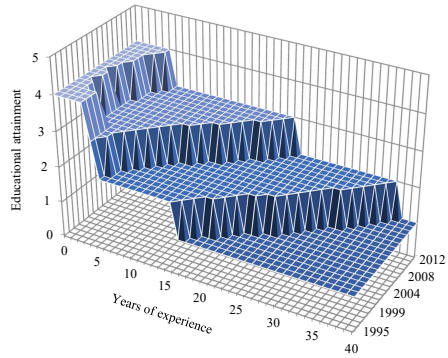
We thought it appropriate to present an alternative measure of educational mismatches, calculated from a country-specific indicator capturing the dynamics in the qualifications of the Portuguese workforce. We determined required education directly from *Quadros de Pessoal*, using the mode as the relevant statistic and taking as a reference both breakdowns of occupations in Table 1.

When one considers the evolution of modal educational attainment by occupation, as a rule this has changed over time, and often the difference in the proportion of employees who have the «first» and the «second» modes is reduced. Such changes in the modal educational attainment mostly occur as younger generations of workers replace older ones. Figure 3 illustrates this issue, presenting the evolution of the modal educational attainment category (1995-2013) for each of the 6 aggregated occupations, *by year of potential experience*. For most occupational categories, there are instances where two levels of educational attainment assume an important role. The exception is Professionals who uniformly possess tertiary education throughout the sample.

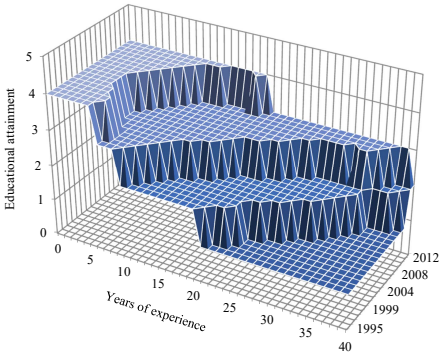
Therefore, in the alternative indicator, we defined required education as the two levels of education with the highest number of employees, i.e. the first and the second mode, calculated within each occupation for a given year, except for Professionals, for whom only the first mode was taken. Furthermore, when the modal qualifications were not contiguous, the in-between level of education was also considered as required education. This procedure also makes the computation of the mode indicator closer to that of the ISCO-ISCED indicator which comprises more than one educational category for most occupations (except for Technicians and Professionals).



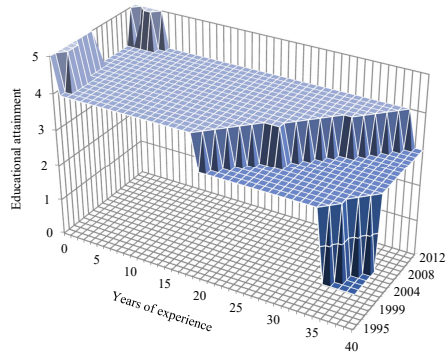
(A) Unskilled workers



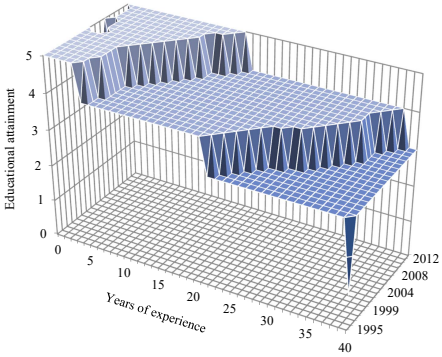
(B) Skilled manual workers



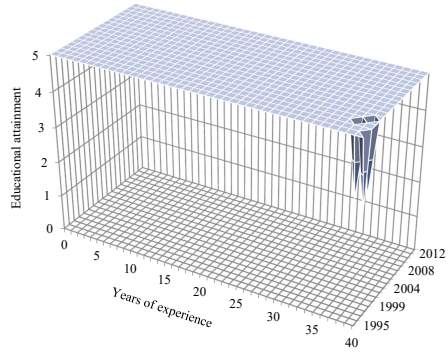
(C) Services and Sales workers



(D) Administrative staff



(E) Technicians



(F) Professionals

FIGURE 3: Evolution of employees' modal education by occupation and years of experience.

Note: Educational attainment: 0=None, 1=1st cycle of primary education, 2=2nd cycle of primary education, 3=3rd cycle of primary education, 4=Upper secondary and Post-secondary education and 5=Tertiary education.
Source: Authors' calculations based on *Quadros de Pessoal* (1995-2013).

Evolution of educational mismatches in the Portuguese labour market

Table 4 shows the evolution (1995-2013) of overall educational mismatches according to both ISCO-ISCED and mode indicators. The mode indicator was computed taking as a reference the two breakdowns of occupations in Table 1 – the more aggregated one being also used for the computation of the ISCO-ISCED indicator.

