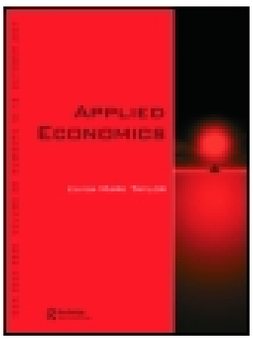

Applied Economics

ISSN: 0003-6846 (Print) 1466-4283 (Online) Journal homepage: https://www.tandfonline.com/loi/raec20

The wage effects of training in Portugal: differences across skill groups, genders, sectors and training types

Santiago Budría & Pedro Telhado Pereira

To cite this article: Santiago Budría & Pedro Telhado Pereira (2007) The wage effects of training in Portugal: differences across skill groups, genders, sectors and training types, Applied Economics, 39:6, 787-807, DOI: 10.1080/00036840500447757

To link to this article: https://doi.org/10.1080/00036840500447757

Applied Economics, 2007, **39**, 787–807

Routledge
Taylor & Francis Group

The wage effects of training in Portugal: differences across skill groups, genders, sectors and training types

Santiago Budría[a] and Pedro Telhado Pereira[b,*]

[a]*University of Madeira and CEEAplA, Portugal*
[b]*University of Madeira, CEPR, IZA and CEEAplA, Portugal*

This article investigates the determinants and wage effects of training in Portugal. In a first stage, we show that there are considerable differences in training participation across groups of workers, with elder and low educated individuals participating substantially less. In a second stage, we show that training has a positive and significant impact on wages. The estimated wage return is about 30% for men and 38% for women. Discriminating between levels of education and working experience and the public and private sector reveals important differences across categories of workers. We find that women, low educated workers and workers with long working experience earn larger returns from training. The average effect of training is similar in the private sector and the public sector. However, differences across experience groups are larger in the private sector, while differences across education groups are larger in the public sector. We use three alternative classifications of training activities and find that training in the firm, training aimed to improve skills needed at the current job and training with duration less than a year are associated to larger wage gains.

I. Introduction and Executive Summary

Education is a scarce and valuable good in the Portuguese labour market. Among EU State Members, Portugal is the country with the lowest schooling levels, while returns to formal education are highest (e.g. Vieira, 1999; Pereira and Martins, 2002, *inter alia*). However, little is still known about the wage effects of training. As stated by Lynch and Black (1998, p. 65), '... the traditional schooling system is not an option that many incumbent workers or firms use when facing the need to upgrade their skills. As a result, the provision (or nonprovision) of employer-provided training is a key factor determining how much and what kind of skill upgrading occurs within firms and across workers' (quoted in Asplund, 2005). In this article, we explore the extent, determinants and wage impact of various forms of training across workers with different characteristics.

In Portugal, participation in training is rather low as compared to countries in the Organization for Economic Cooperation and Development (OECD). This fact raises efficiency concerns. Skills obsolescence may lead to substantial costs in terms of labour productivity, skill deterioration and unemployment. This might be of particular importance in an economy with already low labour productivity that, moreover,

*Corresponding author. E-mail: ppereira@uma.pt

is currently experiencing difficulties in converging to OECD levels after a decade of convergence (EUROSTAT, 2004).

In the past few years, training activities financed by the European Union have been stepped up. For the period 1994–1999, the budget of the European Social Fund (ESF) allocated to programmes of human resources and promotion of employment was ECU 2178 million for Portugal. It was expected that, over those years, ESF assistance would allow the training of 350 000 persons per year. A new programming period started in 2000 and will end in 2006. For that period, the ESF will transfer new funds to co-finance, together with national public funds, mainstream training programmes.[1] The committed budget was Euro 1548 million, which represents the second highest per capita use of this kind of fund among European countries. As regards implementation, however, execution rates are being rather low (CGQCA, 2004). This fact is disturbing, as it indicates that an important opportunity to upgrade the skills of the Portuguese workforce is being lost.

Training participation raises also equity concerns. More educated workers tend to receive more training (Oosterbeek, 1996; OECD, 1999, 2003a; Ok and Tergeist, 2003; Peraita, 2005). At the same time, the returns to formal education are remarkably high in Portugal and the wage gap between high and low skilled workers is substantial. Thus, if training increases wages and is concentrated towards individuals with more favourable labour market characteristics, lower training participation among specific groups of workers may deteriorate the labour market position of already disadvantaged individuals. Moreover, different forms of training may be associated to different returns, which drives an additional wedge between groups of workers that typically participate in different training schemes. Further, individuals who differ in gender, education and professional background may obtain different benefits from training activities, thus warning policy makers that equality of provision does not assure equality of outcome.

Several studies have used international comparable data to analyze the determinants and effects of training participation in different countries (OECD, 1999, 2003a; Brunello, 2004; Arulampalam *et al*., 2003; Ok and Tergeist, 2003). Due to the lack of appropriate data, these studies report typically little evidence on the Portuguese case. At the national level, Saraiva (1999) explores training participation and its impact on wages. His results suggest that training activities that take place in the firm raise wages. As opposite, programmes provided by other institutions such as training centres do not increase wages significantly. Hartog *et al*. (2000) use the European Community Household Panel to explore earnings differentials between participants and nonparticipants in training programmes. They find that differences are significant only for some types of vocational training.

In this article, we use data from the Portuguese Labour Force Survey to explore the extent and determinants of training participation. With such analysis we intend to identify those groups of workers that seldom get trained. To our eyes, they constitute a critical group for policies aimed to increase the overall training participation. In a second stage, we explore the wage effects of training. Our estimates indicate that training raises wages substantially.[2]

The question of whether the wage effects of training vary with the characteristics of the trained worker has received little attention in the literature. This is unfortunate. By differentiating between categories of workers we can obtain valuable information to assess policy choices related to skill formation, such as whether to encourage an overall increase in training levels or to attempt to redirect training investments toward groups in the workforce whose expected returns are larger. This article takes a step towards filling this gap and differentiates simultaneously between workers that differ in education background and working experience, men and women and the private and public sector. We find that workers with long experience and low education levels earn more from training activities. Therefore, policies oriented to increase training participation among individuals with such characteristics are expected, *ceteris paribus*, to reduce wage inequality.

We also differentiate between types of training. In the literature, there is a confusing multitude of definitions of training activities, which mitigates the comparisons across countries and within single countries. In this article, we exploit three alternative classifications: (i) internal vs. external training, (ii) current skills versus future skills training and (iii) long duration vs. short duration training. We find that internal, current skills and short duration training are associated to larger wage gains.

[1] The POEFDS (Portuguese Operational Program of Employment, Training and Social Development) has been recently launched to translate the European Union employment strategy into action. It operates through five sub-programmes: Initial training, Continuous training, Public administration, Employment policy, and Social development.

[2] Another branch of the literature focuses on the productivity rather than wage effects of training. See, for example, Kazamaki-Ottersten *et al*. (1999) for Sweden and Dearden *et al*. (2000) for the UK.

The structure of the article is as follows. Section II presents the data set and the classifications of training that we use throughout the article. Section III offers a background discussion to motivate the choice of the model and its functional form. We follow two alternative approaches: simple Ordinary Least Squares (OLS) estimation and a treatment effects model that controls for the endogeneity of training. Section IV presents the empirical results. In a first stage, we draw on the logit and multinomial logit models to identify patterns of unequal training provision across different worker groups. In a second stage, the results on the wage impact of training are presented. Section V presents the concluding remarks. The article contains additionally three appendices. Appendix A contains the training questions of the Portuguese Labour Force Survey. Appendix B checks whether the independence from irrelvant alternatives (IIA) assumption holds in the multinomial logit models. Appendix C assesses the robustness of our results to changes in the participation equation.

II. The Data

The Portuguese Labour Force Survey (henceforth, IE, *Inquerito ao Emprego*) is a quarterly survey of a representative sample of households in Portugal. Its sample size is about 45 000 individuals and it has a rotating structure in which 1/6 of the sample is dropped randomly in each quarter. Our analysis uses pooled data from 1998 to 2000.

The IE asks individuals about their monthly net wage, age, education level, time when the first contract was obtained, sector of employment, type of contract, professional activity, hours worked, tenure and region, among other variables. The key question about training is

- 'Apart from formal schooling, have you completed any training scheme as a formation for a professional activity?'

Most international surveys explicitly ask for training participation during the last months and disregard training experiences that took place in the past. As opposite, the above question does not refer to a particular time period. Thus, individuals in our sample can report on a training activity that took place years ago. Moreover, we know the date when the activity was finished.

As a shortcoming, the IE does not offer the possibility of reporting more than one training event. Therefore, we assume that workers report the information regarding the most important event in which they have participated.

Trained workers are asked to classify the activities according to three different criteria. We know where the training activity took place, the purpose of the activity and whether or not it had a duration longer than 1 year.[3] The precise form of the questions is given in Appendix A. This information allows us to compare the wage increases associated to different types of training.

