

Almeida, André et al.

Working Paper

Returns to Postgraduate Education in Portugal: Holding on to a Higher Ground?

GLO Discussion Paper, No. 44

Provided in Cooperation with:

Global Labor Organization (GLO)

Suggested Citation: Almeida, André et al. (2017) : Returns to Postgraduate Education in Portugal: Holding on to a Higher Ground?, GLO Discussion Paper, No. 44, Global Labor Organization (GLO), Maastricht

This Version is available at:

<https://hdl.handle.net/10419/156389>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Returns to Postgraduate Education in Portugal: Holding on to a Higher Ground?

André Almeida¹, Hugo Figueiredo^{1,2,7}, João Cerejeira^{1,3,4}, Miguel Portela^{1,3,4,5,8}, Carla Sá^{1,3,4} and Pedro Teixeira^{1,5,6}

¹Centre for Research in Higher Education Policies (CIPES)

²Department of Economics, Management, Industrial Engineering and Tourism, University of Aveiro

³Economic Policies Research Unit (NIPE)

⁴School of Economics and Management, University of Minho

⁵Institute for the Study of Labor (IZA)

⁶University of Porto, Faculty of Economics

⁷GOVCOPP, University of Aveiro

⁸Banco de Portugal

March 2017

Abstract

In this paper we use a large official employer-employee dataset, which includes almost the whole universe of business firms, to document and decompose the rising graduates postgraduates' wage differentials in Portugal. Using a non-parametric matching exercise, we pay particular attention to differences in the assignment of these two groups of workers across occupations and tasks. This allows us to disentangle different sources of postgraduates' relative earnings and look at the creation of *postgraduate jobs*. We further look, however, at *displacement* and *deskilling effects* due to relative demand inertia as possible sources of such evolution of the relative earnings. Our results show that both *displacement* and *deskilling effects*, particularly of graduates with only a first-degree, appear to be at least as important as direct productivity effects in explaining postgraduates premiums. We also conclude that the relative importance of the former has been steadily increasing overtime and that, on the contrary, the net creation of high-paying, postgraduate-only jobs has been relatively modest. This suggests that postgraduate degrees have largely worked as a way of holding on to a higher ground in the labour market.

JEL classification: C21; J24; J31

Keywords: Postgraduate; Wage Differentials; Inequality; Polarization; Skills

1 Introduction

Holding a higher education degree has traditionally conferred a considerable earnings advantage to workers in the Portuguese labor market. This relative advantage has, however, been decreasing since the mid-1990s. In part, this reduction in the average returns to a higher education degree, which were initially very high, both historically and relative to other developed economies, has resulted from the fast massification of tertiary educational attainment among the young. Recent decades saw Portugal converging to its European counterparts not only in terms of the number of workers with a college degree but also of workers with completed high school education (Teixeira *et al.*, 2014). This trend and its consequences have already been widely documented (see for example Figueiredo *et al.*, 2013; Teixeira *et al.*, 2014 or Centeno and Novo, 2014). There is also evidence, however, of a substantial increase in the share of postgraduate degree holders. This trend that has accelerated considerably after the institutional changes in Portuguese higher education (HE) associated with the implementation of the Bologna process, which resulted in the reduction of the duration of first-degrees as part of the creation of a formal three-tier system. The specific role played by postgraduate education as a driver of HE massification and earnings dispersion has received very little attention.

In this paper, we use a large official employer-employee linked dataset (*Quadros de Pessoal*) that comprises the lion's share of the Portuguese private sector to look at the role of postgraduate education as a driver of earnings dispersion among the highly skilled. We focus on the period from 2006 to 2012, a period of fast expansion of postgraduate qualifications. We restrict our analysis to workers with low levels of experience in the labour market (less than 10 years of potential experience) and show evidence of widely distinct trends on the returns to graduate and postgraduate education along the whole wage distribution (decreasing for the first group and increasing for the second). These trends have created a significant cleavage on the Portuguese graduate labour market. We argue that ignoring this cleavage by simply considering the returns of college workers as one homogeneous group leads to a blurred picture of the premium attributed to higher education studies in Portugal.

Using an off the shelf decomposition technique (Ñopo, 2008), we show that postgraduate education has become a fundamental prerequisite to secure high levels of returns to higher education in the Portuguese labour market. Our main contribution is to account in the decomposition for the allocation of graduates and postgraduates to different occupations with different skill profiles. This allows us to disentangle 2 different drivers of postgradu-

ates' premiums: higher wages within occupations shared with lower qualified graduates; but also access to better paid and more demanding (more skill intensive) occupations. To the best of our knowledge, this is the first work to consider this issue in this context. We show in the paper that both sources of the postgraduate earnings premium are significant but also that the latter is becoming increasingly important.

Our results suggest that postgraduate education may have worked as a way to hold on to a higher ground in the Portuguese labour market, making graduates less likely to be assigned to low-paid and less complex occupations. Using data from the *O*NET* occupational profiles, we show that postgraduate education reduces the risk of being allocated to less demanding occupations in terms of skills utilization. We also present evidence of lower dispersion in the skill complexity of occupations held by postgraduates as well as of considerably lower utilization of “complex non-routine cognitive” skills in the occupations held by the least successful graduates, those that fail to access jobs employing postgraduates. Finally, using a *shift-share* analysis (Berman *et al.*, 1994) we show that postgraduates have been increasingly displacing graduates from some occupations, and the same has been happening in the case of graduates and non-graduates. In sum, we conclude that both *deskilling* and *displacement effects* have worked as important drivers behind the rising postgraduates' earnings premiums in Portugal.

The paper proceeds as follows. The next section reviews recent literature on the link between the expansion of postgraduate qualifications and wage inequality. It focus, in particular, on alternative explanations of rising returns to postgraduate education. Section 3 briefly presents the institutional context of HE massification and the expansion of postgraduate education in Portugal. It discusses why countries such as Portugal can provide a different and interesting angle to look at how postgraduate education can lead to rising wage inequality raising specific policy challenges. Section 4 describes our dataset and Section 5 discusses the methodological instruments we use to account for the different sources of rising wage differentials between graduates and postgraduates. Section 6 describes our results. Section 7 concludes and discusses political implications as well as topics worth further research.

2 Sources of Postgraduate Wage Premiums

There is a large body of literature documenting stable (or rising) higher education wage premiums in the last two decades of the previous century, despite fast increases in the supply of tertiary skills (Walker and Zhu, 2008;

Oreopoulos and Petronijevic, 2013). There is also significant interest in the distribution of such returns and the substantial and growing heterogeneity in terms of quality of education, degree class, fields of study (for a brief review see Burgess, 2016). Within these studies there is widespread evidence that returns to postgraduate education are substantial (Burgess, 2016) and rising, at least in the US and UK (Autor *et al.*, 2008; Lindley and Machin, 2016), despite large increases in the number of workers with such qualifications. Relatively few studies have, however, looked specifically at the sources of such rising differentials between postgraduate and graduate education.

Most of these studies implicitly assume postgraduates are more productive but perfect substitutes for undergraduates who compete for similar jobs (Lindley and Machin, 2016). In this light, one could simply look at postgraduate degrees as a way to acquire more or different skills which could improve productivity and lead, therefore, to higher wages. A straightforward human capital interpretation would then work as a first (supply-side) mechanism to explain why postgraduates should be able to enjoy higher returns even if they work as perfect substitutes of less qualified graduates in similar jobs. It could also allow us to make sense of higher returns to experience (or across time) if one is prepared to accept that postgraduate degrees confer individuals with a higher learning potential which could be fostered by firms through firm-specific investments, effectively placing graduates and postgraduates in separate earnings trajectories (Cunha *et al.*, 2006).

In a recent paper, Lindley and Machin (2016) argue, however, that graduates and postgraduates are unlikely to work as perfect substitutes. They also show that both skill and job tasks performed by postgraduates are markedly different and more complex and argue that the progressive computerisation of workplaces has increased demand for postgraduates at the expense of other graduate segments due to greater complementarity. This is in line with the broader idea that the higher educated an individual is, the more able he may be of performing non-routine activities requiring, for example, high-level problem-solving, orchestration, influencing or communication skills (Green, 2012; Elias and Purcell, 2013, Green *et al.*, 2016). It is unclear however that the progressive computerisation of workplaces should result in greater autonomy or involvement for *all* graduates as technology also has the ability to increase employers “control over workers” performance (Brown *et al.*, 2011) and can go hand-in-hand with “command and control” management (Green *et al.*, 2016) particularly among graduates with more easily substitutable skills. The result may be the general upskilling of graduate jobs but decreasing substitutability between graduates and postgraduates.

Decisively, Lindley and Machin (2016) also document strong differences in the occupational structure of the graduate and postgraduate labor mar-

kets and lower dispersion of job profiles in the latter group with greater concentration in professional categories. Such differences in the occupational structures of the two groups have consequences in the differential between graduate and postgraduate premiums. [Lemieux \(2014\)](#), for instance, shows that the effect of higher education on earnings depends not only on a direct productivity effect but equally on an adequate matching between one's level (and field) of education, complexity and task/skill content. The author shows that such combined matching effects are about as important as the direct productivity effect. According to such an "assignment" interpretation of the labor market ([Sattinger, 1993](#); [Acemoglu and Autor, 2011](#); [Baldwin, 2016](#)), educational choices then also have an indirect effect on earnings, by conditioning access to specific occupations with the pool and the characteristics of available jobs working as direct influences on earnings. This sort of evidence does create, therefore, a second (demand-side) mechanism capable of explaining rising postgraduates' premiums.

Within a simple supply and demand story ([Goldin and Katz, 2008](#); [Katz and Murphy, 1992](#)), rising postgraduate premiums could then simply reflect a faster pace of demand for "postgraduate jobs" relative to the supply of workers with such levels of educational attainment. Graduates and postgraduates non-substitutability could make this possible even in times of HE massification. Indeed, if job growth at the top of the wage and skill distribution is intertwined with postgraduate education, this leaves other university graduates more dependent and vulnerable to the possible hollowing out of the job distribution. Postgraduates would be to a much larger extent insulated from competition, having the ability to occupy high-paying, more complex jobs. Less qualified graduates, in turn, will need to move down the occupational hierarchy increasingly displacing less qualified workers in less complex occupations. According to recent research by [Beaudry *et al.* \(2016\)](#) and [Valletta \(2016\)](#), both such polarized demand and deskilling effects can account for the recent flattening or decrease of first degree (college-only) graduates relative to high school graduates that has happened in the US and UK since the beginning of the new century and for younger cohorts in particular ([O'Leary and Sloane, 2016](#))¹ and reinforced after the financial crisis.

¹However, the mere displacement of less qualified workers by graduates in previously routine-intensive occupations does not necessarily explain falling earnings differentials for degree-only graduates. Indeed, [Elias and Purcell \(2004\)](#) argue that the transformation of graduate jobs and the creation of new graduate job profiles largely explained the stability of graduates' high premiums in the UK in the 1990s. Indeed, such displacement effects, *per se*, can also be used to understand an apparent contradiction in the earlier literature on this topic, namely the persistence of high and stable premiums despite sharp increases in the supply of tertiary qualifications and a growing incidence of overeducation.

In the specific context of this paper, the very fast pace of rapid expansion of postgraduate education in Portugal that we document in the next section makes the relative inertia of supply an unlikely explanation of rising postgraduate earnings differentials. However, if the overall demand for high-level cognitive skills proves to be relatively sluggish, the result could actually be a much higher pressure on the relative wages of degree-only holders. In particular, it would increase competition between graduates and postgraduates to guarantee access to an increasingly scarce pool of well-paid jobs. In other words, if such an economy fails to create “new” postgraduate jobs at a pace comparable to that documented for the cases of the US or the UK, greater inequality in graduate labor markets (and beyond) may result from graduates moving down the occupational ladder much faster. This is relevant from a policy point of view. It would be compatible, in particular, with much higher a risk of overeducation (overskilling) and the need to signal higher levels of skills independently of the intrinsic value of postgraduate education (Arum and Roksa, 2011; Oreopoulos and Petronijevic, 2013; van der Velden and Bijlsma, 2016). In both cases, the need to run to stand still (or holding on to the higher ground provided by these relatively scarce top-level jobs) means a higher risk of wasteful resource allocation.

In sum, we suggest that changes in the demand for high-skilled, complex and non-routine jobs, and the way this evolution is intertwined with the demand for postgraduate workers, plays a crucial role in explaining graduate and postgraduate differentials. Moreover, we also suggest that the lower the pace of net creation of high paying, graduate-level jobs, the more important is the indirect return of having access to such occupations. In this paper, we argue that Portugal provides an excellent case study of the challenges faced by developed economies experiencing very fast increases in the supply of graduate and postgraduate education but relative inertia in the structural transformation of their employment structures. We show in particular that the allocation of graduates and postgraduates to different occupations and the higher *deskilling* propensity of degree-only holders provide the most important explanations of rising postgraduate earnings differentials in Portugal. Before we proceed to document our results, we provide a brief overview of the institutional context of higher education expansion in Portugal.