	1995	1997	1999	2002	2005	2007	2009	2011	2013
ISCO-ISCED indicator									
Required education	34.6	37.3	39.3	43.2	47.7	51.6	54.9	57.7	60.0
Overeducation	0.9	1.3	1.6	2.1	2.8	3.2	3.8	4.3	5.1
Undereducation	64.6	61.5	59.1	54.7	49.6	45.2	41.3	38.0	35.0
Mode indicator									
6-occupation breakdown									
Required education	76.8	75.4	74.2	71.6	71.7	69.8	71.4	69.8	70.7
Overeducation	11.3	14.6	14.8	19.0	17.3	20.8	20.1	10.5	9.0
Undereducation	11.9	10.0	11.0	9.4	11.0	9.5	8.6	19.7	20.3
26-occupation breakdown									
Required education	76.4	74.9	73.5	73.9	67.9	66.6	68.7	67.8	68.7
Overeducation	11.3	14.6	16.8	17.8	15.6	19.0	17.9	9.8	8.3
Undereducation	12.3	10.5	9.7	8.3	16.5	14.4	13.4	22.4	23.0

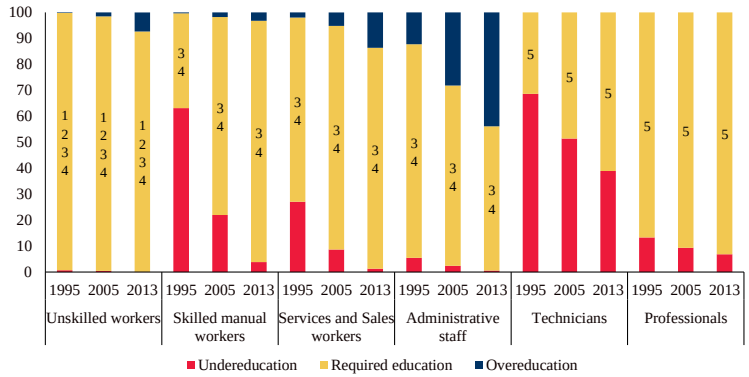
TABLE 4. Evolution of overall educational mismatches according to each indicator.
Source: Authors' calculations based on *Quadros de Pessoal* (1995-2013).

ISCO-ISCED indicator

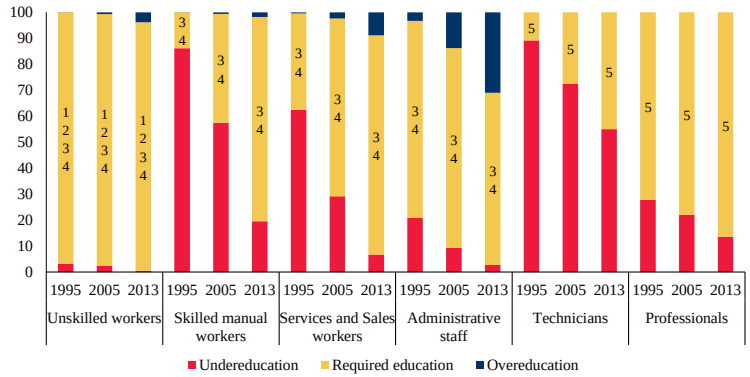
Figure 4 presents the breakdown by occupations and potential experience cohorts for the ISCO-ISCED indicator. We selected the first, an intermediate and the last year of the sample to simplify the presentation of results. The indicator shows a consistent reduction of undereducation over time, from around 2/3 of the employees in 1995 to approximately 1/3 in 2013 (Table 4). This trend is common to all four potential experience cohorts. However, the *level* of undereducation varies substantially across such cohorts (Figure 4). It stood at around 80% for the cohort of employees with more than 30 years of experience, in the mid-90s, remaining at 60% at the end of the sample (affecting in 2013 particularly the skilled manual workers and technicians). In contrast, in the lowest experience cohort, it came down from approximately 33% at the beginning of the sample to 7% at the end of it (being in 2013 largely confined to technicians). The decreasing profile of undereducation over time within potential experience cohorts reflects the gradual replacement of older, less educated, generations in the labour market. Such a reduction reflects the approximation of Portuguese workforce education to European

standards. Nevertheless, other factors may play a role in the results across experience cohorts: for instance, undereducated workers at the beginning of their employment spell may get further education and thus achieve the required attainment level. This would tend to reduce overall undereducation within a given generation of workers as they move up in the distribution of potential experience. However, these factors are better studied by following individual workers' behaviour over time rather than in an aggregate analysis such as here.