Surprisingly, the IE misses the information about the training events of individuals with the lowest education level (<4 years of primary education). This is unfortunate and forces us to restrict our sample to workers with the following highest qualifications: between 4 and 6 years of primary education, 9 years of primary education – which in Portugal corresponds to compulsory education –, secondary and tertiary education.[4]

As a second restriction, we leave out from the analysis workers who after having finished a training activity switched to a different job. The focus of our study is, therefore, the wage impact at the current job of training that took place after the job was obtained, rather than the impact of training that took place before the worker switched to his/her current job.[5] We further restrict our analysis to individuals who, at the time of the survey, were aged between 16 and 60, wage earners during the week of the interview, worked more than 15 hours a week and were not employed in agricultural, fishing or extracting activities. Hence, we exclude self-employed individuals,

[3] An additional classification regards the content of the training activities. There are more than 50 branches, such as health and life sciences, physics, chemistry, engineering, mathematics, and agriculture, among others. Due to the number of candidate answers, we do not exploit this classification.

[4] Workers with 4 years or less education represent only 4.6% of the Portuguese workforce. Thus, restricting the sample to workers with more than 4 years of education is not expected to affect the representativeness of our results by much.

[5] Returns to training may differ importantly between workers who switch to a different job and workers who stay at the same job after having finished training. Loewenstein and Spletzer (1999), Booth and Bryan (2002) and Gerfin (2004) find that workers who stay in the training company tend to reap lower gains than those who move to another firm. More bargaining power, realized gains and promotions are some candidate explanations for this observation. In this article, we disregard moving workers. The reason is that our data set does not provide us with good instruments to account for training participation of workers that switched to a different job. The only information available regards the individual's current job. Therefore, variables observed at the time of the survey such as activity, tenure, firm size, sector and the like can hardly account for training participation in a former job.

as well as those whose main activity status is paid apprenticeship or training, unpaid family worker, out of the labour force and unemployed.

The previous exclusions leave us with a final sample of 27 161 individuals. Table 1 offers descriptive statistics of the raw data. Workers who received some training earn on average about 40% more than workers who did not receive any training at all. Trained workers tend to work in the public sector, have longer tenure, work in average-sized firms and be more educated, relative to untrained workers. As shown in the last row, only 5.2% of the sample population has ever participated in some training activity. This rate is rather low by international standards.[6]

Table 1. Means of selected variables

Variables	Untrained workers	Trained workers
Log hourly wage	1.0	1.4
Log hours	3.7	3.6
Experience	19.0	19.1
Proportions (%)		
Female	45.4	45.2
Part-time	3.3	2.2
Public	23.7	45.8
Cohort		
Age < 30 years	32.9	27.1
30 years ≤ age ≤ 44 years	41.7	46.1
Age > 44 years	25.5	26.8
Tenure		
Tenure < 6 years	45.6	26.8
6 years ≤ tenure ≤ 25 years	46.3	60.7
Tenure > 25 years	8.2	12.5
Firm size		
Firm size < 20 employees	26.9	25.4
20 ≤ firm size ≤ 500 employees	9.7	21.8
Firm size > 500 employees	63.5	52.8
Education		
4–6 years	63.2	29.3
Primary	15.8	26.6
Secondary	11.5	27.7
Tertiary	9.4	16.4
Activity sector		
S1. Food, drinks and tobacco	3.6	1.9
S2. Retail	10.6	3.9
S3. Wood and paper	3.2	2.4
S4. Chemical and mineral products	2.9	2.6
S5. Metallurgy, equipment and vehicles	7.5	5.7
S6. Construction	12.3	2.5
S7. Commerce	13.2	10.6
S8. Restaurants	5.9	4.4
S9. Transports & telecommunications	4.5	6.6
S10. Insurance and finance	2.1	6.3
S11. Public administration	10.0	20.6
S12. Education	8.6	12.5
S13. Health	7.1	10.9
S14. Culture, sport and leisure	2.4	3.9
S15. Others	6.2	5.4
Sample population	94.8	5.2

Training location

Respondents are asked to specify where the training activity took place, using five mutually exclusive categories: (i) college or university, (ii) firm, (iii) training centre, (iv) vocational school and (v) other. We use this information to differentiate between *internal training* and *external training*, depending on whether the training activity took place in the firm or in some other institution.

Panel A of Table 2 reports the proportions of each event. A large fraction of workers have been trained at firms (internally), with 45.2% of men and 37.4% of women reporting this event. Professional schools and centres of vocational training account for some 15% of the events each, while training at a college or university has an incidence of $<5\%$. Finally, the residual category 'other' represents some 25% of the total activities.

Training purpose

The purpose of the training activity must be indicated using the following categories: (i) to improve or update skills, (ii) within a program of continuous training, (iii) to switch to another job or duties, (iv) to help get started with a first job, (v) within a program of initial training, (vi) for personal interest and (vii) other.

As Panel B of Table 2 shows, some 60% of the events are viewed as improving or updating skills. Training for personal interest and continuous training account, respectively, for 11 and 7% of the total activities. Training to switch to another job or duties represents an additional 12% for men and 6% for women. Finally, the lowest shares correspond to training to get started with a first job, initial training and other purposes.

We have regrouped the previous answers into two categories. A first category, called *current skills training*, includes those activities aimed to update or

[6] Arulampalam *et al*. (2003) report that training incidence across European countries is highest in Britain, Denmark, and Finland, with participation rates above 40%, and lowest in Ireland, Italy, and Spain, with participation rates below 10%. Unlike in our data, these rates refer to training activities that took place during the year prior to the survey.

Table 2. Training incidence by categories (%)

			Men	Women
(A) *Training Location*				
College or university			3.2	4.1
Firm			45.2	37.4
Professional school			14.6	15.4
Centre of vocational training			12.7	14.0
Other			24.4	29.2
(B) *Training Purpose*				
To help get started with a first job			5.0	6.8
To improve or update skills			57.5	60.5
To switch to another job or duties			12.1	6.2
Within a program of promotion of employment: initial training			2.5	4.5
Within a program of promotion of employment: continuous training			7.2	7.1
For personal interest			10.6	11.3
Other			5.2	3.6
(C) *Training Duration*				
Vocational formation of tertiary level			4.7	6.3
Specific professional formation with one year or longer duration			20.8	20.8
Any training with less than one year duration			43.8	40.7
Other			30.7	32.2
(D) *Detailed decomposition of training*				
Long duration	Current skills	Internal	4.5	5.1
		External	10.7	14.0
	Future skills	Internal	1.0	1.1
		External	9.3	6.9
Short duration	Current skills	Internal	35.0	29.2
		External	22.0	30.6
	Future skills	Internal	4.7	2.0
		External	12.8	11.1

improve skills that are needed in the current job. It includes categories (i), (ii), (iv) and (v) and represents some 75% of the total activities. In a second category we have included those activities more aimed at improving skills for a future job. Though not explicitly stated by the respondent, training for personal interest is likely to develop skills that can be used in the future. Thus, we assume that (vi), together with (iii) and the residual category (vii), represent *future skills training*.

Training duration

The IE allows us to split the training activities into two categories: *long duration training* (one year or more), which comprises vocational formation of tertiary level and specific professional formation with 1 year or longer duration and *short duration training* (<1 year), which comprises any training with less than one year duration and other forms of training.[7] Panel C of Table 2

[7] In Portugal, the duration of vocational formation of tertiary level is one year or longer. 'Other forms of training' may include informal training such as reading, participation in lectures, courses, seminars, quality circles and specific company training. Though not stated explicitly, the length of these activities is supposed to be much shorter than a year.

shows that nearly 75% of the events have short duration.

In Panel D of Table 2 we report cross-tabulations of location and purpose for long and short duration training. Current skills training tends to have short duration and, when it has long duration, it tends to be external. Future skills training tends to have longer duration and is basically external.

III. The Model

In order to explain earnings, we use schooling levels, experience and experience squared as the standard Mincer terms, a set of explanatory variables to capture the observable individual heterogeneity and a dummy variable for training participation.

We suspect that differently endowed individuals obtain different gains from training. To detect potential differences, we extend the model by interacting the training dummy with working experience and schooling levels. The resulting OLS equation is

$$\log w = \beta X + \gamma_1 ED + \gamma_2 EXP + \mu T + \theta_1 T \times ED + \theta_2 T \times EXP + e \quad (1)$$

where w is the hourly wage, ED and EXP are column vectors of dummies with the education and experience levels, T is a dummy for training participation, X represents other variables assumed to affect earnings, γ_i and θ_i are row vectors of coefficients, μ measures the impact of training on wages and $e \sim \mathrm{N}(0, \sigma^2)$ is the error term.