3 The Portuguese HE Context

The expansion of education has been a theme of significant political and academic interest in Portugal for a long time particularly because the country

has historically presented some of the lowest levels of qualifications in Europe. According to *Eurostat* data, up to 2000, for example, close to 80% of the Portuguese population had less than completed secondary educational attainment while the respective figure for the EU-27 was around 20%. Thus, the massive and very rapid expansion that took place over the last decades in the educational system was surrounded by very high political and social expectations. Regarding the HE system in particular, by the mid-eighties the social and political pressures for expansion became very strong and the system expanded massively since then, both in number of institutions and in enrolled students. Until the early 1980s, the Portuguese HE sector remained very small and elitist and public universities overwhelmingly dominated the HE system (Johnstone *et al.*, 2006). A decade later, however, the non-university public and private sectors were already, absorbing a significant proportion of enrollments, though their share has been recently declining (particularly of private institutions) as the overall number of tertiary education students has stabilized in recent years due to relatively low birth rates. The system also became more geographically dispersed. As a result, educational attainment levels have rapidly converged with those of other more advanced economies, particularly among the young. By 2015, close to 30% of all individuals aged between 30 and 34 had completed a university-degree with significantly higher rates among women (and already close to the European average among the latter group). Participation rates have also increased massively in particular up to the beginning of the financial crisis due to the higher secondary education attainment levels and the increasing participation of older students. According to Unesco Institute for Statistics data, the gross enrollment rate in tertiary education in Portugal was approximately 20% in the early 1990's, and rose to 55.5% in 2006 and 68.5% in 2012. The graduate population has therefore become more diverse as a result of this expansion process both in terms of their innate and education profiles. Portugal has thus seen a very rapid massification of its higher education system. Similar processes of massification happened elsewhere, but much sooner in more developed economies such as France, Germany or the UK (Neave and Amaral, 2011). Portugal is extraordinary in how quickly this massification dynamic has been unfolding. It is also fair to say that, particularly in the earlier period of rapid expansion, degree quality dispersion may have widened considerably.

Despite these concerns, for most of the 1980s and 1990s, the progressive expansion of HE qualifications has lived up to expectations with internal rates of return holding on at very high levels (Hartog *et al.*, 2001). Relative rates of return have also increased and the probability of occupying jobs normally taken by individuals with lower qualifications actually declined as many occu-

pations started to require higher qualifications and to provide higher salaries (Cardoso, 2007; Kiker *et al.*, 1997). However, this success story has become more complicated in recent years. Earnings gaps between graduates and non-graduates have fallen very significantly since the mid-1990s due to a much faster (relative to demand) supply of education qualifications to the market (Centeno and Novo, 2014). The heterogeneity of rates of return also increased massively during the same period. More importantly, this increasing dispersion has happened mainly below the median (Figueiredo *et al.*, 2013) with more successful graduates still able to enjoy very high returns at least until 2009. In this paper, we provide evidence of a further increase in the heterogeneity of returns to HE in more recent years and document a new and revealing dynamic behind such trend, namely the decrease in the relative return of first-degrees and the increase in the return to postgraduate studies across the whole distribution of graduate earnings.

This latest trend has happened in the context of a new paradigm shift in the institutional setting of Portuguese HE. Since 2006/7, the period we cover here, Portuguese was reorganized into a three-tier system following the implementation of the Bologna process. Its most immediate consequence has been the reduction in the average duration of first-degrees, namely of four-to-five-year *Licenciaturas* (mostly provided by Universities) and, in many cases, their break-up in graduate (*Bsc*) and postgraduate (*Msc*) studies. This has led to a significant increase in the number of postgraduate students² and, overtime, in young workers with such level of qualifications (see our own data below). As a result of these changes, the diversity in education trajectories has increased, either through more frequent geographical or institutional mobility, more diverse specialisations or earlier entry in the labour market.³ In theory, such increased mobility and diversity of educational trajectories was an explicit aim of the Bologna process. It should have also led to the harmonisation of education quality and, more importantly, to the implementation of a student centered approach capable of making first-degrees more employment relevant. This was not, however, how it has been perceived by students and employers. Sin *et al.* (2016b), for example, show that the lower employability of first-degree holders vis-a-vis postgraduates, measured by higher unemployment rates, now finds echo in students' negative perceptions about the labour market value of such first-degrees. According to the

²According to official data (from *DGEEC*), in the 2014/2015 academic year, approximately 31.6% of the student population was registered in Master courses while 59.4% was registered in Bachelor courses, compared to, approximately, 8.2% in Master and 86% in Bachelor courses in 2006/2007.

³This applies both to those who complete their first-degrees or who actually drop-out of higher education, an important phenomena in Portugal.

authors' results, the majority of Portuguese students feel unprepared to enter the labour market at the end of their first-degrees and wish to enroll in postgraduate studies immediately after the completion of their first degree. The supply of postgraduate qualifications to the labour market is therefore likely to keep increasing fast.

Finally, there are three further relevant dimensions of Portugal's possible exceptionality. First, the relatively low value of first-degrees is not a characteristic generally applicable to other developed economies across Europe. This includes countries experiencing similar processes of reorganisation or where HE expansion started much earlier. It also includes countries which are further down the road of HE massification. Second, skill demand constraints are likely to have been exacerbated in the context of the financial crisis (after 2010), a period we partially cover here. Whether or not the austerity agenda contributed to the structural transformation of graduate employment, lower skilled individuals are likely to have been hit to a greater extent either through increased competition for a lower number of jobs or more difficult access to *new* (transformed) jobs. Third, while the diversity of education choices has increased, one should not necessarily confuse this with an increase in the dispersion of degree quality. This same period actually saw the implementation of a national quality assurance and accreditation strategy which gained particular strength following the establishment of the Portuguese Agency for Assessment and Accreditation of Higher Education in 2009. According to [Sin *et al.* \(2016a\)](#), by 2015, close to 40% of the programmes on offer in 2009 were discontinued (mostly Master and Doctoral programmes). This points both to the likely excesses and quality problems associated with earlier periods of HE expansion but also to the increased capacity of dealing, for example, with insufficient staff qualifications or a lack of coordination between labour market needs and degree curricula.

We believe, in sum, that Portugal constitutes an interesting case study to look at the links between the expansion of postgraduate education and wage inequality. It combines, in particular, a very fast pace of educational expansion with potential demand rigidities. It also provides a context potentially conducive to signalling and screening dynamics ([Arrow, 1973](#); [Spence, 1973](#); [Stiglitz, 1975](#)) or to students' perceptions of postgraduate education as a positional good ([Marginson, 1998](#); [Sin *et al.*, 2016b](#)). This opens up the discussion on the relative importance of the different mechanisms behind rising or stable postgraduate premiums we covered in the previous section. The next sections present our data and deal, therefore, with how we may disentangle direct productivity effects of postgraduate education within jobs from dynamics of employment transformation and occupational displacement and deskilling overtime.

4 Data and descriptive statistics

We use a large official employer-employee linked dataset (*Quadros de Pessoal*) which aggregates almost the whole universe of business firms with wage-earning employees. The dataset provides very detailed and precise information about worker's earnings and hours worked. The onus of providing the information is on the firms, which makes it less vulnerable to measurement errors due to earnings self-reporting. The richness of the data allows us to fully characterize the returns to education in the Portuguese private sector. Although the magnitude of the sample reduces potential biases due to misspecifications, we use some simple correction routines to avoid such problems in the raw data set. We consider only the information since 2006, given that it is the first year that discriminates the level of higher education degree completed, which is crucial for our analysis. We also restricted the analysis to employees with a time schedule, whose wages are above the yearly national minimum wage, and with between 10 and 40 weekly working hours. We further exclude outliers defined in terms of hours worked and total monthly wage. We drop workers reporting less than 40 and more than 220 monthly working hours and workers that report total wages (the sum of the payments in all the occupations the worker has in a given year) 2.5 times above the 99th percentile (which trims the real monthly wages at €11500). Due to the low coverage of these populations, we also disregard workers in agriculture and fishery activities, as well as workers outside Continental Portugal. Additionally, we excluded workers in occupations without a co-worker in the same job (occupation and industry). We consider only workers with at least high school education completed and we exclude doctorates due to their very low numbers in the private sector (in practice, this consists in considering only workers with 12 to 17 years of schooling). According to Santos *et al.* (2016), in 2009 only 3% of doctorates were working as employees on the private sector, which is clearly a small subset of the population⁴ In addition, self-selection of doctorates into the public sector also plays a crucial role. As Aghion *et al.* (2008) argues, the private sector jobs for doctorates may have some characteristics that disincentive them to participate in the private labor market, such as less autonomy or higher level of applicability than a research

⁴This low share of doctorates in the private labor market is likely to be correlated with the employment structure of the Portuguese economy and the small dimension of firms, both in terms of employees and R&D investment. Based on the 2012's mandatory national survey (IPCTN) to the universe of potential innovative firms (consisting in firms that invest in R&D), only 34% of the firms actually developed R&D activities and half of the firms had annual R&D expenses lower than 50000 euros. Furthermore, only 31 national or international patents were conceded.

job (typical in the public sector). So, one should not reasonably expect that those doctorates working in the private labor market represent the group of doctorates. This motivated their exclusion from our sample.

Thus, henceforth we consider 3 mutually exclusive groups of workers: *high school educated workers*, corresponding to workers with completed high school education; *graduates*, corresponding to workers with a Bachelor degree; and *postgraduates*, which corresponds to the group of workers with a Master degree. We further restrict the data set to workers with at most 10 years of experience, which corresponds to a working population of 18 to 34 years. The final data set contains approximately 1.6 million observations, corresponding to 610000 different workers and 114000 different firms across the time period considered in the analysis. The descriptive statistics of this final subset of workers is presented on Table 1 below.

Table 1: Descriptive statistics after applying all the filters mentioned above.

	Non-graduates	Graduates	Postgraduates
nr.obs.	816959	750393	32364
gender (female)	53.1%	64.3%	51.2%
mean age	24.2 (2.4)	28.2 (2.4)	29.1 (2.8)
mean exper	6.2 (2.4)	6.3 (2.4)	5.1 (2.8)
part-time workers	19.6%	14.1%	10.4%
firm size (workers)			
less than 10 workers	50.5%	43.7 %	30.0%
more than 250 workers	2.3%	2.8%	9.9%
firm size (sales in real terms, base year 2006)			
less than 100k	14.4%	14.1%	8.2%
more than 100M	42.1%	44.6%	67.2%
ownership			
private	92.7%	90.1%	84.7%
public	0.7%	1.1%	2.9%
foreign	6.6%	8.8%	12.4%
occupation			
modal occupation in 2006	Salespersons	Finance, accounting, administrative organization, public and trade relations specialists	Finance, accounting, administrative organization, public and trade relations specialists
modal occupation in 2012	Salesperson	Health professionals	Physical sciences, mathematics, engineering and related techniques specialists

Notes: k stands for thousand and M for million; standard-deviations in parenthesis. Source: own computations based on Portugal, MTSS (2006-2012).

5 Methods

5.1 Baseline estimations

The first goal of our paper is to describe the evolution of the (post)graduates' wage premium across the wage distribution. We propose to do so by following a cross-section estimation approach for each year (from 2006 to 2012) with a simple set of controls, following [Cardoso \(2007\)](#) and [Figueiredo *et al.* \(2013\)](#).⁵ We choose a simpler cross-sectional approach in the attempt to avoid emptying out the higher education premiums from other determinants of the returns highly correlated with higher education attainment and earnings as, for instance, the type of occupation. With this approach, we are following [Peracchi \(2006\)](#) and others, arguing that this consists in a descriptive measure of graduates' and postgraduates' relative benefits over otherwise similar individuals (with the same observable characteristics considered) but only with completed high school education. As argued by the author, these measures can also be seen as the average price attributed to tertiary education at a particular point in time. So, we consider a simple set of controls which only includes potential years of experience and its square.⁶ Latter, on the decomposition exercises, we control for further individual and firm-specific characteristics. We do not control for gender due to its high correlation with both education choices and occupational profiles.⁷ The returns are estimated by the means of a *Quantile Regression*. With this method, the dataset is reweighted in order to pay more attention to specific parts of the wage distribution, which enables the estimate of the returns of the most and least successful graduates. Since we are trying to capture the effect of obtaining a higher education degree, we consider as a control group only those workers who could had chosen to do so but, for several reasons, decided to enter the labor market after completing high school education.⁸

Our approach is open to criticism. The most common critique refers to

⁵The dependent variable considered in the following analysis was the logarithm of the deflated hourly wages, which was computed by dividing all the components of the wage (base, regular, irregular and extra earning) by all the hours worked (normal and extra hours), deflating them using the CPI deflator (base 2005) and applying the logarithm.

⁶We further tested for the effects of introducing gender and part-time work as additional dummies.

⁷We return to this issue in the conclusions of the paper.