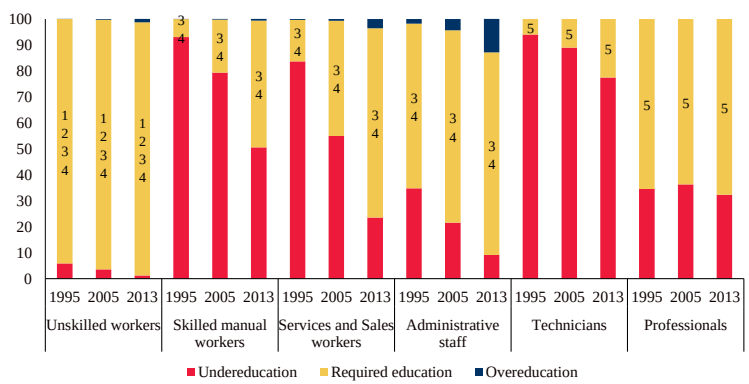
In contrast, overeducation remains a rather unimportant phenomenon throughout, rising from negligible values at the beginning of the sample to around 5% at the end. Overeducation is higher for employees with up to 10 years of experience, increasing from 4% in 1995 to 12% in 2013. For more experienced cohorts, the proportion of overeducated employees is still negligible at the end of the sample. Such a tendency is in line with the coming to the labour market of more educated workers, particularly with Tertiary education, who are not able to find an occupation matching their formal education level. We will come back to this issue later on. Similarly, other factors may influence the differences across experience cohorts towards an attenuation of mismatches as workers become more experienced. Some authors pointed out that overeducation may arise from a trade-off between education and other components of human capital (such as Araújo and Carneiro 2017; Cerejeira *et al.* 2007; Kiker *et al.* 1997; Sicherman 1991). Thus, overeducated employees may substitute education by the lack of previous job experience, accepting jobs requiring less education than they actually have in order to acquire the required experience for job mobility.



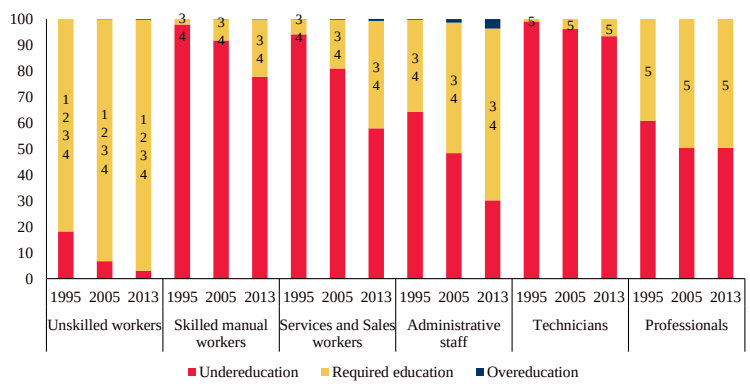
(A) Cohort 0-10 years of experience



(B) Cohort 11-20 years of experience



(C) Cohort 21-30 years of experience



(D) Cohort over 30 years of experience

FIGURE 4: Evolution of educational mismatches by occupation and experience cohorts using ISCO-ISCED indicator (in percentage).

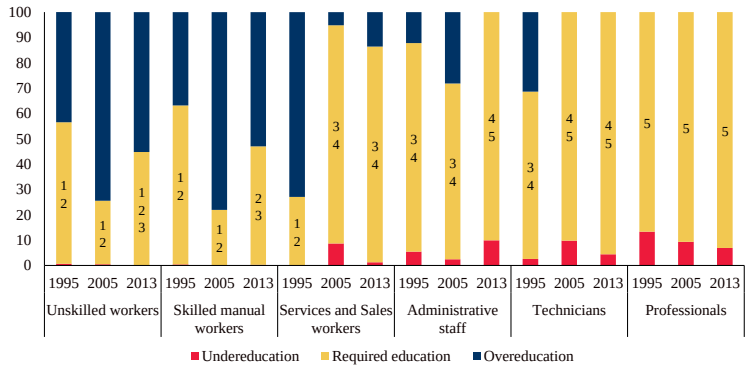
Note: Numbers on the bars refer to the education required for each occupation in each year: 0=None, 1=1st cycle of primary education, 2=2nd cycle of primary education, 3=3rd cycle of primary education, 4=Upper secondary and Post-secondary education and 5=Tertiary education.
Source: Authors' calculations based on *Quadros de Pessoal* (1995-2013).