Training participants are not necessarily a random group. They may be selected (or self-selected) into training because of unobservable characteristics such as commitment, motivation and flexibility. If this is the case, the profitability of the training activity is likely to be related to the probability of participation and, thus, a naive OLS estimation of μ is expected to be biased. To take account of the selectivity problem, we model a participation equation as

$$T = \beta H + u \quad (2)$$

where H is a vector of individual and workplace characteristics and u is an error term. In the Section Determinants of training participation, we describe the variables included in H. Assuming that workers participate in training only if the benefit is positive, we have

$$\begin{aligned} T &= 1 \quad \text{if } T^* > 0 \\ T &= 0 \quad \text{if } T^* \leq 0 \end{aligned} \quad (3)$$

where T^* is the estimated benefit of participation. Therefore, a model that controls for selection bias is

$$\log w = \beta X + \gamma_1 ED + \gamma_2 EXP + \mu T + \theta_1 T \times ED + \theta_2 T \times EXP + \lambda \hat{T}^* + e \quad (4)$$

where $\hat{T}^*$ is the typical selection correction. To estimate the model, we adopt a maximum-likelihood method, in which Equations 2 and 4 are estimated simultaneously. When different types of training are included in the regression, μ and λ are row vectors, T is a column vector of dummies for each type of training and $\hat{T}^*$ is a column vector with the selection corrections.

IV. Empirical Results

This section investigates the determinants and wage effects of training. All the regressions are performed for men and women separately. Standard errors are corrected for heterocedasticity.

Determinants of training participation

We regress training participation on a set of socio-economic characteristics. As explanatory variables we include in vector H education, age, private sector or public sector, full-time or part-time contract, tenure, firm size, whether the worker holds a second job, whether the worker has ever resided in a foreign country and a set of 15 dummies for the activity sectors. We also include controls for Portuguese region and quarter.

Table 3 presents the logit estimates on training participation. The estimated coefficients are the odds ratios. For the reference worker, they represent the factor by which the probability of selection into training increases for a marginal increase in a continuous variable and for a discrete change in the probability for dummy variables.

In line with international evidence, we find that training goes mainly to more educated individuals. Workers with more than primary education are at least 3 times more likely to participate in training than workers with less than primary education. This finding matches *a priori* expectations. As Peraita (2005, p. 1894) puts it, 'employees who have already shown an aptitude to learn new skills by having higher levels of educational attainment are more likely to participate in training provided by their employers'. According to Oosterbeek (1996), more educated individuals not only are more likely to be

Table 3. Selection into training

	Men		Women	
	Odd ratio	*z*-ratio	Odd ratio	*z*-ratio
Primary	3.065***	11.23	3.317***	9.28
Secondary or higher	3.712***	12.55	3.373***	9.91
30 years $\leq$ age $\leq$ 44 years	0.717***	−2.91	0.669***	−3.21
age > 44 years	0.518***	−4.52	0.554***	−3.54
Public sector	1.485***	2.88	1.248	1.50
Part-time	1.182	0.51	0.927	−0.33
Tenure	1.117***	7.47	1.115***	5.98
Tenure squared	0.998***	−4.30	0.997***	−3.83
firm size < 20 employees	1.023	0.23	1.124	1.16
20 $\leq$ firm size $\leq$ 500 employees	2.770***	9.85	2.604***	8.44
Second job	1.678***	4.29	2.002***	3.87
Resided abroad	1.159	−1.45	1.153	−1.33
Food, drinks and tobacco	0.578*	−1.94	0.706	−1.03
Retail	0.772	−1.05	0.556**	−2.36
Wood and paper	0.728	−1.32	1.251	0.69
Chemical products	0.873	−0.59	0.931	−0.19
Metallurgy	0.929	−0.43	1.051	0.19
Construction	0.369***	−4.84	0.409	−1.21
Restaurants	1.222	0.86	1.454*	1.73
Transports	1.171	0.96	1.436	1.36
Insurance, finance	1.531**	2.30	2.228***	3.25
Public administration	1.140	0.77	1.463*	1.76
Education	0.722	−1.43	0.819	−0.92
Health	1.031	0.14	1.430**	1.87
Culture, sport, leisure	1.361	1.17	2.291***	3.61
Others	1.454*	1.89	0.911	−0.43
Average probability	0.0515		0.0512	
Pseudo *R*-squared	0.1512		0.1267	
No. of observations	15,016		12,145	

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level.
The reference individual is a worker with less than primary education, aged <30 years, who has not a second job, has always resided in Portugal, is working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

selected in the firm's training programs, but also have a higher probability of being hired by a firm that provides training.

Older individuals tend to receive less training. The likelihood of training participation is about one-third lower for workers aged between 30 and 44 years and about one half lower for workers aged above 44 years. The negative association between age and training participation is consistent with the human capital theory that predicts that younger workers are more likely to train than older workers, since the period over which they have returns is longer. This result contradicts the concept of *lifelong learning*, which suggests that, in order to prevent that skills become obsolete, continuing training is observed across all age groups.

The impact of the remaining variables is as follows. Having a second job is associated to higher training participation. This may be due to the fact that individuals holding a second job are more motivated or committed to their profession and, accordingly, they are more likely to make an effort to develop competencies on the job and improve performance. The probability of training varies significantly with tenure in the job and in a nonlinear way. Workers in average-sized firms and men in the public sector are more prone to get training. Part-timers are as likely to get training as workers with full-time contracts. Men in insurance and finance and women in culture, sports, leisure, insurance, finance, health, restaurants and public administration are more likely to be trained. As opposite, women in the retail and men in the construction, food, drinks and tobacco sectors are less likely to be trained.

Tables 4 and 5 focus on the selection into different types of training. For each alternative classification,

Table 4. Selection into various forms of training – Men

	Internal		External		Current skills		Future skills		Long duration		Short duration	
	RRR	z	RRR	z	RRR	z	RRR	z	RRR	z	RRR	z
Primary	2.680***	6.97	3.370***	8.95	3.163***	10.01	2.764***	5.49	3.178***	5.42	3.032***	10.00
Secondary or higher	3.247***	8.08	4.220***	10.05	3.862***	11.03	3.397***	6.70	5.527***	8.29	3.262***	9.92
30 years $\leq$ age $\leq$ 44 years	1.327	1.37	0.546***	−4.33	0.840	−1.29	0.507***	−3.34	0.657**	−2.08	0.750**	−2.12
age > 44 years	1.104	0.41	0.323***	−5.78	0.672**	−2.34	0.277***	−4.90	0.324***	−4.04	0.602***	−3.01
Public sector	1.840***	3.65	1.100	0.47	1.615***	3.10	1.140	0.54	1.065	0.24	1.631***	3.21
Part-time	1.477	0.63	1.013	0.03	0.921	−0.18	1.670	1.10	1.140	0.26	1.169	0.37
Tenure	1.139***	5.85	1.106***	4.90	1.109***	6.25	1.163***	4.64	1.093***	3.08	1.128***	7.03
Tenure squared	0.997***	−3.62	0.998***	−2.81	0.998***	−3.35	0.996***	−3.18	0.998	−1.30	0.997***	−4.40
firm size < 20 employees	0.635***	−2.86	1.463***	2.99	1.020	0.18	1.058	0.31	1.058	0.29	1.024	0.21
20 $\leq$ firm size $\leq$ 500 employees	2.846***	7.35	2.671***	7.04	2.727***	8.51	2.783***	5.60	2.050***	3.61	3.009***	9.54
Second job	1.349*	1.71	1.958***	4.39	1.650***	3.65	1.747***	2.67	2.165***	3.99	1.494***	2.81
Resided abroad	1.364*	−1.80	1.111	−0.50	1.153	−0.99	1.287	−1.26	1.200	−0.88	1.183	−1.20
Food, drinks and tobacco	0.406**	−2.13	0.792	−0.63	0.538*	−1.94	0.738	−0.55	0.874	−0.26	0.502**	−2.10
Retail	0.555	−1.44	1.034	0.11	0.671	−1.32	1.118	0.27	0.975	−0.06	0.721	−1.13
Wood and paper	0.626	−1.30	0.852	−0.50	0.754	−1.04	0.683	−0.76	0.657	−0.85	0.757	−1.03
Chemical products	1.074	0.24	0.695	−1.03	0.868	−0.54	0.974	−0.06	0.494	−1.32	1.034	0.13
Metallurgy	0.873	−0.54	1.031	0.14	1.030	0.16	0.728	−0.86	0.827	−0.56	0.987	−0.06
Construction	0.119***	−4.49	0.613**	−2.04	0.345***	−4.41	0.466**	−1.98	0.680	−1.11	0.279***	−4.93
Restaurants	0.653	−1.04	1.783**	2.06	0.941	−0.21	2.235**	2.03	2.166*	1.94	0.941	−0.21
Transports	1.349	1.44	0.701	−1.23	1.146	0.74	1.131	0.35	0.526	−1.47	1.333	1.61
Insurance, finance	1.899***	2.71	1.151	0.50	1.428*	1.73	1.867*	1.68	1.268	0.66	1.621**	2.30
Public administration	0.555**	−2.56	2.315***	3.46	0.842	−0.86	2.643***	3.06	1.532	1.25	1.038	0.20
Education	0.307***	−3.51	1.538	1.47	0.579**	−2.05	1.455	0.98	1.405	0.85	0.567**	−2.15
Health	0.566*	−1.74	1.891**	2.18	0.701	−1.30	2.618**	2.56	2.519***	2.58	0.662	−1.41
Culture, sport, leisure	0.808	−0.51	2.103**	2.29	1.125	0.37	2.367*	1.95	1.695	1.10	1.277	0.81
Others	1.253	0.82	1.565	1.61	1.346	1.34	1.794	1.50	1.265	0.61	1.484*	1.77
Average probability	0.0234		0.0281		0.0372		0.0143		0.0132		0.0384	
Pseudo R-squared	0.1598				0.1401				0.1456			
No. of observations	15,016											