⁸Considering all non-graduate workers as a control group could have led to an over-estimation of the returns to higher education, since workers with completed high school education seem also to have a wage premium compared to workers with less formal education. According to our own computations, workers with completed high school education had a premium of, respectively, 47% and 37% in 2006 and in 2012 compared with other non-graduate workers with less years of schooling.

endogeneity problems. These might arise, for instance, when there is a correlation between any control variable and the unobserved component. Since we do not control for innate ability, this classical problem will always be present (see for instance [Griliches, 1977](#)). One way to overcome it is to consider a panel data approach, which allow us to control for constant unobserved heterogeneity of the workers, that could be interpreted as work-related determinants. We argue, however, that a panel data approach would originate seriously misleading estimates due to the non-representative sample considered in the estimation. This problem arises because a panel data approach cannot capture the marginal effects in the absence of variation in the controls. In this case, this implies that it would only be possible to compute the return for those workers that had a labor market experience before graduating. However, some evidence suggests that these workers correspond to a small non-representative subset of the workers on the Portuguese labor market (less than 2% of the workers in our sample). In fact, in Portugal the percentage of students that conciliate studies with work experience has been historically low. For instance, [Teixeira *et al.* \(2008\)](#) note that in 2004 only 20% of the Portuguese higher education students relied on earnings from work as a source of income.

Another way to deal with this problem is to consider an instrumental variable approach (see, for example, [Angrist and Keueger, 1991](#)). Some authors instrumentalise education with law changes or admission test scores in order to control for work-related determinants. But these methods are also prone to some important critiques. The most relevant refer to their weakness or their correlation with only a subset of the population, resulting in a local treatment effect instead of an average treatment effect (see for example [Card, 1999](#)).⁹

Endogeneity in our analysis might also result from the omission of relevant variables, representing a risk of obtaining inconsistent estimates ([Greene, 2011](#)). To minimize the omitted variables bias we considered as controls those variables that are, in theory, the most fundamental ones. This is, however, a common problem to other more exhaustive approaches since, as [Hastie *et al.* \(2009\)](#) argue, biased estimates may result from any method that shrinks, or sets to zero, some of the least squares coefficients, which resembles the common practice in the profession of sequentially introducing and removing blocks of controls in the regression analysis on an *ad hoc* basis. Thus, although some analysis with a wider set of controls may apparently

⁹In our particular case, as we are discussing an investment in higher education, instruments such as quarter of birth, or mandatory education legislation, are prone to be particularly weak, as they affect mostly those workers whose education is at the margin of the minimum schooling level.

seem to control for this bias, we argue that it is not necessarily that case. Finally, considering a wide set of controls also increases the likelihood of having highly correlated regressors which make the estimates much more unstable (Hastie *et al.*, 2009). In practice this implies that the coefficients of the regressors are determined with short precision.

Even if endogeneity might be seen as a problem, we stand with Lemieux (2014) in arguing that a large literature on this topic suggests that the causal effect of education on earnings suffers only a small bias due to innate ability. Moreover, as suggested by Hastie *et al.* (2009), the overall prediction accuracy in terms of mean square error can sometimes be improved at the expense of relatively small biases by shrinking the number of regressors. By explicitly assuming these drawbacks, we argue that our empirical design is preferable to an alternative of ending up with a problem of a non-representative subsample, or to assume as independent controls that are deeply related, as for instance education and occupation or industry, and to disregard an important part of the higher education premium as a result.

5.2 Decompositions

After estimating graduates and postgraduates' returns we decompose the wage gap between these 2 groups using Nopo (2008) aggregate decomposition and consider additional firm specific controls. We introduced a set of categorical variables for part-time work, location, legal nature, ownership and size of the firm, either in terms of number of employees and in terms of real gross sales. Ultimately, we introduced controls for detailed occupations (a 2-digit occupation within 2-digit industries) (see Table 3 in Appendix).¹⁰ We do not control for occupation and industry separately because of the interdependence between these 2 variables. Splitting these controls wouldn't take into account the variability of wages within a given occupation and across industries, neither the higher incidence of occupations in some industries. Given that our goal with this decomposition exercise is to find for postgraduates a graduate within the same experience group, working in the same type of firm and performing a similar occupation, gender differences should not be considered. This would be equivalent to assume that men and women with the same characteristics should not be in the same occupations.

In general, applying a decomposition method one obtains 2 distinct components: a *composition effect*, which corresponds to the part of the gap attributable to differences in the average characteristics between the 2 groups;

¹⁰We considered as a unit of analysis a 2-digit occupation (according to *ISCO08* classification) within different sets of 2-digit industries (*ISIC Rev.3*), after harmonizing the changes in the occupational classifications.

and a *wage structure effect*, that corresponds to the part of the gap attributed to differences in the average rewards to the characteristics considered in the analysis. The main advantage of [Ñopo \(2008\)](#), however, is that it relaxes the common support assumption, typical in most decomposition methods. Most of such exercises assume that no combination of controls can uniquely identify the membership into one of the groups considered in the decomposition, *i.e.*, assume an overlapping support ([Fortin et al., 2011](#)). This is true, for instance, for the widely known [DiNardo et al. \(1996\)](#) and [Firpo et al. \(2009\)](#) decomposition methods. However, if that is not the case some observations are considered to be out of the common support group, meaning that there is not a similar counterpart. This results in a problem of comparability. To account for this issue, [Ñopo \(2008\)](#) performs a non-parametric matching exercise and this allows us to divide the workers of each group in matched and unmatched workers, where unmatched workers correspond to those workers that do not have a similar counterpart in the other group. These workers are considered to be out of the support group. Then, the wage gap is divided into 4 additive components: a composition and a wage structure component similar to a standard decomposition but computed only over the workers on the common support, and other 2 components that account for the differences in the composition between workers inside and out of the common support for each group of workers considered (which in this case corresponds to the group of graduates and postgraduates).

In this context, we argue that relaxing the common support assumption is critical to our analysis, especially if one considers the role of occupations. Concretely, we argue that if occupations play a major role in the graduates postgraduates differentials, then graduates and postgraduates that do not share the same occupations (and the other combination of controls) are not comparable. So, relaxing the overlapping support assumption allow us to not only to compare graduates and postgraduates that share the same detailed occupations, but also to compare these workers with those that have the same educational level but that do not manage to guarantee the access to the same jobs. Moreover, we argue that relaxing the common support assumption allow us to disentangle 2 sources of the postgraduate premium: a more direct return that consists in receiving higher wages than similar graduates within similar detailed occupations, which will be captured by the *wage-structure effect* among matched workers; and a more indirect one that consists in having access to different occupations, that will be captured by the difference in the composition of matched and unmatched workers within each educational group.

Depending on the magnitude of these components we can also assess the role played by a postgraduate degree in this process. More specifically, if for

instance only the difference in the composition of matched and unmatched graduates is significant, then this implies that unmatched graduates are penalized for not being able to guarantee a place in the same occupations as similar postgraduates. Hence, one shall expect that postgraduate degree works as an insurance to avoid being potentially displaced to low paid occupations, *i.e.*, or, in other words, as a way to hold on to higher wages. In turn, if only the difference in the composition of matched and unmatched postgraduates is significant, then unmatched postgraduates are being positively discriminated for being in different occupations. Hence, if this is the case postgraduate education is likely to be acting as a prerequisite to access top-paid occupations, presumably relying on more complex tasks. In this case, instead of holding on to a higher ground, postgraduates could be seen as jumping to an even higher one.

In this decomposition exercise we also assumed that there is no problem of endogeneity. As Fortin *et al.* (2011) point out, this problem might arise, for instance, due to self-selection of the individuals in the decision to participate in the labor market or even in self-selecting into one of the groups. In our particular case, both problems are plausible since, for example, innate ability, institutional status and the financial background may have an important role on graduates' decision to persecute more advanced studies. As we made clear already, however, concerns with endogeneity will always be present in these exercises. Nevertheless, we consider this to be a very helpful descriptive tool. Another possible limitation of the decomposition methods in general is, as Fortin *et al.* (2011) point out, the fact that they do not seek to recover the "deep structural parameters" or the mechanisms behind the relation of the controls and the dependent variables. However, both the existence of these mechanisms or the structural forms considered on a given estimation are questionable. Nevertheless, as Fortin *et al.* (2011) suggest, decomposition methods are useful by indicating which factors are quantitatively more important, suggesting the factors that should be investigated in more detail. In our case, they allow us to reinforce the importance of access to detailed occupations in conditioning the evolution of returns to higher education over recent years.

5.3 Deskilling and displacement effects

Given the important role played by the structure of available jobs, we close our analysis looking more specifically to the presence of *deskilling* and *displacement effects*. Put simply, for our purposes here, *displacement* consists in more qualified workers substituting less qualified ones in the same detailed occupations. *Deskilling* corresponds to a situation where new jobs performed

by higher education graduates actually make use of a different and, arguably, less complex set of tasks.

In order to look at *deskilling effects* we then describe the set of occupations held by matched and unmatched workers of both groups in the top and on the bottom of the wage distribution. To this purpose, we consider from the *O*NET database (version 21.0)* several measures of the importance of different tasks in a given occupation, such as the importance of *analyzing data or information*, *repeating the same tasks* or *thinking creatively*.¹¹ We grouped these tasks into 5 broad categories inspired by [Acemoglu and Autor \(2011\)](#) work: *non-routine cognitive analytical*; *non-routine cognitive interpersonal*; *routine cognitive*; *routine manual* and *non-routine manual* (see Table 6 in [Appendix](#)). The data was collected using the *Standard Occupational Classification (SOC)*. We normalized and converted to 3-digit *ISCO08* occupations by applying a crosswalk between the 2 classifications¹². We further (weighted) averaged and normalized these measures to obtain a description of the relative importance of each task for each 2-digit occupation. Finally, we computed the average importance of each type of task on the top and bottom of the wage distribution of each group (1st and 5th quintiles). Comparing the importance of tasks in different points of the distribution gives an insight of the heterogeneity of the occupational structure both within and between groups of workers. We argue that this can be seen as a measure of the risk of being allocated to less demanding jobs (in terms of type of skills used). Because this data is collected only for occupations we can not account for the heterogeneity of occupations across industries.

Finally, to evaluate the importance of *displacement effects* we perform a *shift-share analysis* ([Berman et al., 1994](#)). This methodology allows us to decompose the absolute percentage point increase in a given share of workers into 3 main components: one that accounts for the changes in the skill intensity within occupations (assuming that the overall representation of those same occupations in the economy, in terms of employment, remains constant over time), usually called *within effect*; and other 2 components that account for the portion of the overall *upskilling* due to changes in the weight of given industries and due to changes in the weight of given occupations in total employment with the skill intensity levels within occupations fixed over time. These 2 components together form what is usually called the *between effect*. The *within-effect* is related to the presence of displacement effects, which might result from the increasing complexity of the existing jobs or,

¹¹Information available at www.onetonline.org.

¹²Data and codes prepared by the Institute for Structural Research, www.ibs.org.pl/resources.

alternatively, from a mere substitution effect. In turn, the *between-job effect* is more deeply related with an upgrade effect, operating through changes in a country’s productive structure. Using this methodology we decompose both the increase in the share of workers with a college degree in our sample and the increase in the share of postgraduates in the total of workers with a college degree. The aim of this analysis is to understand the role of occupational/industrial change in the *upskilling* of the Portuguese labor force qualifications and the extent to which this *upskilling* has been accomplished, instead, by a downward movement of graduates and non-graduates across the occupational ladder.

6 Results

In this section we present the main findings of our analysis. In subsection 6.1 we present the results of the regression analysis regarding the returns for graduates and postgraduates across the wage distribution, in subsection 6.2 we present the results of the [Nopo \(2008\)](#) aggregate decomposition and, finally, in subsection 6.3 we look at differences in the graduates and post-graduates’ occupational structure and the results of the *shift-share analysis*.

6.1 Graduates and Postgraduates’ premiums

As discussed above, we estimate the broad returns to higher education using a *Quantile regression* approach. We consider a wage equation controlling for experience, experience square where our variables of interest are the coefficients of the dummy variables that assume the value 1 depending on the completion of, respectively, a graduate or a postgraduate degree (where the base category is completed high school education).¹³ Hence, these coefficients measure respectively the average percentual increase in real wages due to the attainment of a graduate and a postgraduate degree. The results of this regression are presented on Table 4 in [Appendix](#). Figure 1 below illustrates these results, with the coefficients converted to actual returns. We report estimates for the returns on the 10th, 25th, 50th, 75th and 90th quantiles.

These results show two different dynamics for graduates’ and postgraduates’ returns along the distribution. Concretely, in all points of the distribution considered graduates’ returns were consistently decreasing whereas

¹³Introducing controls for gender and part time work does not change quantitatively or qualitatively the results presented below.

postgraduates' returns were almost always increasing, apart from an apparent stagnation on the top (75th and 90th quantiles). These distinct dynamics have opposite impacts in terms of the heterogeneity of returns. The decrease in graduates returns led to an increasing dispersion in returns among workers in this group, especially below the median. In turn, the dispersion of postgraduates' return kept relatively unchanged on the bottom and decreased on the top of the distribution, giving some evidence of a clustering of returns. Finally, these results suggest that graduates' returns at the bottom of the wage distribution were already in 2012 at a relatively low level (approximately 20%). The situation becomes even sharper for graduates when one notices that the 25% least successful postgraduates have approximately the same returns than the most successful graduates, with the same observed characteristics.