Mode indicator

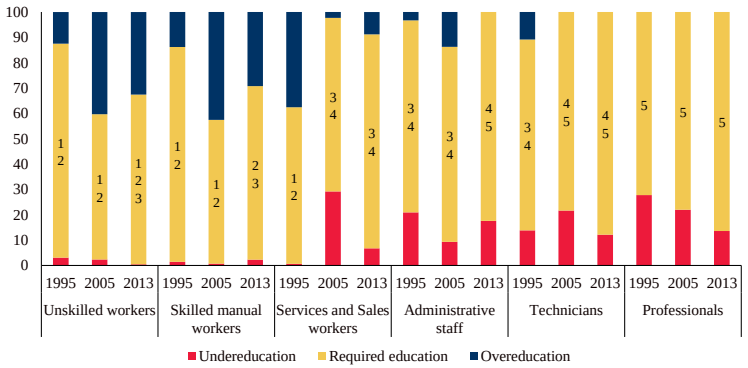
The measured levels of under- and overeducation for the mode indicator on the basis of each of the two occupational breakdowns considered are very close, while differing substantially from those on the basis of the ISCO-ISCED correspondence both as to the level and trend (Table 4). The ISCO-ISCED indicator is generally more demanding in terms of workers' qualifications, given that it takes as a reference up-to-date international standards (ILO 2012). In contrast, the mode indicator reflects the characteristics of the Portuguese workforce, and partly accommodates the gap to international standards by a lower level of required education for some occupations. As a consequence, there is a striking difference in the percentage of undereducation, lower in mode indicator particularly at the beginning of the sample, while overeducation is higher (Araújo and Carneiro 2017, also using *Quadros de Pessoal*, obtained results in line with ours).

Figure 5 presents the breakdowns by occupations and experience cohorts for the mode indicator, considering the more aggregated occupational breakdown, also showing the respective required education levels (matching Figure 4 above). Required education is lower than in the ISCO-ISCED correspondence at the beginning of the sample for Skilled manual workers and Technicians. For other occupations, such as Administrative staff and Professionals, required education either coincides in both methodologies or, in the case of Administrative staff, is higher at the end of the sample, reflecting the increasing weight of college graduates in that occupation. It is worth noting that the larger amount of undereducation, and smaller amount of overeducation, in the upper vis-à-vis the lower cohorts of potential experience holds for both methodologies.

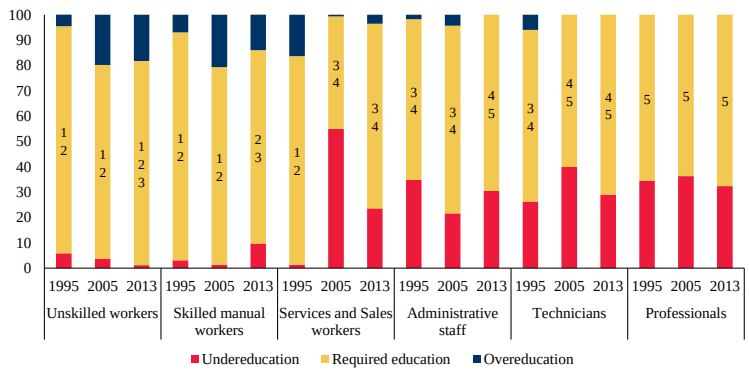
Unlike the ISCO-ISCED indicator, for the mode indicator the overall under- and overeducation figures do not show marked trends, because the modal educational attainment categories change over time for some occupations. This renders the indicator less appropriate for assessing the evolution of these phenomena over time. In particular, undereducation decreases slightly in the initial period after 1995, denoting improvements in the workforce qualifications, but this eventually leads to an upward revision in the modal categories, and to a hike in undereducation. Such was the case of Service and sale workers, from 2002 onwards, and Skilled manual workers, from 2010 onwards. The trajectory of overeducation is affected in an analogous way. It shows a rising trend at the beginning of the sample, as younger workers possessing intermediate education enter into low-skilled occupations, but it then jumps down when such workers become the group with modal education level.



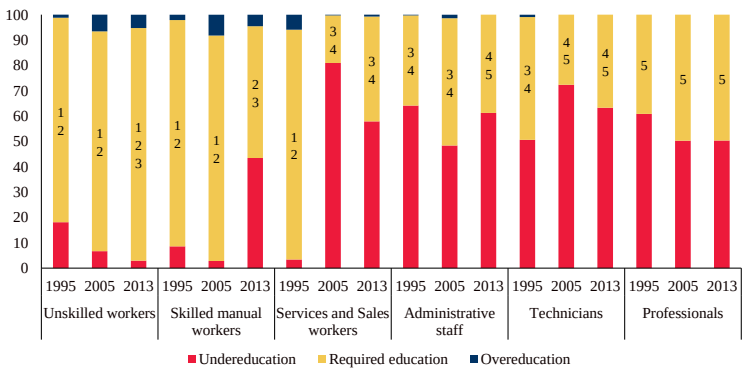
(A) Cohort 0-10 years of experience



(B) Cohort 11-20 years of experience



(C) Cohort 21-30 years of experience



(D) Cohort over 30 years of experience

FIGURE 5: Evolution of educational mismatches by occupation and experience cohorts using mode indicator (in percentage).