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level.
The reference individual is a worker with less than primary education, aged < 30 years, who has not a second job, has always resided in Portugal, is working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

Table 5. Selection into various forms of training – Women

	Internal		External		Current skills		Future skills		Long duration		Short duration	
	RRR	z	RRR	z	RRR	z	RRR	z	RRR	z	RRR	z
Primary	2.870***	5.41	3.603***	7.63	3.821***	9.29	1.853**	2.18	3.451***	4.14	3.319***	8.44
Secondary or higher	2.364***	4.58	4.168***	9.03	3.434***	8.86	3.238***	4.76	6.558***	7.27	2.692***	7.02
30 years $\leq$ age $\leq$ 44 years	0.927	−0.34	0.576***	−3.68	0.736**	−2.15	0.487***	−2.90	0.559**	−2.44	0.724**	−2.22
age > 44 years	0.849	−0.59	0.463***	−3.76	0.627**	−2.44	0.385***	−3.11	0.375***	−3.09	0.654**	−2.22
Public sector	1.542*	1.83	1.105	0.56	1.412**	2.14	0.821	−0.62	0.980	−0.08	1.374*	1.81
Part-time	0.385	−1.58	1.141	0.53	0.594*	−1.65	2.003**	2.00	0.608	−0.96	1.021	0.08
Tenure	1.121***	3.65	1.113***	4.83	1.114***	5.13	1.115***	3.23	1.069**	2.01	1.134***	5.92
Tenure squared	0.997**	−2.37	0.997***	−3.13	0.997***	−3.36	0.997*	−1.89	0.999	−0.50	0.997***	−4.20
firm size < 20 employees	0.839	−1.01	1.329**	2.35	1.114	0.95	1.186	0.82	0.800	−1.13	1.273**	2.04
20 $\leq$ firm size $\leq$ 500 employees	3.262***	7.05	2.250***	5.61	2.698***	8.02	2.282***	3.36	1.962***	3.34	2.954***	8.29
Second job	1.883**	2.01	2.059***	3.43	1.694**	2.42	2.943***	3.68	2.996***	3.99	1.576**	2.01
Resided abroad	1.499**	−2.02	1.030	−0.19	1.142	−0.94	1.304	−1.06	1.030	−0.13	1.239	−1.49
Food, drinks and tobacco	0.521	−1.21	0.829	−0.44	0.822	−0.55	0.280	−1.21	0.721	−0.43	0.678	−1.04
Retail	0.644	−1.11	0.534**	−1.98	0.567**	−2.06	0.506	−1.26	0.638	−0.87	0.547**	−2.14
Wood and paper	0.584	−0.69	1.662	1.41	0.966	−0.08	2.186	1.45	1.757	0.96	1.142	0.34
Chemical products	1.776	1.17	0.578	−1.01	0.867	−0.34	1.184	0.26	–	–	1.304	0.71
Metallurgy	1.773	1.43	0.737	−0.84	1.318	0.99	0.201	−1.53	1.173	0.32	1.041	0.13
Construction	–	–	0.578	−0.74	0.258	−1.32	0.899	−0.10	–	–	0.545	−0.82
Restaurants	1.137	0.34	1.626*	1.87	1.355	1.21	1.750	1.37	2.703**	2.44	1.187	0.68
Transports	2.030*	1.90	0.972	−0.07	1.584	1.62	0.665	−0.53	1.300	0.48	1.48	1.34
Insurance, finance	3.44***	3.41	1.547	1.34	2.32***	3.12	1.597	0.89	2.225*	1.72	2.203***	2.85
Public administration	1.269	0.68	1.552*	1.65	1.310	1.13	2.082*	1.65	2.308**	2.12	1.254	0.90
Education	0.601	−1.43	0.965	−0.13	0.839	−0.73	0.639	−0.94	1.170	0.40	0.723	−1.30
Health	0.879	−0.39	1.828***	2.65	1.187	0.78	2.403**	2.42	2.613***	2.88	1.126	0.51
Culture, sport, leisure	1.393	0.76	2.784***	3.90	2.234***	3.04	2.381**	1.96	3.000**	2.51	2.114***	2.83
Others	0.754	−0.76	0.999	−0.00	0.992	−0.03	0.661	−0.89	0.7503	−0.59	0.938	−0.27
Average Probability	0.0193		0.0316		0.0404		0.0108		0.0139		0.0373	
Pseudo R-squared	0.1297				0.1234				0.1268			
No. of observations	12 145											

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level.
The reference individual is a worker with less than primary education, aged < 30 years, who has not a second job, has always resided in Portugal, is working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.
In some cases, women in the activity sectors 'construction' and 'chemical products' were dropped from the estimating sub-sample, for the incidence of one of the training categories in those sectors was exactly zero.

we present the results of multinomial logits where the dependent variable is a 3-point categorical variable indicating the worker's allocation to training events, where the reference category is *no training*. The estimated coefficients are relative risk ratios (RRR), which can be interpreted as odds ratios.

We find that education, age, tenure, having a second job and working in average-sized firms explain significantly male and female participation in most training types. The positive effect of education and the negative effect of age is particularly evident in the case of long duration training. It is worth noting that age does not influence the likelihood of internal training, while it is highly significant for the remaining categories. This pattern suggests that training in the firm is more aimed to prevent skills from becoming obsolete and, consequently, it is observed across all age groups.

For both genders, public sector is positively associated to internal, current skills and short duration training. Having a part-time contract is nonsignificant among men, while among women it is positively associated to future skills training and negatively associated to current skills training. Workers who have resided in a foreign country are more likely to have participated in internal training. Finally, looking at the average probability of participation reported in the bottom part of Tables 4 and 5, one finds that women tend to enrol into external and current skills training more than men.

The estimation of a multinomial logit model assumes that the exclusion of one of the outcomes in the dependent variable does not affect the RRR of the regressors in the remaining categories. This assumption is known as the independence from irrelevant alternatives (IIA) and, if it does not hold, the parameter estimates may be inconsistent. In Appendix B, we have used the Hausman test to check whether or not the IIA assumption holds. The chi-squared statistics of Table 1B show that for all training classifications and for both genders the null hypothesis is not rejected, i.e. there is no evidence that the IIA assumption has been violated.

Selection into training

To control for the potential endogeneity of training, we draw on a treatment effects model. As long as the errors of the participation equation are uncorrelated with the errors of the wage equation, the estimated coefficients are no longer exposed to selectivity bias.[8] This approach requires that some variables in the participation equation – which are supposed to affect training but not wages – are omitted from the wage equation. We use as excluded instruments two dummy variables: one for having a second job, one for having resided abroad. The motivation is as follows. Holding a second job may proxy the individual's degree of commitment and motivation. If more motivated individuals are more likely to enrol into training activities, then such variable should account for training participation. In a related article, Harris (1999) analyses the determinants of training participation in the UK and interestingly finds that having a second job is positively associated with training participation. Similarly, individuals who have ever resided in a foreign country may be more flexible and ready to upgrade their skills. Moreover, once abroad, they may have benefited from greater facilities in the access to training.

As shown in Tables 4 and 5, *having a second job* is highly significant among men and women for all types of training. As opposite, *resided abroad* is significant only in the case of internal training and, therefore, this instrument helps only partially to identify workers with training events.

In Appendix C, we perform several well-known tests to assess the quality of the excluded instruments. We find that our exclusion restrictions pass the Sargan's orthogonality test and the Bound *et al.* (1995) validity test.[9] We also investigated the effects of adding two additional exclusion restrictions: *marital status* (single or not) and *looking for an extra job*.[10] In computations not reported here, these variables were found to be significant to account for some training events. However, the orthogonality test rejected their inclusion in the participation equation.

Wage effects

Our wage equations control for school highest qualification, experience (and squared), tenure,

[8] However, there is no guarantee that just by addressing the endogeneity of training our estimates will be less biased if other forms of self-selection are present.

[9] It may be argued that 'having a second job' is a bad instrument, for it is likely to be correlated with wages. This would be the case if (i) the wage variable includes wages from a second job, and (ii) individuals with lower wages tend to look for a second job in order to raise monthly earnings. As regards (i), our wage variable refers to the main working activity and, therefore, does not include earnings from a second job. We also checked hypothesis (ii), and found in calculations not reported here that 'having a second job' was not significant in the wage regression.