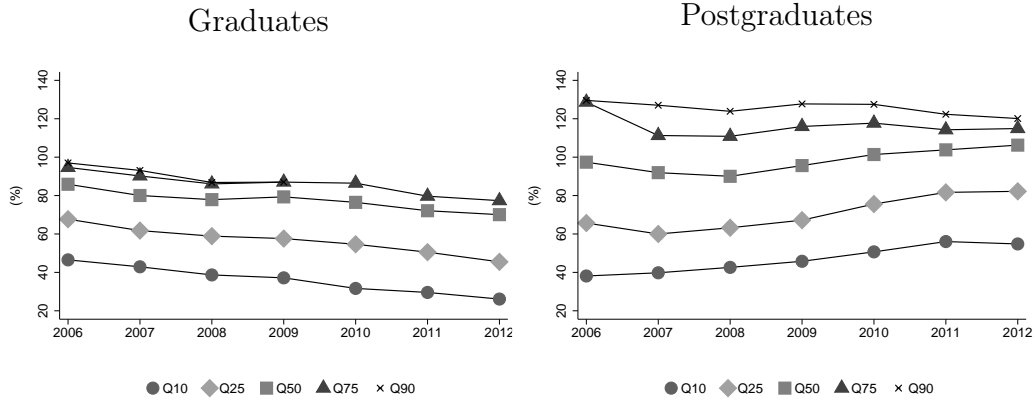


Figure 1: Returns to higher education degree for graduates (left) and postgraduates (right) along the distribution, controlling for $exper$ and $exper^2$. Source: Own calculations.

In sum, our results seem to suggest that, in general, the returns to postgraduate education remained very high in Portugal, even for those at the bottom of the wage distribution. In contrast, graduates' returns seem to be considerable only on the upper part of the distribution, since in the lower part it has been consistently decreasing to relatively low levels (between 20 and 40%, approximately). A closer look at the evolution of gross real mean wages (Figure 2) shows that the reduction in graduates' returns were also accompanied by an erosion in their purchasing power. This suggests that this trend results from a fall in graduates' wages instead of an increase on non-graduates' wages. In turn, postgraduates increasing returns below the median seem to result from increases in real wages which is striking considering the large increase in the supply of such qualifications over this period.

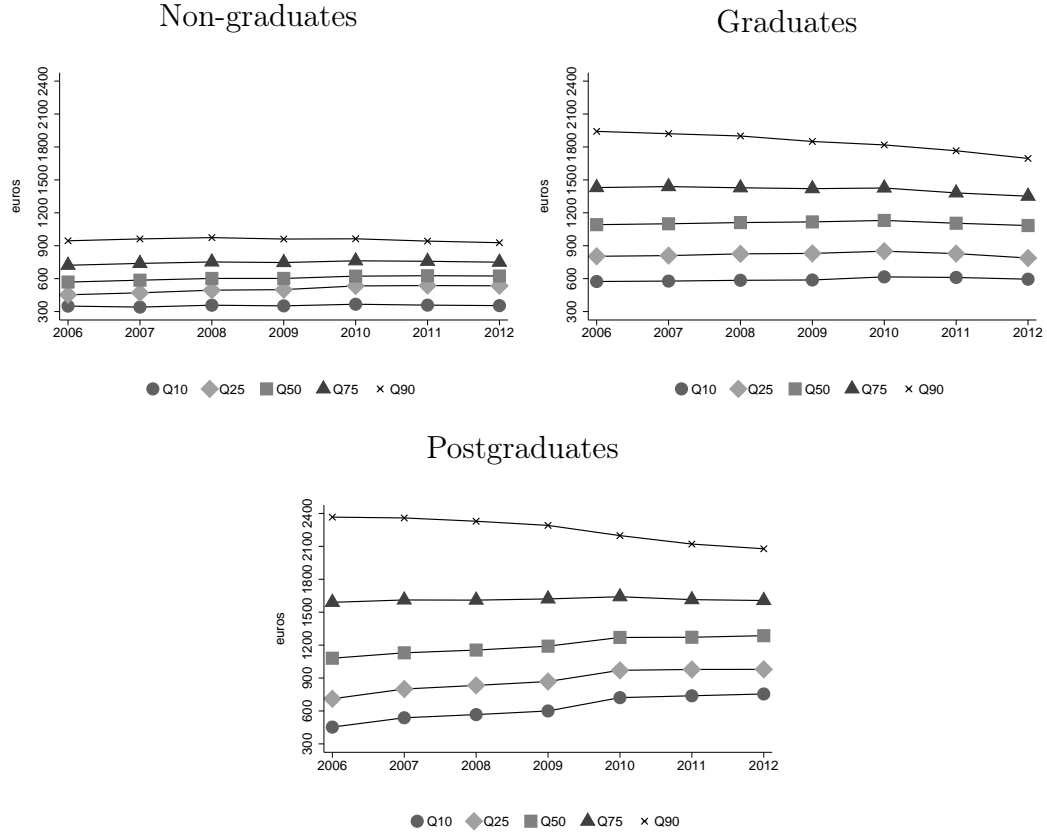


Figure 2: Real wages for graduates (left) and postgraduates (right) across the wage distribution.
Source: Own calculations.

6.2 Decomposing the returns

Using the [Nopo \(2008\)](#) decomposition, as discussed above (see Section 5.2), we are able to disentangle the part of the wage gap that is due to differences, either in endowments or in their wage coefficients, among workers that share the same combination of characteristics (including detailed occupation), and the part of the gap that is due to differences in the characteristics between these and the other workers. In this analysis we considered controls for detailed occupation (2 digit occupation within 2-digit industry) and a further set of firm specific controls: location, legal nature, ownership and size of the firm (see Table 3 in [Appendix](#)). We then performed the same analysis several times by interactively introducing additional controls in the matching procedure. We left for last, controls for industries and for detailed occupations. As noted by [Nopo \(2008\)](#), considering more variables in the decomposition increases, *per se*, the extent to which the gap can be explained while decreasing the likelihood of the match. However, with this exercise we are not interested

in the precise value of the change but rather on its relative magnitude. Figure 3 illustrates the percentage of workers *per* educational group that have a similar counterpart, *i.e.*, that are on the matched group, considering different sets of controls. In this case, *base* corresponds to the matching procedure considering all the controls except for industry and occupation; *industry* extends the previous case by introducing controls for industries and, finally, *occupation* extends the previous case by introducing controls for occupation.

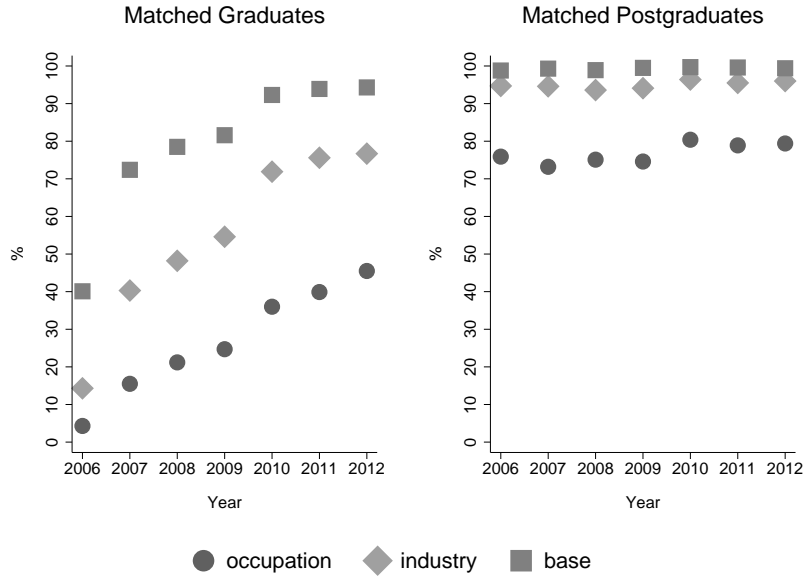


Figure 3: Percentage of matched graduates and postgraduates for each year considering different sets of control. *Source: Own calculations.*

Regarding postgraduates, it is possible to find a similar graduate counterpart for almost all the workers in the sample when considering several firm specific controls and even when controlling for industry. When introducing controls for occupation, however, the percentage of matched postgraduates falls approximately 20 p.p. This means that it is not possible to find for a significant share (1/5) of postgraduates a graduate with the same years of experience, working on a similar type of firm and with the same detailed occupation. In the case of graduates, the share of workers with no similar postgraduate counterpart was even higher, being approximately 60% in 2012. These results stand in line with our argument and reinforce the importance of relaxing the *overlapping support assumption*, discussed on Section 5.2.

Moreover, Figure 3 shows a relatively stable share of unmatched postgraduates (outside the common support) during this period, despite the massification of postgraduates in the labor market, and an increasing share of

matched graduates. We argue that these results illustrate the differences in graduates and postgraduates' occupational structures.

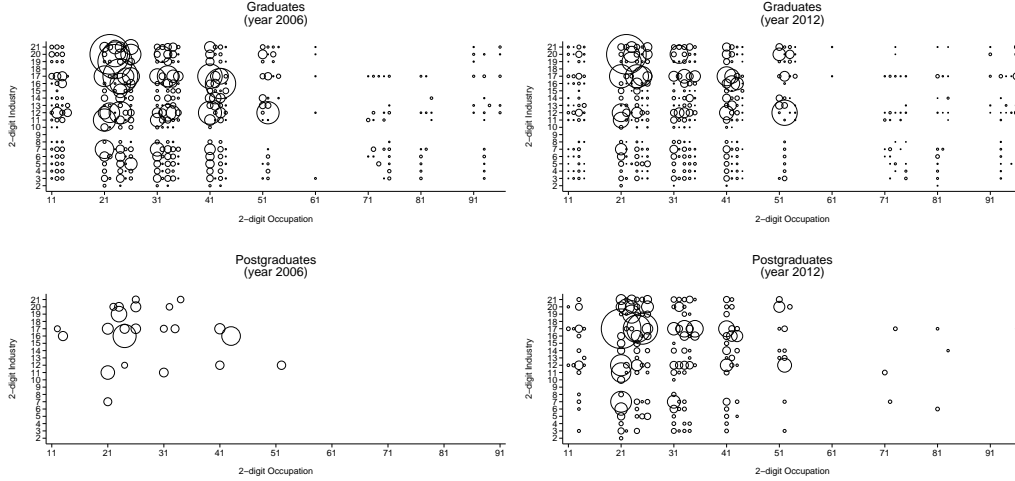


Figure 4: Concentration of graduates and postgraduates in different occupations and industries for the years 2006 and 2012. Each circle is weighted by the number of workers of that group. *Source: Quadros de Pessoa.*

Figure 4 illustrates for the years 2006 and 2012 the concentration of each group of workers in the different occupations and industries considered¹⁴, where the size of the circles is directly proportional to the number of workers of that group. This consists in a descriptive measure of the change in the occupational structure of the 2 groups. In 2006, there were a short number of postgraduate in the Portuguese private labor market, mainly working in the *Financial Intermediation* and in *Real estate, renting and business activities* (category 16 and 17, respectively). In 2012, despite these 2 industries continue to be the most important, their occupational structure was much more heterogeneous, with the lion's share of postgraduates concentrated in occupations below category 40. There are, however, signs of increasing (potential) overeducation among postgraduates, with an increasing concentration of workers above category 50, once associated with lower skill intensity (we will further analyze differences in the occupational structure in terms of skills). Here, it stands out the increasing concentration of postgraduates in occupations such as *Personal service workers* and *Salesperson* (categories 51 and 52, respectively). In the case of graduates, in this period the movement to occupations above category 50 was much more pronounced, although the majority still managed to guarantee a place in occupations below category 40.

¹⁴We plot only occupations within industries with more than 5 workers of the group.

Hence, although the number of postgraduates have increased considerably in this period (which makes it easier to find a counterpart), postgraduates seem to have been guaranteeing access to different occupations, which makes the job of finding a similar counterpart not so easy after all. In other words, the increase in the supply of postgraduates was compensated by a differentiated pattern of change in the occupational structure of both groups.

Considering only matched workers, *i.e.* workers that have a similar counterpart, we present in Figure 5 the cumulative distribution for the deflated *log* wages *per* group. As shown below, the cumulative distribution for postgraduates became stochastically dominant in 2012, including for those on the bottom. This seems to indicate that the least successful postgraduates did relatively better than the least successful graduates.

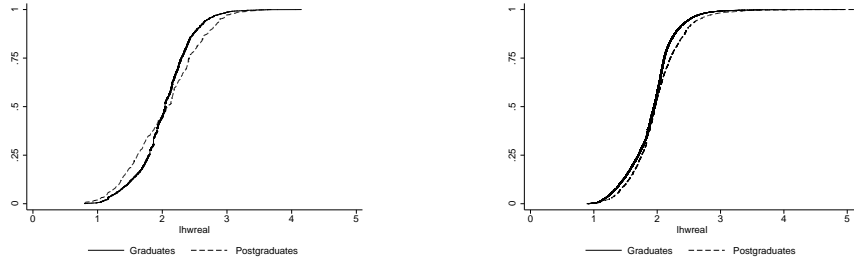


Figure 5: Cumulative distributions of *log* real hourly wages for graduates and postgraduates considering the year 2006 (left) and 2012 (right). *Source: Own calculations.*

As [Ñopo \(2008\)](#) notes, at any height, the horizontal difference between these 2 cumulative distributions corresponds to the wage gap at that percentile. Figure 6 illustrates these differences in relative terms in different points of the distribution for the years 2006 and 2012. One should note that here we are comparing the wage gap between matched graduates and postgraduates on the same part of the distribution. This implies that, for instance, we are comparing the least (most) successful graduates with the least (most) successful postgraduates. We consider this to be the most appropriate way to compare the two groups due to factors such as innate ability. Specifically, we argue that it is more likely that a least successful graduate belonged to the group of the least successful postgraduates if he decided to take a postgraduate degree, than belonging to the most successful group, and vice-versa.