Note: Numbers on the bars refer to the education required for each occupation in each year: 0=None, 1=1st cycle of primary education, 2=2nd cycle of primary education, 3=3rd cycle of primary education, 4=Upper secondary and Post-secondary education and 5=Tertiary education.
Source: Authors' calculations based on *Quadros de Pessoal* (1995-2013).

Overeducated college graduates

The rise in the proportion of graduates in the labour force has been a prominent development in the last decades, as seen in Figure 1. This section looks more in detail into how the occupational structure of the Portuguese labour market has accompanied such a development. Figure 6 shows that the proportion of college graduates increased substantially between 1995 and 2013, in the considered activities, from about 3 to 16%. These employees have been mainly hired by the service sector, whose weight in employment of college graduates has gone up, matching a decrease in the weight of manufacturing industry.

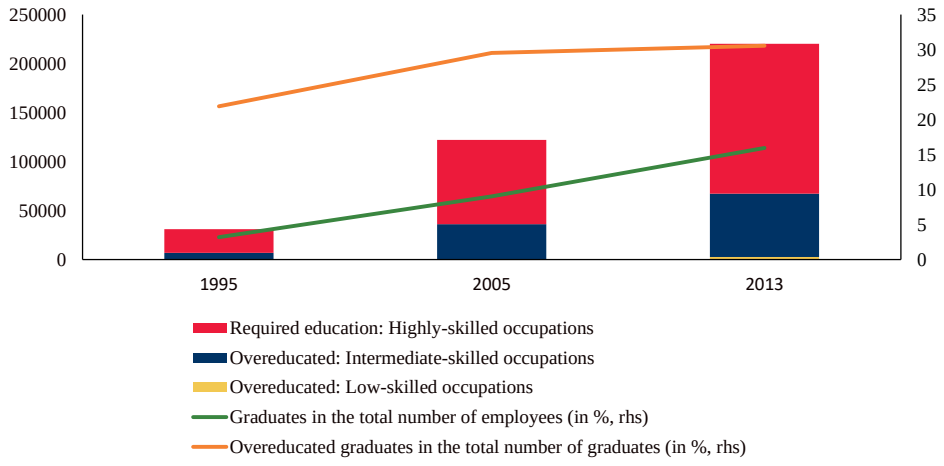


FIGURE 6: Occupations and educational mismatches of graduates.

Notes: Low-skilled occupations include Unskilled workers; intermediate-skilled occupations include Skilled manual workers, Services and Sales workers and Administrative staff; highly-skilled occupations include Technicians and Professionals. According to ISCO-ISCED correspondence (Tables 2 and 3), overeducated college graduates are those in low- and intermediate-skilled occupations.
Source: Authors' calculations based on *Quadros de Pessoal* (1995-2013).

The share of overeducated college graduates in the total number of college graduates has gone up in the first decade of the sample (from 20 to 30%) and then approximately stabilized. Additionally, the rising profile of overeducation within potential experience cohorts (Figure 7) signals that this has become more prevalent among the new generations of college graduates. Moreover, overeducated college graduates are predominantly in the service sector, performing administrative jobs.

Figure 7 also presents the breakdown by field of study of overeducated college graduates, who are mainly from Economics, Social Sciences and Law. These results are consistent with the literature. Capsada-Munsech

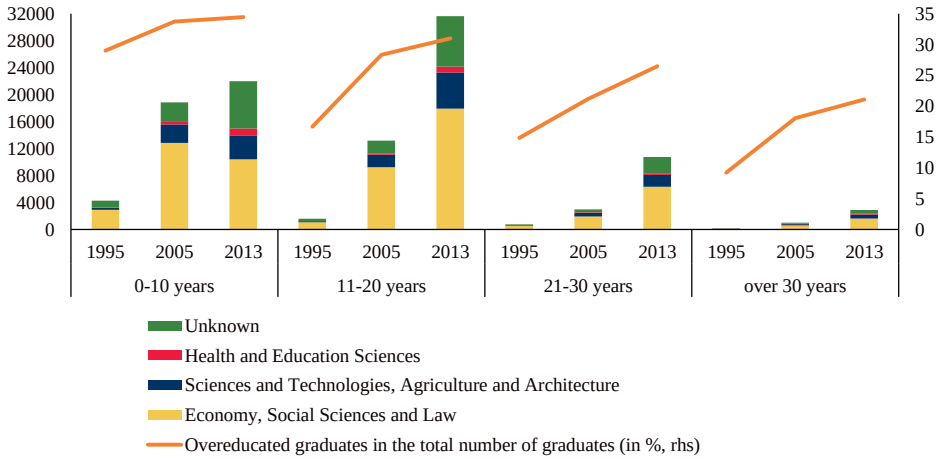


FIGURE 7: Evolution of overeducated graduates by field of study and experience cohort.