[10] The IE asks individuals whether or not they are looking for an extra job, regardless of the number of jobs they already have.

Table 6. Wage returns to training – OLS and Treatment effects model

	Men				Women			
	OLS		Treatment effects		OLS		Treatment effects	
	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio
Training	0.127***	9.46	0.303***	4.29	0.084***	6.29	0.375***	6.35
Primary	0.196***	24.38	0.187***	20.55	0.210***	24.38	0.193***	20.38
Secondary	0.334***	31.58	0.322***	27.18	0.346***	35.43	0.330***	32.21
Tertiary	0.905***	58.29	0.890***	52.51	0.926***	81.23	0.904***	71.30
Experience	0.026***	32.67	0.025***	31.94	0.020***	22.92	0.019***	22.51
Experience squared (×100)	−0.042***	−25.19	−0.041***	−24.62	−0.035***	−17.96	−0.034***	−17.63
Public sector	0.128***	11.58	0.121***	10.55	0.176***	16.59	0.171***	15.76
Part-time	0.145***	4.03	0.143***	3.98	0.151***	9.13	0.152***	9.16
6 years ≤ tenure ≤ 25 years	0.089***	13.98	0.084***	12.69	0.109***	17.27	0.102***	15.29
tenure > 25 years	0.227***	19.24	0.219***	18.04	0.275***	21.26	0.265***	19.66
firm size < 20 employees	−0.058***	−8.90	−0.058***	−8.90	−0.045***	−6.46	−0.046***	−6.56
20 ≤ firm size ≤ 500 employees	0.036***	3.78	0.023**	2.15	0.010	1.19	−0.006	−0.67
Food, drinks and tobacco	−0.051***	−3.58	−0.047***	−3.33	−0.020	−1.22	−0.015	−0.94
Retail	−0.065***	−5.29	−0.064***	−5.15	−0.074***	−6.62	−0.070***	−6.16
Wood and paper	−0.032**	−2.47	−0.031**	−2.34	−0.023	−1.06	−0.026	−1.18
Chemical products	0.059***	3.93	0.060***	3.99	0.045**	2.14	0.047**	2.20
Metallurgy	0.000	0.01	0.000	0.05	0.047***	3.62	0.046***	3.48
Construction	0.041***	4.77	0.043***	4.94	0.096***	3.25	0.104***	3.46
Restaurants	−0.083***	−5.19	−0.084***	−5.21	0.015	1.21	0.010	0.79
Transports	0.106***	7.98	0.105***	7.88	0.176***	7.10	0.172***	6.82
Insurance, finance	0.398***	20.98	0.390***	20.14	0.358***	13.49	0.340***	12.67
Public administration	0.011	0.81	0.010	0.78	0.103***	6.47	0.096***	5.86
Education	0.025	1.29	0.029	1.49	0.102***	7.20	0.108***	7.45
Health	−0.027	−1.59	−0.027	−1.56	0.003	0.25	0.000	0.01
Culture, sport, leisure	0.015	0.51	0.012	0.41	0.005	0.33	−0.007	−0.42
Others	0.044***	2.58	0.040**	2.34	0.004	0.36	0.004	0.38
Selection term			−0.089**	2.52			−0.145***	4.89
No. of observations	15 016				12 145			

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level. The reference individual is an untrained worker with less than primary education, < 6 years of tenure, working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

public or private sector, full-time or part-time job, workplace size and activity sector. In addition, regional and seasonal conditions are captured by a set of dummies for Portuguese regions and quarters. We do not control for female self-selection into the labour market. Using Heckman's two-step approach, Pereira and Martins (2001, 2002) report evidence that the OLS and the 2-step estimates are statistically equivalent for women. Based on this evidence, we assume that working women are a representative sample.

Table 6 reports the OLS and the treatment effects estimates jointly. To allow for comparison with previous work, at this stage we do not include interaction terms between the training dummy and the experience and schooling levels. According to the OLS estimation, the wage differential between trained and untrained workers is 12.7% for men and 8.4% for women. Under the treatment effects model, the wage impact of training for an employee with reference characteristics is 30.3% for men and 37.5% for women. The significance of the selection term indicates that trained workers are not a random group. This suggests that the OLS estimates are downward biased. Therefore, the treatment effects model is our preferred specification.

Our results indicate that the wage effects of training in Portugal are higher than previously thought. Hartog *et al.* (2000) estimates are 11.4% for men and 6.7% for women. However, they do not control for the endogeneity of training and, consequently, their results are very close to our OLS estimates. In Saraiva (1999), the estimated wage return is 7% or lower.

As regards the effects of school qualifications, we find that having primary, secondary and tertiary

Table 7. Wage returns to training – OLS and Treatment effects model with interaction terms

	Men				Women			
	OLS		Treatment effects		OLS		Treatment effects	
	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio
Training	0.221***	9.16	0.420***	6.49	0.178***	4.86	0.551***	8.78
Primary	0.194***	23.47	0.184***	20.67	0.205***	23.23	0.190***	20.35
Secondary	0.338***	30.49	0.324***	27.31	0.346***	34.41	0.331***	31.82
Tertiary	0.920***	56.70	0.904***	52.62	0.932***	79.44	0.912***	72.91
Experience	0.025***	31.97	0.025***	31.51	0.019***	22.31	0.019***	22.14
Experience squared (x 100)	−0.041***	−24.76	−0.041***	−24.34	−0.034***	−17.60	−0.034***	−17.41
Public sector	0.126***	11.44	0.116***	10.18	0.174***	16.45	0.169***	15.55
Part-time	0.146***	4.08	0.144***	4.05	0.152***	9.17	0.154***	9.26
6 years ≤ tenure ≤ 25 years	0.088***	13.92	0.083***	12.66	0.107***	17.04	0.099***	15.08
Tenure > 25 years	0.222***	18.84	0.213***	17.59	0.270***	20.96	0.257***	19.30
Firm size < 20 employees	−0.057***	−8.89	−0.058***	−8.89	−0.045***	−6.44	−0.046***	−6.45
20 ≤ firm size ≤ 500 employees	0.034***	3.57	0.018*	1.66	0.0077	0.92	−0.009	−0.98
Selection term			−0.115***	3.59			−0.159***	6.62
	Interaction terms							
Primary	0.002	0.05	−0.044	−1.25	0.045	1.23	−0.024	−0.66
Secondary	−0.029	−0.82	−0.077**	−2.03	0.020	0.54	−0.046	−1.23
Tertiary	−0.162***	−3.61	−0.215***	−4.62	−0.087**	−2.32	−0.157***	−4.18
Experience < 6 years	−0.182***	−4.72	−0.130***	−3.18	−0.231***	−5.48	−0.177***	−4.07
6 years ≤ experience ≤ 25 years	−0.091***	−3.19	−0.074***	−2.59	−0.091***	−2.77	−0.074**	−2.27
No. of observations	15 016				12 145			

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level. The reference individual is an untrained worker with less than primary education, more than 25 years of experience, < 6 years of tenure, working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

education raises wages by about 20, 33 and 90%, respectively. The estimated returns are practically identical for men and women. As expected, hourly wages are higher among employees with more experience and tenure. Working part-time, in a relatively large firm and in the public sector is associated to additional wage increases. Construction, chemical products, insurance and finance are sectors that pay higher wages. Men working in activities related to food, wood and article production, retail and restaurants earn lower wages. Among women, metallurgy, public administration, transports and education are associated to higher wages.

Differences across skill groups. In Table 7 we present a more elaborated model where the training dummy interacts with education and experience levels. To save space, we omit the activity sectors.

As a main result, gains from training are largest for less educated and high experienced workers, that is, for those workers who typically participate less in training activities. In the preferred treatment effects model, men with reference characteristics earn a 42% wage increase from training. Among women, the estimated increase is 55%. These coefficients fall dramatically among high educated and low experienced workers. On the one hand, having a tertiary degree decreases the estimated effect by 21.5% points for men and 15.7% points for women. On the other hand, having < 26 years of experience reduces the premium by at least 7.4% points. Among workers with < 6 years of experience, this decrease is much sharper: 13.0% points for men and 17.7% points for women.

An important difference between men and women has to due with the role of education and experience. For men, education is a more important determinant of the returns to training than experience. As opposite, experience is a more important factor among women.

Overall, our results indicate that training in the Portuguese labour market is remedial, that is, it provides valuable skills to those workers with low qualifications. As a consequence, sharper wage effects

are observed among low educated workers. As regards experience, our results indicate that training helps to update the skills of workers whose formal qualifications are more obsolete. As a consequence, more experienced employees end up receiving larger wage benefits. A complementary explanation is that workers with longer experience have more bargaining power than job entrants and, therefore, can capture a larger premium from their training investment.

Differences between the private sector and the public sector. In this section, we ask whether and to what extent the wage effects of training in the public and the private sector are different. To that purpose, we split the sample into private and public servants and recalculate the returns to training for both subsamples. In Tables 8 and 9, we report the OLS and treatment effects estimates of a model with interaction terms.