Figure 6 suggests that the wage gap between the most successful workers of both groups was considerable during this period, in favor of postgraduates. Concretely, the wage gap was, approximately, 10% of the average graduates' wage at that percentile, both in 2006 and in 2012. In the bottom of the distribution, however, the scenario seem to have changed in the past years.

While in 2006 the wage gap benefited graduates, in 2012 the scenario was the opposite with considerable earnings for postgraduate workers. This result suggests that even when graduates manage to guarantee a place in the same type of firms and detailed occupation as postgraduates, postgraduates earn significantly more.

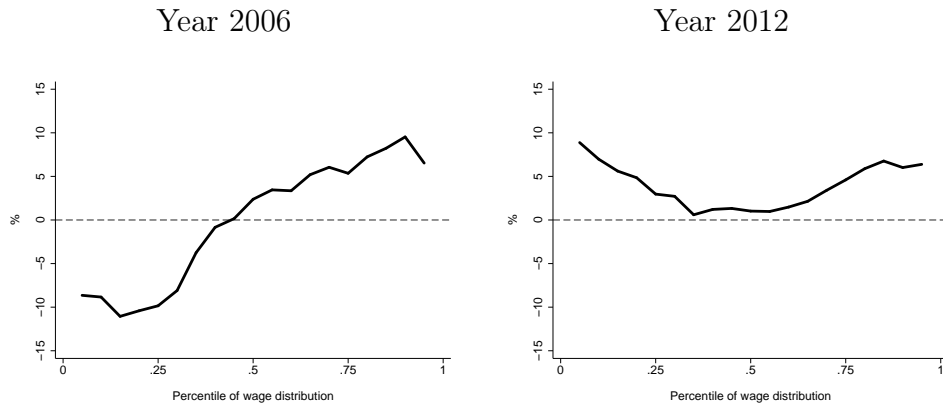


Figure 6: Wage gap (in relative terms) between matched graduates and postgraduates along the distribution in 2006 (on the left) and 2012 (on the right) after [Nopo \(2008\)](#) decomposition. *Source: Own calculations.*

The overall results of [Nopo \(2008\)](#) decomposition considering the entire sample of college degree workers are presented on Table 5. We follow the same notation used by the author, where Δ corresponds to the total wage gap, Δ_X to the part of the gap attributable to differences in the endowments of matched workers across groups, Δ_F is the part attributable to differences in the endowments of matched and unmatched graduates, Δ_M is the same as Δ_F but for postgraduates, and Δ_0 corresponds to the unexplained part of the wage gap, which consists in the typical *wage-structure effect* among matched workers. Figure 7 resumes this information.

Figure 7 shows that the wage gap (Δ) between graduates and postgraduates has been increasing over time. Most importantly, these results show that without controlling for occupation, either controlling or not for industry, the major part of the wage gap is attributable to the *wage-structure effect*, *i.e.* remains unexplained. Controlling for industry in the matching procedure only slightly improves the explanation power by reducing Δ_0 . On the other hand, controlling for occupation reduces significantly the unexplained part of the gap by increasing the importance of differences in the composition of matched and unmatched graduates. In this case, approximately half of the wage gap between graduates and postgraduates can be explained by differences in endowments (such as gender, firm size and occupation within a given industry, among other variables) of matched and

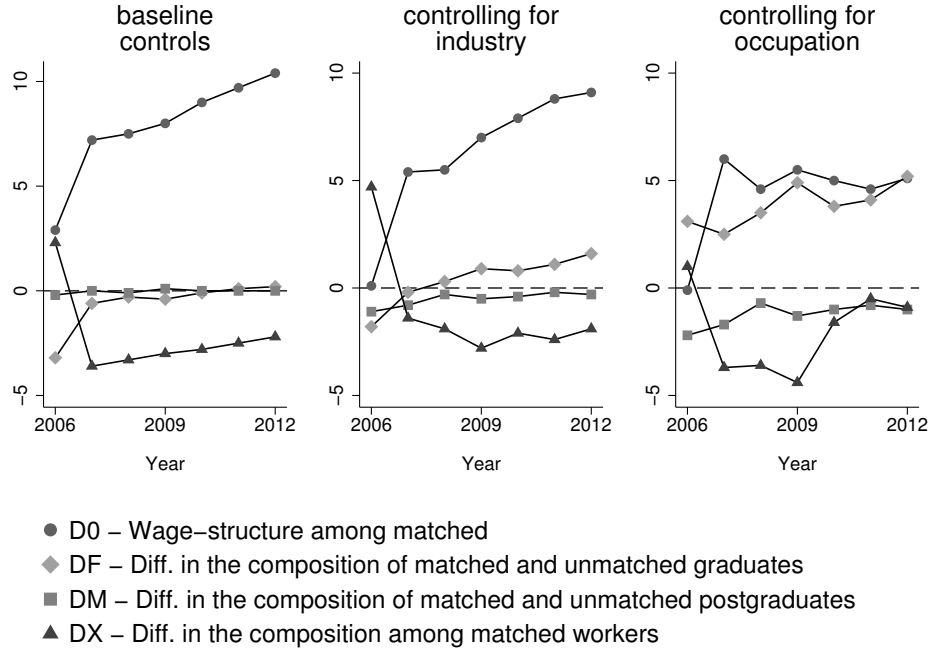


Figure 7: [Nopo \(2008\)](#) decomposition controlling for baseline characteristics in the matching procedure (on the left), after introducing industry (on the middle) and after introducing occupation within industries (on the right). *Source: Own calculations.*

unmatched graduates (ΔF). Without controlling for occupation this component was negligible which we consider to be a signal of the importance of occupational assignment. We argue that this results from the difficulty in graduates guaranteeing a place in some occupations, forcing them to accept different and lower paid jobs. In fact, Figure 7 suggests that it is becoming increasingly more difficult for graduates to guarantee access to those occupations, with ΔF almost doubling during this period.

Although the part of the gap attributable to differences in the composition of matched and unmatched postgraduates (ΔM) seem also to be important to explain graduates postgraduates wage differentials, it seem to became insignificant after 2009. A negative ΔM means that the wage gap between graduates and postgraduates would be higher if the groups of matched and unmatched postgraduates shared the same characteristics. Thus, we argue that until 2009 those postgraduates that did not manage to guarantee the access to some occupations were also penalized in the same way as unmatched graduates. Since 2010, however, while this penalization became harsher for graduates, it reduced significantly for postgraduates. We argue that the evolution in ΔM and ΔF resume the changing role played by postgraduate education in Portugal. Concretely, during the first

years of postgraduate massification in the sequence of the implementation of the Bologna process, postgraduate education acted as a way to access better paid occupations or, in other words, to jump to a higher ground. The most successful postgraduates who managed to do it benefited also from considerable higher wages than graduates in the same occupations (see Figure 6). In turn, since 2010 the rapid increase in the number of postgraduates in the labor market and the escalation of the economic crisis in Portugal transformed postgraduate education into a way to hold on to a higher ground. During this period, unmatched graduates were considerably penalized in terms of wages and even those who manage to guarantee the access to some occupations were penalized in almost all points of the wage distribution. In fact, as shown in Figure 6, the wage penalization (in relative terms) among the least successful matched graduates was almost as high as the penalization of the most successful ones. This results seems to suggest that, especially since 2010, there have been significant wage differentials between graduates that are able to share the same occupation as postgraduates and those who aren't, which indicates that graduates are having more difficulty to enter those occupations that have been increasingly dominated by postgraduates. The entry gate for some occupations may have narrowed for graduates, which makes access to higher returns more difficult. Furthermore, even those who manage to enter do not obtain the same returns as postgraduates. Finally, for all the different sets of controls considered there seems to be significant differences in the composition of matched workers from both groups.

We obtain similar results by breaking the analysis into different experience and of firm dimension groups (presented in Figure 8 and Figure 9). Once again, for all levels of experience the wage gap is increasing, especially among the less experienced workers, which suggests that the wage gap has a tendency to continue increasing in the future, and differences in the composition of matched and unmatched graduates should continue to play the most important role. Regarding different firm dimension groups, the results are mostly the same (apart from the case of the biggest firms where the wage gap has been decreasing over time) but being reproduced at a lower level.

Until now we have been talking in terms of occupations without specifically describing their differences. To illustrate the differences in graduates and postgraduates' occupations we computed, for the year 2012, a ranking of the occupations that employ more unmatched workers per group. The top 10 occupations in terms of employment for each group of matched workers are listed on Table 2 below. Table 2 shows an higher representation of unmatched postgraduates on 2-digit *specialist* occupations (below category 30); predominantly *STEM* (*Science, Technology, Engineering and Mathematics*) specialists. In turn, on the graduates ranking there are occupations tradi-

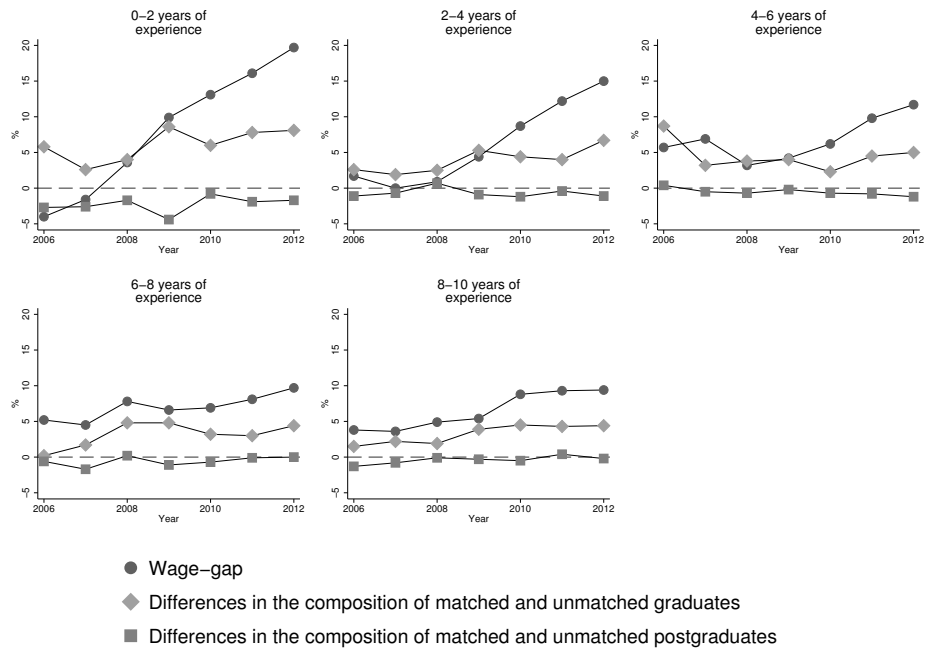


Figure 8: Results from [Nopo \(2008\)](#) considering the full set of controls (including detailed occupation) reported by different levels of experience.

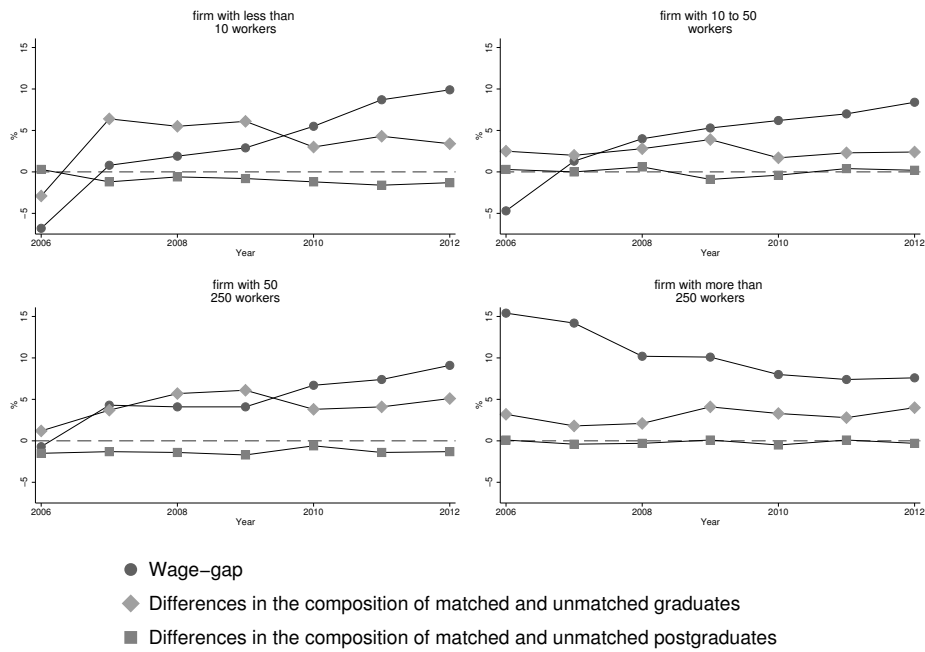


Figure 9: Results from [Nopo \(2008\)](#) considering the full set of controls (including detailed occupation) reported by different levels of firm dimension.

tionally held by non-graduates in the past, such as *Clerical support workers* (categories 41 and 42) or *Salespersons* (category 52). In fact, in 2012 approximately 30% of unmatched graduates were concentrated in occupations such as *Clerical support workers*, compared to 12% unmatched postgraduates. This evidence suggests that while postgraduates may be displacing graduates from some specialist occupations, in the other hand, graduates may be displacing non-graduates from some less demanding occupations, which rely on less complex skills. Henceforth we will analyze in more detail the differences in graduates and postgraduates occupational structure.