Notes: The field of study Health and Education Sciences includes Health, Education Sciences and Teacher Training. The field of study Sciences and Technologies, Agriculture and Architecture includes Sciences and Technologies, Agriculture and Natural Resources, Architecture, Design and Arts. The field of study Economy, Social Sciences and Law includes Economy, Management, Accounting, Social Sciences, Humanities, Services and Law.
Source: Authors' calculations based on *Quadros de Pessoal* (1995-2013).

(2015) found that fields of study where work performance is evaluated less objectively (such as, Humanities, Social Sciences and Economics) are associated with a higher probability of overeducation. In line with previous evidence, Dolton and Vignoles (2000) concluded that Social Sciences and Arts graduates are more likely to be overeducated relative to Engineers.

In spite of the increase in overeducation, the bulk of the incoming college graduates to the Portuguese labour market in the last two decades were able to find highly-skilled occupations, in which the economy should profit most from their qualifications. A caveat in this analysis is that we are looking at on-the-job mismatches and we do not observe the graduates who could not find a job (and perhaps were unemployed or emigrated), something that may be particularly important in the last years of the sample coinciding with the crisis.

Educational mismatches: Portugal vis-à-vis the European Union

We finalize this article by presenting an international comparison of educational mismatches based on harmonized microdata from the Survey of Income and Living Conditions (EU-SILC), covering a wide range of countries belonging to the EU, on an annual basis. We applied to this dataset the same selection criteria as for *Quadros de Pessoal*, focusing on full-time employees, aged between 16 and 65 years and with information about occupation and educational attainment. Moreover, we considered the same economic activities as described above. Our database contains data for Portugal plus 25 European Union countries, and we present results for 2007 (102,660 employees) and for the last year available, 2016 (94,617 employees).[7] All the results were calculated using the sample weights available (cross-sectional databases), which allow an extrapolation to the entire population.

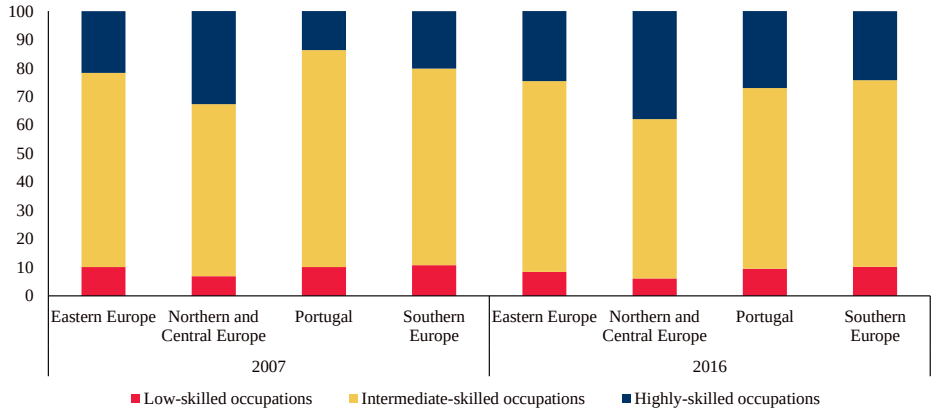


FIGURE 8: Evolution of employment structure by occupation for Portugal and three groups of EU countries (in percentage).

Notes: All results were weighted with sample weights. Northern and Central Europe includes Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Denmark and Sweden; Southern Europe includes Cyprus, Greece, Italy, Malta and Spain; Eastern Europe includes Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia.
Source: Authors' calculations based on EU-SILC.

Measured educational mismatches in a given country depend on the structure of occupations in the economy. More specifically, the overall figures are the average of mismatches by occupation weighted by that structure. Therefore we start with by showing the occupational structure in Portugal

7. For Ireland, Luxembourg, Italy and Malta, due to the unavailability of more recent data, 2015 data were used.

and in the remaining countries aggregated, for the sake of presentation, into three groups: Northern and Central Europe, Southern Europe and Eastern Europe (Figure 8). In general, in the last year of the sample, Portugal compares unfavourably only with Northern and Central Europe. There was a gap in the proportion of highly-skilled occupations in 2007 between Portugal and each of the groups, but this shrank in the ensuing decade. Within intermediate-skilled occupations, the skilled manual workers (not shown) were over-represented in Portugal vis-à-vis the three groups in 2007, making up half of the work force, both this proportion has come down to about 1/3 in 2016, a figure close to the ones for Southern and Eastern Europe.