According to the preferred treatments effects model, women earn a higher return in either sector. The coefficient on training for an employee with reference characteristics is similar in both sectors. However, the interaction between training and skills differs importantly across sectors. On the one hand, in the private sector experience is a strong determinant of the returns to training. After controlling for selection bias, we find that private servants with <6 years of experience earn 13.6% points less in the case of men and 23.9% points less in the case of women from training than workers with long experience. In the public sector, differences across experience levels are much smaller. Among women, experience is not a determinant of the profitability of training, indeed. Among men, only those with an experience ranging from 6 to 25 years earn a lower return. On the other hand, in the public sector education is a key factor affecting the returns to training. In the treatment effects model, men with tertiary and secondary education earn, respectively, 25.9 and 13.7% points less from training than men without formal qualifications. Among women, the differential rises to 33.8 and 23.1% points, respectively. In contrast, in the private sector only men with tertiary education appear to receive a lower return from training. In this case, the differential of 19.2% points is lower than in the public sector.

Overall, our results indicate that the interaction between training and individual characteristics differs importantly across sectors. The main lesson is that less experienced individuals earn less from training in the private sector, while more educated individuals earn less from training in the public sector.

Table 8. Wage returns to training in the private sector – OLS and Treatment effects model with interaction terms

	Men				Women			
	OLS		Treatment effects		OLS		Treatment effects	
	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio
Training	0.184***	6.09	0.437**	2.56	0.157***	3.40	0.540***	8.63
Primary	0.170***	18.40	0.160***	14.63	0.151***	14.86	0.135***	12.64
Secondary	0.292***	22.52	0.275***	17.25	0.277***	23.91	0.256***	21.46
Tertiary	0.860***	35.36	0.841***	30.73	0.795***	35.44	0.759***	31.86
Experience	0.024***	27.87	0.024***	27.25	0.017***	17.20	0.017***	16.86
Experience squared (x 100)	−0.039***	−20.90	−0.039***	−20.52	−0.032***	−14.39	−0.032***	−14.04
Part-time	0.101***	2.59	0.098**	2.53	0.134***	7.92	0.134***	7.77
6 years $\leq$ tenure $\leq$ 25 years	0.076***	11.07	0.071***	9.35	0.077***	11.02	0.069***	9.50
tenure $>$ 25 years	0.188***	13.98	0.180***	12.86	0.181***	10.87	0.170***	9.97
firm size $<$ 20 employees	−0.062***	−8.89	−0.064***	−8.91	−0.058***	−7.16	−0.061***	−7.35
20 $\leq$ firm size $\leq$ 500 employees	0.042***	3.80	0.028**	2.04	0.004	0.48	−0.010	−1.01
Selection term			−0.120*	−1.83			−0.188***	−8.18
	Interaction terms							
Primary	0.006	0.14	−0.043	−0.81	0.076*	1.71	0.016	0.36
Secondary	−0.004	−0.09	−0.063	−1.08	0.092**	2.03	0.024	0.53
Tertiary	−0.137*	−1.72	−0.192***	−2.27	0.047	0.63	−0.011	−0.16
Experience $<$ 6 years	−0.186***	−4.06	−0.136***	−2.40	−0.288***	−4.58	−0.239***	−3.95
6 years $\leq$ experience $\leq$ 25 years	−0.060	−1.54	−0.043	−1.11	−0.115**	−2.14	−0.105**	−2.02
No. of observations	11 764				8 457			

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level. The reference individual is an untrained worker with less than primary education, more than 25 years of experience, <6 years of tenure, working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

Table 9. Wage returns to training in the public sector – OLS and Treatment effects model with interaction terms

	Men				Women			
	OLS		Treatment effects		OLS		Treatment effects	
	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio	Coeff.	*t*-Ratio
Training	0.252***	6.55	0.394***	3.22	0.245***	3.76	0.579***	5.80
Primary	0.280***	14.94	0.268***	12.21	0.311***	18.08	0.285***	15.22
Secondary	0.465***	21.66	0.4540***	19.14	0.490***	25.29	0.471***	23.65
Tertiary	1.025***	45.46	1.014***	40.20	1.040***	73.92	1.022***	68.18
Experience	0.028***	13.33	0.027***	13.25	0.020***	11.70	0.020***	11.62
Experience squared (× 100)	−0.043***	−11.14	−0.043***	−11.01	−0.028***	−7.51	−0.028***	−7.51
Part-time	0.334***	4.05	0.336***	4.08	0.239***	4.94	0.245***	5.10
6 years ≤ tenure ≤ 25 years	0.154***	9.39	0.147***	8.45	0.192***	14.41	0.178***	12.86
tenure > 25 years	0.323***	12.81	0.311***	11.16	0.369***	17.68	0.351***	16.18
Firm size < 20 employees	−0.031*	−1.90	−0.029***	−1.75	−0.021*	−1.66	−0.022*	−1.67
20 ≤ firm size ≤ 500 employees	0.003	0.18	−0.012	−0.54	0.026	1.51	0.000	0.01
Selection term			−0.074	−1.19			−0.172***	−5.12
	Interaction terms							
Primary	−0.057	−1.08	−0.076	−1.43	−0.109	−1.52	−0.175**	−2.43
Secondary	−0.121**	−2.01	−0.137**	−2.27	−0.183**	−2.49	−0.231***	−3.15
Tertiary	−0.240***	−3.96	−0.259***	−4.23	−0.277***	−4.17	−0.338***	−5.06
experience < 6 years	−0.063	−0.85	−0.050	−0.67	−0.020	−0.28	0.015	0.21
6 years ≤ experience ≤ 25 years	−0.087**	−2.07	−0.082**	−1.97	−0.000	−0.00	0.009	0.22
No. of observations	3 252				3 688			

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level. The reference individual is an untrained worker with less than primary education, more than 25 years of experience, < 6 years of tenure, working full-time in the public, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

Differences across training types. In the following, we exploit our three alternative classification criteria in order to characterize the returns to different types of training. We summarize the results in Table 10.

First, we focus on the internal-external distinction. As Panel A shows, company training carries a larger return than external training. After controlling for selection bias, the coefficient on external training turns to nonsignificant for men, while among women it is sensitively lower than the coefficient on internal training. In the previous section we found that, as compared to men, women are more prone to train externally. This pattern may obey to a labour market signal, insofar as women obtain positive wage gains by enrolling into activities off-the-firm.

Next, we differentiate between current skills and future skills training. The OLS estimates indicate that workers who enrolled in future skills training earn, on average, higher wages. However, once we control for selection bias, the coefficient on future skills training turns to nonsignificant. As opposite, training to improve skills that are needed at the current job is associated to positive and significant wage increases.

It is common in the literature to use the distinction between external and internal training to proxy the distinction between general and firm-specific training. Similarly, skills acquired for the current job are expected to be more specific than those skills acquired for a future job. Thus, we can use the previous two classifications to test whether general or specific skills attract larger wage increases. Our results indicate that specific training gives largest wage gains. This finding confirms the intuition that specific skills are more valuable by the current employer than skills that can be used at other jobs.

Finally, Panel C shows that short duration training raises wages more than long duration training. Our estimates seem to contradict the intuition that investing in human capital for longer periods must yield larger gains. It turns out, however, that more than 40% of the training with a short duration is internal an aimed to improve current skills, while this proportion falls to nearly 17% for training with a duration of 1 year or more. Thus, the coefficient on short duration training reported in Panel C is partially capturing the (positive) effects of internal and current skills training.

The research on incidence, extent and impacts of training is biased towards participation versus non-participation in training, while corresponding results for the role of the intensity are mostly lacking. This is basically due to the lack of appropriate data. We are

Table 10. OLS and treatment effects estimates for alternative definitions of training

	Men		Women	
	OLS	Treatment Effects	OLS	Treatment Effects
(A) *Training location*				
Internal	0.174***	0.850***	0.125***	0.601***
Selection term		−0.321***		−0.215***
External	0.087***	0.102	0.059***	0.514***
Selection term		−0.008		−0.210***
(B) *Training purpose*				
Current skills	0.124***	0.754***	0.081***	0.700***
Selection term		−0.304***		−0.299***
Future skills	0.134***	−0.200	0.095***	0.257
Selection term		0.141**		−0.066
(C) *Training duration*				
Long duration	0.072***	0.526***	0.098***	0.499***
Selection term		−0.186***		−0.167***
Short duration	0.146***	1.160***	0.079***	1.427***
Selection term		−0.483***		−0.630***

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level.
The reference individual is an untrained worker with less than primary education, <6 years of tenure, working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

aware that our distinction between activities of long duration and short duration is a rough measure of training intensity. However, it constitutes an initial attempt to provide further light on the connection between training effort and wages in Portugal.