Table 2: List of the 10 occupations that employed more unmatched graduates and postgraduates in 2012. See Table 3 for occupations and industries description.

Rank	Graduates		Postgraduates	
	Occupation	Industry	Occupation	Industry
1st	22	20	21	17
2nd	52	12	21	6
3rd	32	20	21	7
4th	41	17	21	12
5th	23	19	35	17
6th	42	17	21	11
7th	23	20	25	17
8th	21	12	23	19
9th	41	12	24	17
10th	24	17	21	21

Source: own computations based on Portugal, MTSS (2006-2012).

6.3 Differences in skill intensity

To describe the differences in the complexity of the occupations held by matched and unmatched workers of each group we use data for the importance scale of different tasks from *O*NET Work Activities* and *Work Context* files (see discussion in 5.3). We group these tasks into 5 broad categories following the work of Acemoglu and Autor (2011): *non-routine cognitive analytical*; *non-routine cognitive interpersonal*; *routine cognitive*; *routine manual* and *non-routine manual* (see Table 6 in Appendix). To compute the importance scale *per* individual task we collapse each task scale into *SOC* occupations and then standardize to have mean zero and unitary standard deviation. We then sum the scale of the tasks within each category and proceed to the same standardization. Finally, we compute the mean of each broad category in the top and bottom of the wage distribution (1st and 5th quintiles) for matched and unmatched workers of each group in the different

years. This consists in a measure of the average importance of different types of tasks in graduates and postgraduates' occupational structure. The result of this descriptive analysis are resumed on Figure 10.

Figure 10 suggests that there are not significant differences in the importance of different types of tasks between matched graduates and postgraduates in the same part of the wage distribution, both on the top and on the bottom. In both parts of the distribution graduates and postgraduates occupations rely mainly on *non-routine analytical* tasks, although those on the top part rely on these much more heavily. These occupations on the top part of the distribution seem to depend less of *non-routine interpersonal* tasks. In fact there are not many differences between occupations on the top part of the distribution between matched and unmatched workers. The major differences are between unmatched graduates and postgraduates at the bottom of the distribution. While unmatched postgraduates at the bottom are also in occupations that rely on *non-routine analytical* tasks, unmatched graduates' in this part of the distribution stand out as the group with the least demanding occupations. These workers are increasingly in occupations that rely in *routine cognitive tasks*. Furthermore, these occupations became (on average) even less demanding during this period.

Thus, since there is higher heterogeneity in the types of tasks for unmatched graduates' occupations, we argue that for graduates, not being able to guarantee access to specific, relatively detailed, occupations, *i.e.* being unmatched) represents a considerable risk of being allocated to less demanding and complex occupations and henceforth of *deskilling* in the sense described above. Given that the difference between matched and unmatched graduates in the importance of more complex types of tasks (as *non-routine* types of tasks) has widened, this risk seem have become stronger during this period. This evidence suggests that the increasing differences in graduates and postgraduates' occupations, with considerable impacts on the wage gap, do not result from an increasing movement of postgraduates to more complex occupations, but result mainly from an increasing movement of graduates to less complex and less demanding occupations. This evidence supports the view that postgraduates might be displacing graduates from some occupations which, consequently, might lead to displacement movements between graduates and non-graduates. We will analyze these two trends next by the means of a *shift-share analysis*.

6.4 Shift-share analysis:

To investigate the importance of displacement effects between groups we consider a *shift share analysis*. With a *shift-share analysis* we try to disentangle,

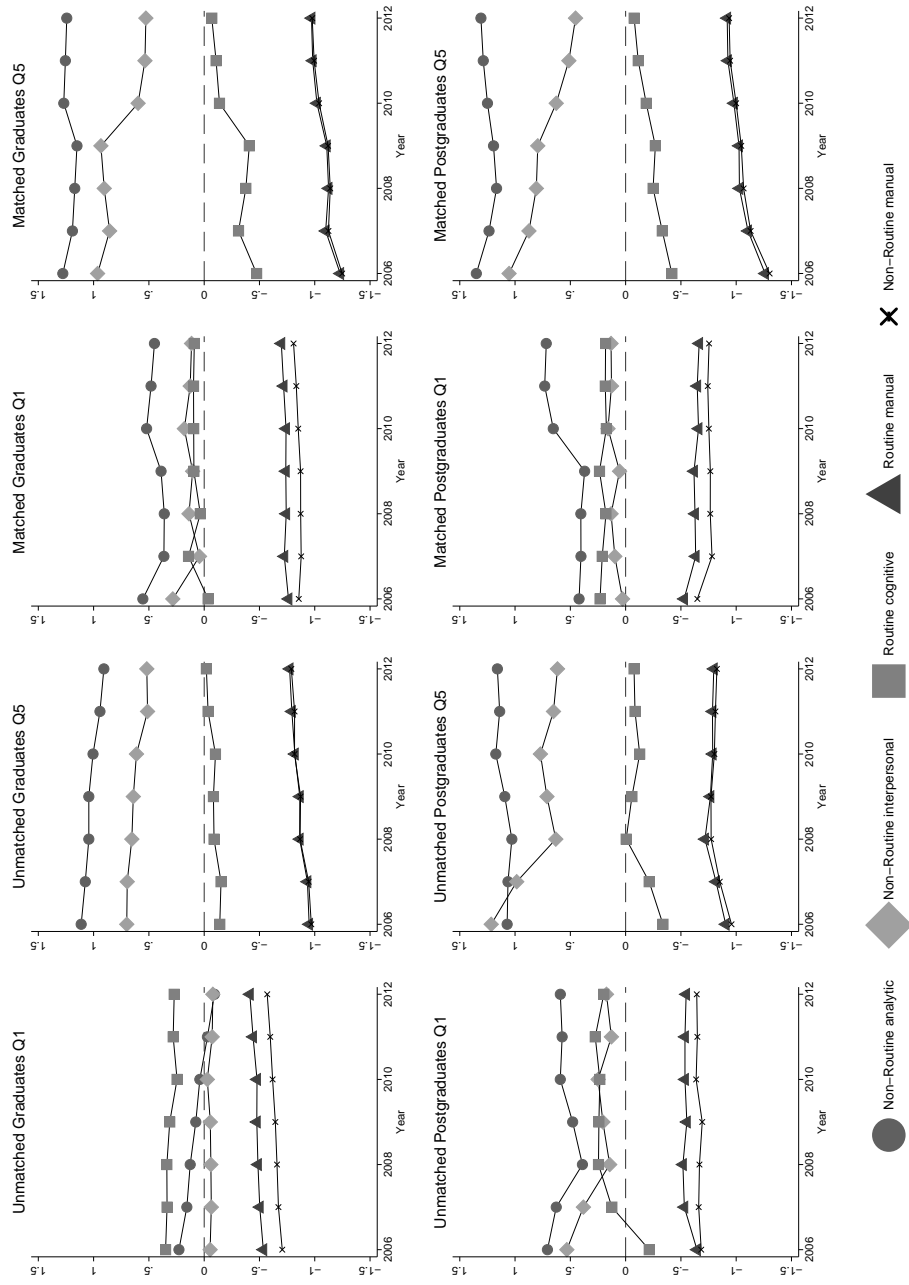


Figure 10: Evolution of the importance of difference types of tasks in the occupational structure of matched and unmatched workers of each groups, in different points of the wage distribution

for instance, the increase in the share of postgraduates on the total of college educated workers on a given period that is due to changes in the relative importance of different occupations and industries (*between effect*) from the increase due to changes in the relative intensity of skills on the occupations (*within-effect*). While the *between-effect* is more related to changes on a country productive structure, the *within-effect* on the other hand is more related to the presence of displacement effects, *i.e.*, more qualified workers substituting less qualified ones in the same occupation, which might result from the increasing complexity of the existing jobs or, alternatively, from a mere substitution effect. Thus, the higher the *within-effect* the more important are these displacement effects. Here, we perform this analysis at 2 different levels. We consider the increase in the share of college degree workers (graduates and postgraduates) in our sample, which consists in workers with at least upper secondary education completed, and the increase in the share of postgraduates in the total of college educated workers. While this last approach allow us to evaluate the magnitude of displacement effects between graduates and postgraduates, the first approach gives us an idea of the displacement effects between non-graduates and college educated workers which, as our previous analysis suggests, is mainly determined by the movement of graduates. One shall note that considering a similar analysis with non-graduates and graduates only would not render interpretable results because of the influence of postgraduates. The results of the *shift-share analysis* considering 2006 as the base year are presented on Figure 11 below.

Both analysis suggest that the *within-job effect* was the most important mechanism behind the *upskilling* of the Portuguese labor force. In some sense, this should be expected since the *between-job effect* is more deeply related with the change in a country's productive structure, which typically takes more time to produce effects. The share of college educated workers in the sample increased more than 1 percentage point (*p.p.*) per year, except in 2009, due to the *within effect*. In the case of postgraduates, the *within effect* followed a similar pattern, but more pronounced in the recent years. This suggests that since 2010 postgraduates started to increasingly displace more graduates from some occupations. Regarding the *between effect*, its contribution was different in the two analyses considered. While it hasn't contributed significantly to the increase in the share of postgraduates (Figure 11 on the right), it seems to have contributed negatively to the increase in the share of college educated workers (Figure 11 on the left). Moreover, there seemed to be opposite *industry* and *occupation between-effect*, with the first contributing positively until 2010 and negatively afterwards, and the second contributing negatively during all the time frame. This implies that occupations which in this period had an higher increase (decrease) in terms

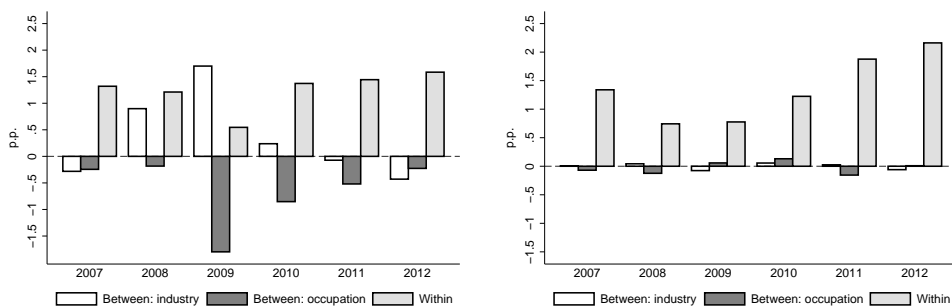


Figure 11: *Shift-share analysis* regarding the share of college educated workers in the sample (on the left), and the share of postgraduates in the total of college educated workers (on the right), considering 2006 as the base year. *Source: Own calculations.*

of employment were those that had a lower (higher) share of college educated workers in 2006, which reinforces the importance of displacement effects.

In sum, these results suggest that there was not a sufficiently strong pattern of structural change in terms of the importance of high-skill occupations and industries in the last 7 years in Portugal. They also suggest that despite modest, there are some signs that this change was based on the increasing importance of industries and occupations with fewer college educated workers relative to non-graduates. Moreover, this also indicates that after 2010 postgraduates may have started increasingly displacing graduates from some detailed occupations. This trend coincided with the fall in job vacancies due to the escalation of the financial crisis in Portugal, and with the increase in the rate of entry of postgraduates on the labor market. During this period, the number of postgraduates in our sample increases approximately 20% from 2008 to 2009 and 60% from 2009 to 2010. Therefore, we argue that the dynamics of the Portuguese structure didn't accommodate the increase in the share of graduates and postgraduates, pressuring significantly the returns of the first group, and displacing them to worse paid and less demanding occupations, further displacing non-graduates from those occupations. With the increase in the relative supply of postgraduates after 2010, this pressure became harsher for graduates.