Figure 9 presents the educational mismatches for all countries in the database, using the ISCO-ISCED methodology. Portugal was the country with the highest incidence of undereducation in both years considered, despite the reduction from 2007 to 2016. As regards overeducation, Portugal has an incidence below the EU average and, as shown below, this holds throughout experience cohorts.

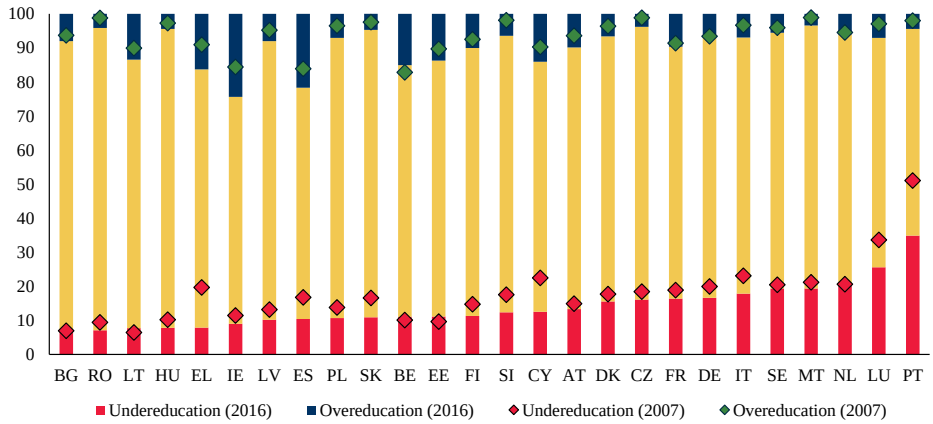


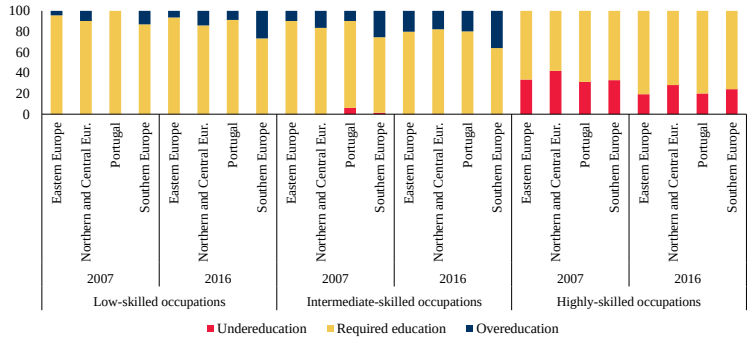
FIGURE 9: Evolution of educational mismatches by European Union country between 2007 and 2016 (in percentage).

Notes: All results were weighted with sample weights. The 26 countries represented are: Belgium (BE), Bulgaria (BG), Czech Republic (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI) and Sweden (SE).
Source: Authors' calculations based on EU-SILC.

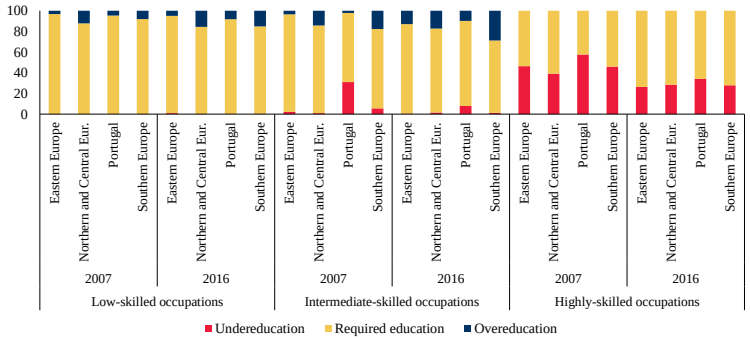
We carried out an additional exercise, at the country level, in order to separate out the contributions to the overall mismatches coming, respectively, from mismatches within occupations and from the occupational structure. To this end, we took a standard occupational structure given by the average for the countries considered, in 2007 and 2016. We replicated Figure 9, keeping the

occupational structure constant throughout countries, in each year. However, results do not significantly change, in particular for Portugal. This reflects the fact that the economies in the EU are relatively homogeneous in terms of occupations, as suggested by Figure 8.