Tables 11 and 12 report the main estimates of the treatment effects models with interaction terms. We omit the corresponding OLS estimates. We find that for most training types the returns are significantly lower for more educated individuals. Thus, for example, male workers with a university degree earn a wage return from internal, current skills and short duration training that is nearly 40% points lower than the return earned by male workers with less than primary education. Two exceptions are future skills and long duration training, for which differences across education groups are not significant. Among women, the wage differential between workers with a university degree and workers with less than primary education ranges from 18.6% points in the case of future skills training to 36.8% points in the case of long duration training.

We also detect important differences across experience groups. For men with <6 years of experience, the estimated coefficient on external and long duration training is, respectively, 12.8 and 18.1% points lower. In contrast, the wage return of the remaining categories of training does not depend on experience. Among trained women, those with less experience earn a lower return from all training categories.

V. Conclusion

In this article we have explored the extent, determinants and wage effects of training in Portugal. In a first stage, we found considerable differences in training participation across groups, with elder, low educated workers participating substantially less in training activities. In a second stage, we explored the impact of training on wages. Our main findings can be summarized as follows. The wage effects of training activities are large and significant. Discriminating between education and experience levels, genders and the public and private sector uncovers important differences across categories of workers. Women, workers with low qualifications and workers with long working experience earn significantly more from training. The average effect of training is similar in the private sector and the public sector. However, the interaction between individual characteristics and training differs between sectors. Differences across experience groups are larger in the private sector, while differences across education groups are larger in the public sector.

Table 11. Treatment effects model with interaction terms – Men

	Internal		External		Current skills		Future skills		Long duration		Short duration	
	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*
Training	1.103***	11.37	0.339**	2.53	1.173***	11.27	−0.217	−1.16	0.230	1.02	0.953***	10.10
Selection term	−0.380***	−9.51	−0.070	−1.32	−0.421***	−9.35	0.147**	2.15	−0.038	−0.49	−0.327***	−7.82
	Interaction terms											
Primary	−0.164***	−3.25	−0.017	−0.33	−0.163***	−3.90	−0.019	−0.24	0.017	0.23	−0.142***	−3.35
Secondary	−0.171***	−2.99	−0.074	−1.41	−0.210***	−4.43	−0.017	−0.24	0.077	0.86	−0.189***	−4.16
Tertiary	−0.389***	−5.17	−0.149**	−2.42	−0.394***	−6.41	−0.082	−1.02	−0.045	−0.50	−0.373***	−5.81
experience < 6 years	0.106	1.15	−0.128**	−2.49	0.005	0.09	−0.065	−0.84	−0.181**	−2.53	−0.000	−0.00
6 years ≤ experience ≤ 25 years	−0.012	−0.30	−0.063	−1.50	−0.067**	−2.02	0.050	0.80	−0.096*	−1.71	−0.029	−0.84
No. of observations	15016											

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level.
The reference individual is an untrained worker with less than primary education, more than 25 years of experience, <6 years of tenure, working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

Table 12. Treatment effects model with interaction terms – Women

	Internal		External		Current skills		Future skills		Long duration		Short duration	
	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*	Coeff.	*t*
Training	0.667***	4.88	1.158***	6.06	1.100***	8.45	0.761***	2.75	0.940***	3.49	1.038***	8.48
Selection term	−0.208***	−4.05	−0.386***	−5.47	−0.395***	−7.82	−0.196**	−2.19	−0.197**	−2.31	−0.385***	−8.00
	Interaction terms											
Primary	−0.049	−0.80	−0.136**	−2.35	−0.141***	−2.85	−0.056	−0.62	−0.176	−1.62	−0.105**	−2.30
Secondary	−0.040	−0.58	−0.192***	−3.16	−0.115**	−2.23	−0.258***	−2.71	−0.296***	−2.71	−0.080*	−1.70
Tertiary	−0.217***	−3.14	−0.268***	−4.33	−0.291***	−5.82	−0.186**	−2.02	−0.368***	−3.23	−0.242***	−5.22
experience < 6 years	−0.169***	−2.47	−0.169***	−3.05	−0.130***	−2.70	−0.182*	−1.74	−0.238***	−2.83	−0.116**	−2.22
6 years ≤ experience ≤ 25 years	−0.004	−0.08	−0.119***	−2.67	−0.082**	−2.30	−0.039	−0.44	−0.123	−1.63	−0.065*	−1.80
No. of observations						12 145						

Notes: *Signals significant at the 10% level, **signals significant at the 5% level and ***signals significant at the 1% level.
The reference individual is an untrained worker with less than primary education, more than 25 years of experience, < 6 years of tenure, working full-time in the private, commerce sector, in a firm with more than 500 workers.
Control variables are included for region and quarter.
SE are obtained using White's (1980) method.

We used three alternative classifications of training activities and found that training in the firm, training aimed to improve skills needed at the current job and training with a duration less than a year are associated with larger wage gains.

As a shortcoming, our article considers only participation in training activities. It does not take into account the amount, quality and costs of such activities. Such information would be valuable to shed light on important questions, such as the net returns on human capital investment that employers and employees earn and the complementarities between different training schemes. Further, we use cross-sectional data. Longitudinal data containing the timing of the investment in which earnings growth is the focus of the analysis is preferable, insofar as the temporal ordering of cause and effect can be established. Unfortunately, in the Portuguese Labour Force Survey individuals are seldom kept for more than a few quarters and the impact of training events on earnings growth can not be properly assessed. Further progress in the acquisition and development of new training data could help fill these gaps[11].

Nonetheless, we can draw some tentative conclusions with the limited data currently available. First, the incidence of training in Portugal is one of the lowest in Europe, while the estimated returns to training appear to be considerable. Therefore, policies aimed to encourage and increase the overall participation in training may be of particular importance. Second, it has been argued that the different returns observed across different types of workers are due to barriers to the access to training. The argument is that workers and employers would increase training participation across categories of workers until their marginal productivity equalize. According to this, we find that barriers are important, with low qualified workers typically participating less in training schemes. Third, training appears to be remedial, i.e. it provides valuable skills to workers with low education attainment. In the international literature, there is no general consensus concerning the returns that workers with different educational background receive from training[12]. We find that in Portugal the wage effects of training are much larger for low educated workers. This suggests that policies aimed to facilitate the access to training of the less qualified are expected to reduce wage inequality. Assistance from the European Social Fund can contribute importantly to implement such policies. Unfortunately, according to the monitoring committees, execution rates are being rather low in Portugal. This warns that an important opportunity to improve the labour market position of less favoured individuals is, therefore, being lost.

Recently, the OECD has recommended that reforms in the Portuguese Labour Market should be accompanied by a stronger emphasis on training.[13] This article is an attempt to provide useful information regarding those types of training and groups of workers towards which those reforms should be oriented.

Acknowledgements

We gratefully acknowledge the financial support of the European Commission, EDWIN project, HPSE-CT-2002-00108. We thank participants in the seminars of the UAB Department of Economics, the EALE 2004 and the SPIE 2004 conferences for helpful comments. We also thank Rita Asplund, Ali Skalli, Earling Barth, Krisp Klander, Peter Dolton and Panos Tsakloglou for stimulating suggestions.

References

Arulampalam, W., Booth, A. and Bryan, M. (2003) Training in Europe, *Journal of the European Economic Association*, **2**, 346–60.

Asplund, R. (2004) The provision and effects of company training – A brief review of the literature, *The Nordic Journal of Political Economy*, **31**, 47–73.

[11] A candidate longitudinal data source is the Portuguese sub-sample of the European Community Household Panel. However, it presents additional problems, such as gaps in the training data and small estimating sub-samples due to the low incidence of training and the high concentration (almost 80%) of workers in the first education level.

[12] Among others, Lynch (1992) for US, Blundell *et al*. (1996) for UK, and Kuckulenz and Zwick (2003) for Germany found that returns are higher for more educated workers, while Long (2001) for Australia and OECD (1999) for a variety of countries suggest the opposite.

[13] According to OECD (2003b), reforms in the Portuguese Labour Market 'should be accompanied by a stronger emphasis on vocational training, to ease the school-to-work transition. New rules permitting employment of unqualified youths on condition that training is provided by the employer may help, but it would be better if the schools themselves were better able to provide school-leavers with qualifications useful to employers [. . .]. These reforms should be accompanied by the training and re-training of existing workers. The government's aim to provide employment-related training to all youths who are registered in employment centres and a renewed emphasis on life-long training are welcome. If successful, these incentives would increase the productivity and earnings capacity of those who might otherwise exit the labour force'.

Blundell, R., Dearden, L. and Meghir, C. (1996) The determinants and effects of work-related training in Britain, The institute of Fiscal Studies, London.

Booth, A., Bryan, M. (2002), *Who pays for general training? New evidence for british men and women*. IZA Working Paper 486.

Bound, J., Jaeger, D. and Baker, R. (1995) Problems with Instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak, *Journal of the American Statistical Association*, **90**, 443–50.

Brunello, G. (2004) On the complementarity between Education and Training in Europe, in D. Checchi and C. Lucifora (eds), Education, *Training and Labour Market Policies in Europe*, Palgrave, 2004.