7 Conclusions

In this paper, we present new evidence on the role played by graduate and postgraduate education in the Portuguese labor market. Our results suggest that there are significant and increasing returns to postgraduate education in Portugal, while returns to graduate education have been decreasing in some cases to relatively low levels (approximately 20%). While the de-

crease in graduate returns might be expected due to the *upskilling* of the Portuguese labor force, more surprising is the actual rise in postgraduate wage premiums in view of the very significant increase in the supply of such qualifications. This raises a number of important issues, namely whether a postgraduate degree is increasingly a mechanism to lower the degree of substitutability in graduate labour markets. There are various mechanisms that could explain such a trend, namely the increasing segmentation of demand for postgraduate and graduate qualifications (with much stronger increases for postgraduate qualifications) and the role of postgraduate qualifications in the assignment to different occupations. In this paper we show that this trend has been fostered mainly by the assignment to different occupations. We show that graduates that do not manage to share occupations (and other characteristics) with postgraduates earn considerably lower wages. We also show, however, that even those graduates who manage to guarantee a place in those occupations receive lower wages compared to similar postgraduates. Our results suggest, therefore, that a postgraduate degree has become a very important instrument to avoid the risk of obtaining low-paid and less attractive occupations or, in other words, as a way to hold on to higher grounds in the labour market. It appears that the distinct rhythms of structural change and supply of skills to the labour market led to significant displacement effects, with postgraduates increasingly displacing graduates, and graduates displacing non-graduates to worse paid and less demanding types of jobs. In a country that still has relatively low levels of educational attainment among its workforce and where higher education degrees have been traditionally associated with high returns, these trends can lead to significant expectations mismatches and drags to the continuation of the process of massification of higher education among the young. More importantly, the demand for postgraduate degrees may equally derive from their capacity of *signalling* higher capacity or *positioning* graduates in different competitive spheres independently of their intrinsic value or quality. This can lead to an inefficient use of public and private resources and to insufficient pressures for the diversification of the system to accommodate, precisely, the expectations and capabilities of new segments of the population entering higher education for the first time.

There are, therefore, a number of research avenues worth pursuing in the future which we do not directly address in the paper. First, how gender interacts with this story is notably absent from our analysis. We are certainly not arguing that it is unimportant. On the contrary. Since its effect may be pervasive in job assignment processes, including it as simple control variable in our decomposition exercises would simply work to artificially reduce the explanatory power of the allocation of individuals to particular jobs as a

source of rising postgraduate wage differentials. Whether or not women, for example, benefit or lose in such processes due to aspects of education choice or occupational segregation, for example, is a deserving topic on its own. Is equally important to look at whether this contributes to the persistence of gender pay gaps among the highly qualified. Second, whether or not actual displacement across the occupational structure results necessarily in genuine and not simply apparent overeducation. It is possible, for example, that the reduction in the duration of first-degrees, following the implementation of the Bologna process, led to the relative downskilling of new generations of college-only graduates. It is equally possible that the increasing presence of degree-holders in jobs previously performed by non-graduates contributes to the actual transformation of such jobs and the upgrading of skill demand. Finally, the specific role played by postgraduates and college-only graduates in processes of job polarization, particularly in the case of countries facing relatively slow net creation of graduate and postgraduate level jobs is certainly worth further research.

References

- Acemoglu, D. and Autor, D. (2011). Chapter 12 – Skills, tasks and technologies: Implications for employment and earnings. volume 4, Part B of *Handbook of Labor Economics*, pages 1043 – 1171. Elsevier.
- Aghion, P., Dewatripont, M., and Stein, J. C. (2008). Academic freedom, private-sector focus, and the process of innovation. *The RAND Journal of Economics*, 39(3):617–635.
- Angrist, J. D. and Keueger, A. B. (1991). Does compulsory school attendance affect schooling and earnings? *The Quarterly Journal of Economics*, 106(4):979–1014.
- Arrow, K. J. (1973). Higher education as a filter. *Journal of Public Economics*, 2(3):193–216.
- Arum, R. and Roksa, J. (2011). *Academically adrift: limited learning on college campuses*. University of Chicago Press.
- Autor, D. H., Katz, L. F., and Kearney, M. S. (2008). Trends in us wage inequality: Revising the revisionists. *The Review of Economics and Statistics*, 90(2):300–323.
- Baldwin, R. (2016). *The Great Convergence: Information Technology and the New Globalization*. Harvard University Press.

- Beaudry, P., Green, D. A., and Sand, B. M. (2016). The great reversal in the demand for skill and cognitive tasks. *Journal of Labor Economics*, 34(S1):S199–S247.
- Berman, E., Bound, J., and Griliches, Z. (1994). Changes in the demand for skilled labor within us manufacturing: evidence from the annual survey of manufactures. *The Quarterly Journal of Economics*, 109(2):367–397.
- Brown, P., Lauder, H., and Ashton, D. (2011). *The global auction: The promise of education, jobs, and income*. New York: Oxford University Press.
- Burgess, S. (2016). Human capital and education: The state of the art in the economics of education. *IZA Discussion Paper*, (9885).
- Card, D. (1999). Chapter 30 – The causal effect of education on earnings. volume 3, Part A of *Handbook of Labor Economics*, pages 1801 – 1863. Elsevier.
- Cardoso, A. R. (2007). Jobs for young university graduates. *Economics Letters*, 94(2):271–277.
- Centeno, M. and Novo, Á. A. (2014). When supply meets demand: Wage inequality in portugal. *IZA Journal of European Labor Studies*, 3(1):23.
- Cunha, F., Heckman, J. J., Lochner, L., and Masterov, D. V. (2006). Chapter 12 – Interpreting the evidence on life cycle skill formation. volume 1 of *Handbook of the Economics of Education*, pages 697 – 812. Elsevier.
- DiNardo, J., Fortin, N. M., and Lemieux, T. (1996). Labor market institutions and the distribution of wages, 1973-1992: A semiparametric approach. *Econometrica*, 64(5):1001–1044.
- Elias, P. and Purcell, K. (2004). Is mass higher education working? evidence from the labour market experiences of recent graduates. *National Institute Economic Review*, 190(1):60–74.
- Elias, P. and Purcell, K. (2013). Classifying graduate occupations for the knowledge society. *Institute for employment research. University of Warwick. Futuretrack working paper*, 5.
- Figueiredo, H., Teixeira, P., and Rubery, J. (2013). Unequal futures? mass higher education and graduates’ relative earnings in portugal, 1995–2009. *Applied Economics Letters*, 20(10):991–997.

- Firpo, S., Fortin, N. M., and Lemieux, T. (2009). Unconditional quantile regressions. *Econometrica*, 77(3):953–973.
- Fortin, N., Lemieux, T., and Firpo, S. (2011). Chapter 1 – Decomposition methods in economics. volume 4, Part A of *Handbook of Labor Economics*, pages 1 – 102. Elsevier.
- Goldin, C. D. and Katz, L. F. (2008). *The Race Between Education and Technology*. Harvard University Press.
- Green, F. (2012). Employee involvement, technology and evolution in job skills: A task-based analysis. *Industrial & Labor Relations Review*, 65(1):36–67.
- Green, F., Felstead, A., Gallie, D., and Henseke, G. (2016). Skills and work organisation in britain: a quarter century of change. *Journal for Labour Market Research*, 49(2):121–132.
- Greene, W. H. (2011). *Econometric Analysis*. Pearson.
- Griliches, Z. (1977). Estimating the returns to schooling: Some econometric problems. *Econometrica: Journal of the Econometric Society*, pages 1–22.
- Hartog, J., Pereira, P. T., and Vieira, J. A. (2001). Changing returns to education in portugal during the 1980s and early 1990s: Ols and quantile regression estimators. *Applied Economics*, 33(8):1021–1037.
- Hastie, T., Tibshirani, R., and Friedman, J. (2009). *Unsupervised learning*. Springer.
- Johnstone, D. B., Rosa, M. J., Teixeira, P. N., and Vossensteyn, H. (2006). *Cost-Sharing and Accessibility in Higher Education: A Fairer Deal? Higher Education Dynamics*. Springer.
- Katz, L. F. and Murphy, K. M. (1992). Changes in relative wages, 1963–1987: supply and demand factors. *The Quarterly Journal of Economics*, 107(1):35–78.
- Kiker, B. F., Santos, M. C., and De Oliveira, M. M. (1997). Overeducation and undereducation: evidence for portugal. *Economics of Education Review*, 16(2):111–125.
- Lemieux, T. (2014). Occupations, fields of study and returns to education. *Canadian Journal of Economics/Revue canadienne d’économique*, 47(4):1047–1077.

- Lindley, J. and Machin, S. (2016). The rising postgraduate wage premium. *Economica*, 83(330):281–306.
- Marginson, S. (1998). *Managing higher education diversity in a climate of public sector reform*, chapter 6: Competition and diversity in the reformed Australian higher education system, pages 81–96. Canberra Department of Employment, Education, Training and Youth Affairs.
- Neave, G. and Amaral, A. (2011). *Higher education in Portugal 1974-2009: A nation, a generation*. Springer Science & Business Media.
- Ñopo, H. (2008). Matching as a tool to decompose wage gaps. *The Review of Economics and Statistics*, 90(2):290–299.
- O’Leary, N. and Sloane, P. (2016). Too many graduates? an application of the gottschalk–hansen model to young british graduates between 2001–2010. *Oxford Economic Papers*, 68(4):945–967.
- Oreopoulos, P. and Petronijevic, U. (2013). Making college worth it: A review of the returns to higher education. *The Future of Children*, 23(1):41–65.
- Peracchi, F. (2006). Chapter 5 – Educational wage premia and the distribution of earnings: An international perspective. volume 1 of *Handbook of the Economics of Education*, pages 189 – 254. Elsevier.
- Santos, J. M., Horta, H., and Heitor, M. (2016). Too many phds? an invalid argument for countries developing their scientific and academic systems: The case of portugal. *Technological Forecasting and Social Change*, 113, Part B:352–362.
- Sattinger, M. (1993). Assignment models of the distribution of earnings. *Journal of Economic Literature*, 31(2):831–880.
- Sin, C., Tavares, O., and Amaral, A. (2016a). The impact of programme accreditation on portuguese higher education provision. *Assessment & Evaluation in Higher Education*, pages 1–12.
- Sin, C., Tavares, O., and Amaral, A. (2016b). Student perceptions of the employability of the first degree in portugal. *Education & Training*, 58(9):966–983.
- Spence, M. (1973). Job market signaling. *The Quarterly Journal of Economics*, 87(3):355–374.

- Stiglitz, J. E. (1975). The theory of “screening,” education, and the distribution of income. *The American Economic Review*, 65(3):283–300.
- Teixeira, P., Cerejeira, J., Simões, M., Sá, C., and Portela, M. (2014). Educação, economia e capital humano – notas sobre um paradoxo. In Alexandre, F., Bação, P., Lains, P., Martins, M. M., Portela, M., and Simões, M., editors, *A Economia Portuguesa na União Europeia: 1986-2010*, chapter IV, pages 329–351. Actual Editora.
- Teixeira, P., Rosa, M. J., and Amaral, A. (2008). A broader church? Expansion, access and cost-sharing in portuguese higher education. In *Cost-Sharing and Accessibility in Higher Education: A Fairer Deal?*, pages 241–264. Springer.
- Valletta, R. G. (2016). Recent flattening in the higher education wage premium: Polarization, skill downgrading, or both? In *Education, Skills, and Technical Change: Implications for Future US GDP Growth*. University of Chicago Press.
- van der Velden, R. and Bijlsma, I. (2016). College wage premiums and skills: a cross-country analysis. *Oxford Review of Economic Policy*, 32(4):497–513.
- Walker, I. and Zhu, Y. (2008). The college wage premium and the expansion of higher education in the uk. *The Scandinavian Journal of Economics*, 110(4):695–709.

Appendix

Occupation and Industry reclassification:

During the time span of the analysis both the occupational (in 2010) and the industrial (2007) classification suffered a reclassification. The nature of the change in the classification does not allow for a direct correspondence. To deal with the occupational reclassification we made an effort to make a correspondence, up to a 2-digit aggregation, from the previous to the new classification (*ISCO08*). We were able to convert approximately 96% occupational categories, which correspond to 93% of the total labor force in our sample. For those which we couldn't make a direct correspondence (because they disaggregate even considering only 2-digit categories) we converted the new classification to the previous one (*ISCO88*). So, in practice we are considering 2 distinct classifications at the same time, which might be seen as problematic. However, considering only one of those would make it impossible to keep a consistent classification during all the time span, because some new occupational categories would be created simply due to the reclassification. We also argue that our method should not be seen as problematic since the gross part of the workers is classified according to the newest classification. Hence, in the choice between consistency of the occupational categories and the consistency of the occupational classification, we decided for the first one. Regarding industrial classification, it was not possible to perform a similar exercise because there is no dominant classification. So, we decided to make the correspondence to the *ISIC rev.3* international classification that groups the industries in 18 different levels.