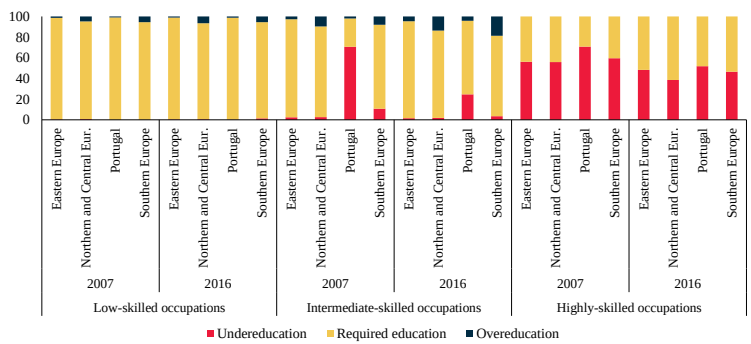
Figure 10 presents educational mismatches broken down by potential experience cohorts and occupations. The results show that the disadvantage of Portugal vis-à-vis the European Union mainly reflects the low levels of education of older generations in intermediate-skilled occupations. Such a disadvantage has, however, faded away considerably in the last two decades. It is worth noting that the Portuguese workers in low-skilled occupations also had lower levels of education than their European peers, but this does not show up as undereducation because the ISCO-ISCED correspondence considers as required education elementary attainment levels. Undereducation remains relatively high for younger workers in highly-skilled occupations (more specifically, for Technicians) in Portugal, but this is common to other European countries.



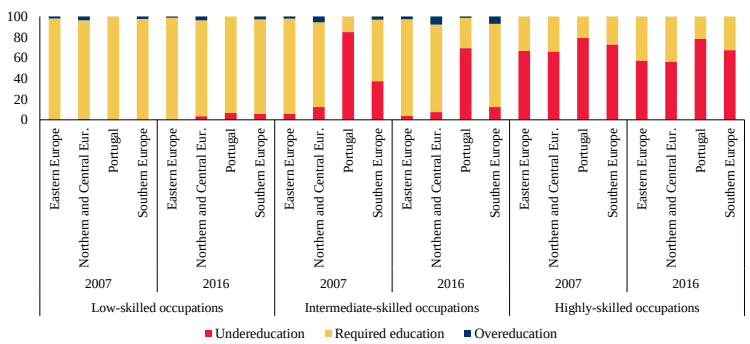
(A) Cohort 0-10 years of experience



(B) Cohort 11-20 years of experience



(C) Cohort 21-30 years of experience



(D) Cohort over 30 years of experience

FIGURE 10: Evolution of educational mismatches by occupation and experience cohorts: Portugal vs. European Union countries groups (in percentage).

Notes: All results are weighted by sample weights. See the note to Figure 6 for the breakdown of occupations and the note to Figure 8 for the composition of countries groups.
Source: Authors' calculations based on EU-SILC.

Concluding remarks

This article assessed the evolution of educational mismatches in Portugal over the last two decades, on the basis of two datasets: *Quadros de Pessoal*, for Portugal (1995-2013), and EU-SILC, for the European Union (2007 and 2016). In doing so, we used two methodologies, namely, a correspondence between ISCO and ISCED (belonging to the job evaluation methods) and the mode of worker's education within occupations (belonging to the empirical methods). Measured levels and trends of under- and overeducation are quite sensitive to the methodology used.

The ISCO-ISCED indicator lends itself better to a comparison across countries and over time. The catching up of education of the Portuguese workforce to higher levels has meant a considerable reduction of undereducation, according to this indicator. The approximation of the Portuguese workforce education level to international standards has implied that the disadvantage vis-à-vis the European Union – mainly associated with low levels of education in intermediate-skilled occupations – has largely faded away for younger generations. Some undereducation remains in highly-skilled occupations, an issue common to other European countries.

Overeducation is still of limited importance. In particular, the bulk of incoming college graduates coming to the Portuguese labour market in last two decades were able to find highly-skilled occupations, in which their qualifications in principle can be best put to use.

The figures for undereducation are lower, and those for overeducation higher, in the mode indicator. This indicator partly accommodates the gap to international standards by a lower level of required education for some occupations. Moreover, it does not show marked trends, as the modal educational attainment categories within some occupations change over time.

An important caveat for all this analysis is that formal education is an imperfect approximation of the qualifications needed for workers to adequately perform their jobs.

In terms of further research, two lines could be in particular pursued, at a micro level. A first one would be to ascertain the «typical» reaction of undereducated workers, in terms of getting further education, or overeducated workers, in terms of changing job, vis-à-vis comparable workers with required education. A second line would be to study the relationship between educational mismatches and productivity, at the firm level, which to the best of our knowledge has not yet been analysed for Portugal.

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