CGQCA (Comissão de Gestão do Quadro Comunitário de Apoio III) (2004) *Quadro Comunitário de Apoio III – Portugal* 2000–2006. *Relatório Final* (*Community Support Framework III – Portugal 2000–2006*. *Final report*). Available at http://www.qca.pt/publicacoes/RelatQCA2003.pdf

Dearden, L., Reed, H. and van Reenen, J. (2000) Who gains when workers train? Training corporate productivity in a panel of British industries. The Institute for Fiscal Studies, WP 00/04, London.

EUROSTAT (2004) *EUROSTAT structural indicators,* Luxembourg. Available at: http://europa.eu.int/comm/eurostat/.

Gerfin, M. (2004) Firm-sponsored general training in frictional labour markets: an empirical analysis for Switzerland. IZA Discussion Paper 1077.

Harris, R. (1999) The determinants of work-related training in Britain in 1995 and the implications of employer size, *Applied Economics*, **31**, 451–63.

Hartog, J., Pereira, P.T. and Vieira, J.C. (2000) Vocational Training and Earnings in Portugal. *Economia,* **XXIV**, 35–52.

Kazamaki-Ottersten, E., Lindh, T. and Mellander, E. (1999) Evaluating firm training, effects on performance and labour demand, *Apllied Economics Letters*, **6**, 431–8.

Kuckulenz, A. and Zwick, T. (2003), The impact of training on earnings – Differences between participant groups and training forms. ZEW Discussion Paper 03 – 57.

Loewenstein, M. A. and Spletzer, J. R. (1999) General and specific training: evidence and implications, *Journal of Human Resources*, **34**, 710–33.

Long, M. (2001), The effect of firm-based training on earnings. Working Paper 37, Monash University.

Lynch, L. (1992) , Private sector training and the earnings of young workers, *American Economic Review*, **82**, 299–312.

Lynch, L. M. and Black, S. E. (1998) Beyond the incidence of employer-provided training, *Industrial and Labour Relations Review*, **52**, 64–81.

OECD (1999) Training of Adult Workers in OECD Countries: Measurement and analysis. OECD Economic Outlook 1999, OECD, Paris.

OECD (2003a), Employment Outlook. Paris.

OECD (2003b) *Portugal – Assessment and Recommendations*, OECD Economic Surveys, available at http://www.bportugal.pt/publish/other/ocde03e.htm.

Ok, W. and Tergeist, P. (2003), Improving workers' skills: analytical evidence and the role of the social partners. OECD Social, Employment and Migration Working Papers 10, Paris.

Oosterbeek, H. (1996) A decomposition of training probabilities, *Applied Economics*, **28**, 799–805.

Peraita, C. (2005) Firm-sponsored training in regulated markets: evidence for Spain, *Applied Economics*, **37**, 1885–98.

Pereira, P. T. and Martins, P. S. (2001) Returns to Education in Portugal, 1982–1995: High and Rising, in *Education and Earnings in Europe – A Cross Country Analysis of Returns to Education* (Eds) C. Harmon, I. Walker, and N. W. Nielsen, Edward Elgar, Cheltenham, UK.

Pereira, P. T. and Martins, P. S. (2002) Education and Earnings in Portugal. Bank of Portugal Conference Proceedings.

Saraiva, A. (1999), Incidência e Impacto Salarial da Formação Profissional em Portugal (Extent and Wage Impact of Training in Portugal). *Economia*, **XXII**, 27–43.

Vieira, J. (1999) Returns to Education in Portugal, *Labour Economics*, **6**, 535–41.

White, H. (1980) A Heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica*, **48**, 817–38.

Appendix A. Training Questions in the IE, 1998–2000

- Apart from formal schooling, have you completed any training scheme as a formation for a professional activity? (1 = yes, 2 = no)
- What type of training?
  - (1) Vocational formation of tertiary level
  - (2) Specific professional formation with one year or longer duration
  - (3) Any training with less than one year duration
  - (4) Other.
- Where did you receive this training?
  - (1) University or college
  - (2) Firm
  - (3) Training centre
  - (4) Vocational school
  - (5) Other.
- What was the objective of the training activity?
  - (1) To help get started with a first job
  - (2) To improve or update skills
  - (3) To switch to another job or duties
  - (4) Within a program of promotion of employment: initial training

Table 1B. Chi-squared statistics

Classification	Omitted category	Chi-squared		Prob > chi-squared	
		Men	Women	Men	Women
Location	Internal training	−1.02	−0.17	–	–
Purpose	Current skills training	−0.38	−0.26	–	–
Duration	Long duration training	−1.70	−0.68	–	–

(5) Within a program of promotion of employment: continuous training
(6) For personal interest
(7) Other

Appendix B. Hausman Test for the IIA Assumption

The Hausman test is based on estimating the multinomial logit for the full sample and for a restricted sample, where the restricted sample results from dropping the observations corresponding to one of the alternatives of the dependent variable (omitted category). The statistic is

$$\chi^2 = (\hat{\beta}_r - \hat{\beta}_u)'[\hat{V}_r - \hat{V}_u](\hat{\beta}_r - \hat{\beta}_u)$$

where r indicates the estimators based on the restricted sample, u indicates the estimator of the unrestricted sample and $\hat{V}_r$ and $\hat{V}_u$ are the respective estimates of the asymptotic covariance matrices. The statistic has a chi-squared distribution with $K-1$ degrees of freedom, where K is the number of regressors. The null hypothesis, H_0 states that the difference in the coefficients is not systematic (IIA assumption). Negative values of the statistic must be interpreted as strong evidence in favour of the null hypothesis.

Appendix C. Quality of the Excluded Instruments

It is well-known that the hypothesis test relating to the endogeneity of training can be extremely sensitive to the identifying variables used and this should always be borne in mind when conducting a test for selection bias. We need to interrogate the data carefully playing particular attention to the identifying instruments and the sensitivity of the estimated selection effects to alterations in this instrument set.

In the first row of Table 1C we report the coefficient on training under alternative specifications of the participation equation. Each column indicates the instruments that have been excluded (i.e. the set of instruments that have been included in the training equation but excluded in the wage equation). The results reported in the article correspond to specification (3). Luckily to us, changes in the participation equation have only a small impact on the estimated effect of training. This finding gives us some confidence about the robustness of our results. In all cases, the selection term is significant at the 5% confidence level, which suggests that trained workers are not a random group. We conclude, therefore, that a treatment effects model is preferred to an OLS model.

It is well known that instruments should be *valid*, i.e. they must be uncorrelated (orthogonal) to the structural error. Otherwise, the estimates are likely to be biased and inconsistent. Moreover, instruments must be *relevant*, i.e. they must be sufficiently correlated with the endogenous regressor. Bound *et al.* (1995) have shown that a weak correlation between the endogenous variable and the instruments will exacerbate the problems associated with a correlation between the instruments and the structural error.

In Table 1C we check the quality of the excluded instruments using the Sargan's test for orthogonality and the Bound *et al.* test for the significance of the excluded instruments. In column (1), having a second job, marital status, looking for an extra job and residence abroad are the excluded instruments. According to the *F*-test, these instruments are jointly significant. However, the Sargan's test detects significant correlation between the error terms of the training equation and the wage equation.

Column (2) shows that reducing the number of instruments does not necessarily solve the problem of orthogonality. In column (3) the set of excluded instruments has been restricted to pass the orthogonality test. The *F*-statistic is highly significant and compares favourably to the criteria suggested by Bound *et al.* Moreover, comparing the partial R-squared in columns (1) and (3) reveals that using four instead of two excluded instruments does not change the explanatory power of the training equation by very much. Finally, in column (4) the model is just identified.

Table 1C. Choice of excluded instruments with tests of orthogonality and validity of the instruments

	(1) Second job, single looking for an extra job, Resided abroad				(2) Second job, looking for an extra job				(3) Second job, resided abroad				(4) Second job			
	Men		Women		Men		Women		Men		Women		Men		Women	
Coefficient on training	0.326***	(0.073)	0.379***	(0.059)	0.298***	(0.075)	0.380***	(0.057)	0.303***	(0.071)	0.375***	(0.059)	0.303***	(0.071)	0.377***	(0.058)
Endogeneity of training																
Selection term	−0.101***	(0.037)	−0.147***	(0.029)	−0.086**	(0.037)	−0.148***	(−0.029)	−0.089**	(0.035)	−0.145***	(0.030)	−0.089**	(0.035)	−0.146***	(0.029)
Orthogonal errors																
Sargan's test	200.86***		21.30***		24.91***		13.32***		2.91		1.36					
Instrument relevance																
F-test	8.03***		8.10***		13.65***		15.55***		12.53***		15.97***		23.42***		30.83***	
Partial *R*-squared	0.0022		0.0027		0.0018		0.0026		0.0017		0.0027		0.0016		0.0026	

Notes: SE in parentheses. ***Significant at the 1% level, **significant at the 5% level.