Table 3: Variables considered in the analysis, with the corresponding description and control values

Variable	Description	Control values
<i>pt</i>	<i>part-time worker</i>	<i>pt=0, full-time workers; pt=1, part-time worker</i>
<i>expcut</i>	<i>potential years of experience</i>	<i>expcut=1, less than 2 years; expcut=2, 2 to 4 year; expcut=3, 4 to 6 years; expcut=4, 6 to 8 years; expcut=5, 8 to 10 years</i>
<i>size_emp</i>	<i>number of employees</i>	<i>size_emp=1, less than 10 employees; size_emp=2, 10 to 49 employees; size_emp=3, 50 to 249 employees; size_emp=4, more than 250 employees</i>
<i>local</i>	<i>location of the firm</i>	<i>local=1, North coast; local=2, Center coast; local=3, Lisbon and Tagus Valley; local=4, Inland; local=5, Algarve</i>
<i>natjur</i>	<i>legal nature of the firm</i>	<i>natjur=1, limited liability company; natjur=2, one-person business; natjur=3 single shareholder limited liability company; natjur=4, public limited company; natjur=5, other</i>
<i>ownership</i>	<i>type of the major shareholder</i>	<i>ownership=1, private national shareholder ownership=2, public; ownership=3, private foreign shareholder</i>
<i>real_sales</i>	<i>real sales in 2006's euros (using GDP deflator)</i>	<i>real_sales=1, less than 100th. euros; real_sales=2, 100th to 10M euros; real_sales=3, 10M to 100M euros; real_sales=4, more than 100M euros</i>
<i>occup_detail</i>	<i>2-digit (ISCO08) occupation within industry</i>	<p>Industry categories</p> <p>2 "minning", 3 "food, bev, tob.", 4 "textiles, dressing, leather", 5 "wood, cork, paper, no furniture", 6 "manufacture of non-metallic products", 7 "manufacture of metals products", 8 "manufacturing of furniture, and manuf." 10 "electricity, gas and water supply", 11 "construction", 12 "wholesale and retail trade; repair of veic., motorcycles", 13 "hotels and restaurants", 14 "transport, storage, and communications", 15 "post and telecommunications", 16 "financial intermediation", 17 "real estate, renting and business activ", 19 "education", 20 "health and social work", 21 "other community, social and personal service activities"</p> <p>Occupation categories</p> <p>11 "Legislative power and executive bodies representatives, senior officials of Public Administration, of special-interest organizations, enterprises directors and managers", 12 "Administrative and commercial directors", 13 "Production and specialised services directors", 14 "Hotels, food service, trade and others services directors", 21 "Physical sciences, mathematics, engineering and related techniques specialists", 22 "Health professionals", 23 "Teachers", 24 "Finance, accounting, administrative organization, public and trade relations specialists", 25 "Information and communications technology specialists", 26 "Legal, social, artistic and cultural matters specialists", 31 "Science and engineering associate professionals", 32 "Health technicians and associate professionals", 33 "Financial, business and administration associate professionals", 34 "Legal, social, sport, cultural and related services intermediate level technicians", 35 "Information and communications technicians", 41 "Office clerks, general secretaries and data keyboard clerks", 42 "Customer direct support staff", 43 "Data, accounting, statistical, financial services and material recording operators", 44 "Other clerical support workers", 51 "Personal service workers", 52 "Salespersons", 53 "Personal care and similar workers", 54 "Protective and safety services workers", 61 "Market-oriented farmers and skilled agricultural and farming of animals workers", 62 "Market-oriented skilled forestry, fishery and hunting workers", 63 "Subsistence farmers, fishers, hunters and gatherers", 71 "Building and related trades skilled workers, excluding electricians", 72 "Metal, machinery and related trades skilled workers", 73 "Printing and precision instruments manufacturing skilled workers, jewelers, craftsman and similar workers", 74 "Electrical and electronic trades skilled workers", 75 "Food processing, wood working, garment and other craft and related trades workers", 81 "Stationary plant and machine operators", 82 "Assemblers", 83 "Drivers and mobile plant operators", 91 "Cleaners and helpers", 92 "Agricultural, farming of animals, forestry and fishery not skilled workers", 93 "Mining, construction, manufacturing and transport not skilled workers", 94 "Food preparation assistants", 95 "Street vendors (excluding food) and street, service workers", 96 "Refuse workers and other elementary workers"</p>

Table 4: Results from a Quantile Regression for each year considering as regressors potential years of experience and its square.

Variables	Year 2006				
	Q10	Q25	Q50	Q75	Q90
Graduates	0.3823*** (0.0022)	0.5168*** (0.0037)	0.6203*** (0.0022)	0.6658*** (0.0029)	0.6782*** (0.0033)
Postgraduates	0.3227*** (0.0267)	0.5047*** (0.0427)	0.6803*** (0.0146)	0.8271*** (0.0326)	0.8313*** (0.0267)
Experience	0.0188*** (0.0019)	0.0140*** (0.0020)	0.0132*** (0.0013)	0.0352*** (0.0016)	0.0588*** (0.0037)
Experience squared	0.0000 (0.0001)	0.0012*** (0.0002)	0.0022*** (0.0001)	0.0016*** (0.0001)	0.0008* (0.0003)

Note: the number of observations is 208,792.

Variables	Year 2007				
	Q10	Q25	Q50	Q75	Q90
Graduates	0.3574*** (0.0026)	0.4805*** (0.0028)	0.5884*** (0.0021)	0.6432*** (0.0025)	0.6576*** (0.0037)
Postgraduates	0.3349*** (0.0184)	0.4702*** (0.0226)	0.6524*** (0.0146)	0.7478*** (0.0189)	0.8199*** (0.0272)
Experience	0.0197*** (0.0015)	0.0190*** (0.0022)	0.0126*** (0.0016)	0.0276*** (0.0022)	0.0515*** (0.0026)
Experience squared	-0.0002 (0.0001)	0.0005** (0.0002)	0.0019*** (0.0001)	0.0020*** (0.0002)	0.0013*** (0.0002)

Note: the number of observations is 208,233.

Variables	Year 2008				
	Q10	Q25	Q50	Q75	Q90
Graduates	0.3270*** (0.0018)	0.4633*** (0.0016)	0.5762*** (0.0013)	0.6211*** (0.0015)	0.6249*** (0.0029)
Postgraduates	0.3549*** (0.0162)	0.4900*** (0.0098)	0.6418*** (0.0133)	0.7461*** (0.0161)	0.8057*** (0.0157)
Experience	0.0167*** (0.0023)	0.0183*** (0.0022)	0.0121*** (0.0016)	0.0274*** (0.0012)	0.0535*** (0.0027)
Experience squared	-0.0001 (0.0002)	0.0004 (0.0002)	0.0017*** (0.0001)	0.0020*** (0.0001)	0.0009*** (0.0002)

Note: the number of observations is 232,558.

Continues on next page (...)

Table 4 – (...) continued from previous page

Variables	Year 2009				
	Q10	Q25	Q50	Q75	Q90
Graduates	0.3159*** (0.0022)	0.4548*** (0.0025)	0.5839*** (0.0024)	0.6259*** (0.0025)	0.6258*** (0.0043)
Postgraduates	0.3769*** (0.0138)	0.5136*** (0.0106)	0.6711*** (0.0091)	0.7703*** (0.0127)	0.8231*** (0.0147)
Experience	0.0198*** (0.0014)	0.0185*** (0.0015)	0.0179*** (0.0017)	0.0287*** (0.0019)	0.0517*** (0.0035)
Experience squared	-0.0004*** (0.0001)	0.0002 (0.0001)	0.0009*** (0.0002)	0.0016*** (0.0002)	0.0009** (0.0003)

Note: the number of observations is 223,868.

Variables	Year 2010				
	Q10	Q25	Q50	Q75	Q90
Graduates	0.2745*** (0.0027)	0.4358*** (0.0020)	0.5682*** (0.0017)	0.6227*** (0.0018)	0.5918*** (0.0025)
Postgraduates	0.4037*** (0.0110)	0.5587*** (0.0061)	0.7004*** (0.0064)	0.7865*** (0.0054)	0.8312*** (0.0171)
Experience	0.0223*** (0.0013)	0.0218*** (0.0015)	0.0253*** (0.0016)	0.0237*** (0.0016)	0.0295*** (0.0024)
Experience squared	-0.0008*** (0.0001)	-0.0004** (0.0001)	0.0000 (0.0001)	0.0011*** (0.0001)	0.0024*** (0.0002)

Note: the number of observations is 248,089.

Variables	Year 2011				
	Q10	Q25	Q50	Q75	Q90
Graduates	0.2588*** (0.0023)	0.4092*** (0.0022)	0.5426*** (0.0019)	0.5856*** (0.0020)	0.5633*** (0.0037)
Postgraduates	0.4447*** (0.0101)	0.5966*** (0.0065)	0.7118*** (0.0033)	0.7623*** (0.0070)	0.7987*** (0.0103)
Experience	0.0255*** (0.0015)	0.0305*** (0.0014)	0.0305*** (0.0013)	0.0243*** (0.0021)	0.0338*** (0.0030)
Experience squared	-0.0010*** (0.0001)	-0.0009*** (0.0001)	-0.0003** (0.0001)	0.0012*** (0.0002)	0.0019*** (0.0003)

Note: the number of observations is 185,632.

Continues on next page (...)

Table 4 – (...) continued from previous page

Variables	Year 2012				
	Q10	Q25	Q50	Q75	Q90
Graduate	0.2317*** (0.0022)	0.3747*** (0.0030)	0.5313*** (0.0021)	0.5730*** (0.0021)	0.5383*** (0.0042)
Postgraduate	0.4369*** (0.0064)	0.5995*** (0.0073)	0.7238*** (0.0051)	0.7651*** (0.0058)	0.7889*** (0.0090)
Experience	0.0285*** (0.0011)	0.0368*** (0.0015)	0.0418*** (0.0016)	0.0399*** (0.0018)	0.0350*** (0.0038)
Experience squared	-0.0011*** (0.0001)	-0.0012*** (0.0001)	-0.0011*** (0.0001)	-0.0003 (0.0002)	0.0014*** (0.0003)

Note: the number of observations is 175,691. Source: own computations based on Portugal, MTSS (2006-2012).

Table 5: Overall results from [Ñopo \(2008\)](#) aggregate decomposition considering different sets of controls: controlling for baseline characteristics (on top); after introducing controls for industries (on the middle), and after controlling for occupation within industries (on the bottom).

Year	Baseline controls						
	2006	2007	2008	2009	2010	2011	2012
D - Total wage gap	0.018	0.031	0.037	0.047	0.062	0.073	0.084
D0 - Wage structure effect among matched workers	0.029	0.072	0.075	0.080	0.090	0.097	0.104
DM - Differences in the composition of matched and unmatched postgraduates	-0.002	0.000	-0.001	0.001	0.000	0.000	0.000
DF - Differences in the composition of matched and unmatched graduates	-0.032	-0.006	-0.003	-0.004	-0.001	0.001	0.002
DX - composition effect among matched workers	0.023	-0.036	-0.033	-0.030	-0.028	-0.025	-0.022
% matched postgraduates	98.8	99.3	98.9	99.5	99.7	99.6	99.4
% matched graduates	40.1	72.4	78.5	81.6	92.3	93.9	94.3

Source: own computations based on Portugal, MTSS (2006-2012).

Continued on next page (...)

Table 5 – (...) continued from previous page

<i>Introducing controls for industries</i>							
Year	2006	2007	2008	2009	2010	2011	2012
D - Total wage gap	0.018	0.031	0.037	0.047	0.062	0.073	0.084
D0 - Wage structure effect among matched workers	0.001	0.054	0.055	0.000	0.079	0.088	0.091
DM - Differences in the composition of matched and unmatched postgraduates	-0.011	-0.008	-0.003	-0.005	-0.004	-0.002	-0.003
DF - Differences in the composition of matched and unmatched graduates	-0.018	-0.002	0.003	0.009	0.008	0.011	0.016
DX - composition effect among matched workers	0.047	-0.014	-0.019	-0.028	-0.021	-0.024	-0.019
% matched postgraduates	94.7	94.6	93.6	94.1	96.4	95.5	96
% matched graduates	14.3	40.3	48.2	54.6	71.9	75.6	76.7

Source: own computations based on Portugal, MTSS (2006-2012).

<i>Introducing controls for occupations within industries</i>							
Year	2006	2007	2008	2009	2010	2011	2012
D - Total wage gap	0.018	0.031	0.037	0.047	0.062	0.073	0.084
D0 - Wage structure effect among matched workers	-0.001	0.060	0.046	0.055	0.050	0.046	0.051
DM - Differences in the composition of matched and unmatched postgraduates	-0.022	-0.017	-0.007	-0.013	-0.010	-0.008	-0.010
DF - Differences in the composition of matched and unmatched graduates	0.031	0.025	0.035	0.049	0.038	0.041	0.052
DX - composition effect among matched workers	0.010	-0.037	-0.036	-0.044	-0.016	-0.005	-0.009
% matched postgraduates	75.9	73.2	75.1	74.6	80.4	78.9	79.4
% matched graduates	4.3	15.5	21.2	24.7	36	39.9	45.5

Source: own computations based on Portugal, MTSS (2006-2012).

Table 6: *O*NET* task measures from *O*NET Work Activities* and *Work Context* importance scales used to construct task categories.

Classification	Task
Non-Routine Cognitive	Analytical Analyzing Data or Information Thinking Creatively Interpreting the Meaning of Information for Others
	Interpersonal Coaching and Developing Others Guiding, Directing, and Motivating Subordinates Establishing and Maintaining Interpersonal Relationships
Routine Cognitive	Importance of Being Exact or Accurate Importance of Repeating Same Tasks Structured versus Unstructured Work (reverse)
Routine Manual	Pace Determined by Speed of Equipment Spend Time Making Repetitive Motions Controlling Machines and Processes
Non-Routine Manual	Spatial Orientation Manual Dexterity Operating Vehicles, Mechanized Devices, or Equipment Spend Time Using Your Hands to Handle, Control, or Feel Objects, Tools, or Controls