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Overeducation and Undereducation: Evidence for Portugal

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Abstract—Using a unique data set of Portuguese workers, we attempt to contribute additional empirical evidence to the debate on whether or not a discrepancy exists between the educational attainment of workers and the skill requirements of jobs, with the related impact on earnings functions and the returns to education. It appears that earnings are not uniquely determined on the basis of the educational attainment of workers. The placement of the worker in a particular job plays a role in wage determination. Hence, estimates of the impact of education on earnings using the standardized human capital earnings model may give misleading results, as estimates of the return to additional education beyond that required to perform the job may be lower than those associated with required education. [*JEL* I21, J31] ©1997 Elsevier Science Ltd. All rights reserved

1. INTRODUCTION

USING A UNIQUE data set of Portuguese workers, we attempt to contribute additional empirical evidence to the debate on whether or not a discrepancy exists between the educational attainment of workers and the skill requirements of jobs, with the related impact on earnings functions and the returns to education. The focus of the paper generally is on attempting to answer the following questions: (1) Are higher levels of education always more productive than lower ones and thus fully utilized and rewarded? (2) Is education beyond a required level rewarded at a lower rate than the return to required education, or is it non-productive, suggesting a zero, or perhaps negative, return? (3) Does the way one goes about measuring over- and undereducation yield different results and thus change "conventional wisdom" about the incidence and returns to inadequate education?

While there is a growing literature on the issue of "over- and undereducation", a representative sample of the findings are as follows. Using the 1976 wave of the United States Panel Study of Income Dynamics (PSID) which allows one to measure over- and undereducation based on self-reported proxies, Duncan and Hoffman (1981) found overeducation to be widespread in the United States labor market and to be rewarded positively, albeit at a lower rate than that of required education. They report that overeducated workers earn higher returns to their years of schooling than co-workers who are not overeducated, but lower returns than workers with similar education who work in jobs that require that level of education. Undereducated workers receive lower returns than their co-workers with the required, and thus higher, level of education; they receive higher returns than employees who have the same educational attainment, but work in jobs that just require their level of education.

Using data from the 1969 United States Survey on Working Conditions and the 1973 and 1977 waves of the Quality of Employment Survey (with the proxy for overeducation derived from evaluations of skills required for jobs by job analysts and the employee), Rumberger (1987) and Tsang *et al.* (1991) found about the same impact of overeducation in the United States labor market as did Duncan and Hoffman. With a sample of males drawn from the 1976 and 1978 waves of the PSID and employing the same methodology as Duncan and Hoffman, Sicherman (1991) obtained similar results—as did Cohn and Khan (1995) using data from the 1985 wave of the PSID. Duncan and Hoffman's model was replicated for the Dutch labor market by Hartog and Oosterbeek (1988) and for the Spanish labor market by Alba-Ramírez (1992). Hartog and Oosterbeek's definition of over- and undereducation is based on the evaluation of skill requirements of jobs by the individual. Their results are consistent with those from prior research done for the United States, as are the findings reported by Alba-Ramírez for Spain which are based on the worker's self-evaluation of the required education for adequate job performance. Using data from a 1986 sample of Eugene, Oregon employees in 18 manufacturing and warehouse firms, Hersch (1991) reported

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values for the returns to worker's self-reported required and surplus schooling similar to those found by Duncan and Hoffman and by Rumburger.

Verdugo and Verdugo (1989) employ a random sample of males from the 1980 Census to define over- and undereducation in each 3-digit occupation level. They construct indexes of required education based on the distribution of actual educational attainments.[1] Over- and undereducation dummy variables, defined as deviations from the average level of education, were created and their effects on earnings were estimated. The results of Verdugo and Verdugo's analysis suggest that overeducated workers earn less than those with similar levels of education, but who possess the education required to perform their jobs. Conversely, undereducated workers earn more than those workers who possess the same level of education, but have the required education for job performance. In the analyses referred to above, Alba-Ramírez also estimated the Verdugo and Verdugo model for Spain and found similar effects, as did Sicherman, and Cohn and Khan using data for the United States. Using a preferred variant of the Verdugo and Verdugo method, Cohn and Khan also report positive returns to overeducation and negative returns to undereducation in the United States.[2]

The conclusions reported above support the notion that wages are not uniquely determined on the basis of educational attainment of employees. The placement of the worker in a particular job seems to play an important role in wage determination. Accordingly, estimates of the impact of education on earnings using the standardized Mincerian earnings model may be misleading, as estimates of the returns to over- and undereducation may be different from those associated with required education.

The determination of over- and undereducation requires the measurement of educational skills of workers and skill requirements of jobs. As indicated above, most analysts have used the number of years of schooling attained through the formal educational system as a proxy for educational skills, while proxies for skill requirements for jobs usually have been set subjectively by job analysts or by the workers themselves. In at least one case, deviations from the actual educational attainments of workers have been used to proxy skill requirements. An important objective of this paper is to determine if different measures of the skill requirements affect differently the incidence of inadequate education and the sign and magnitude of the returns to education.

2. DATA AND DEFINITIONS OF OVEREDUCATION AND UNDEREDUCATION

The sample used in this study was drawn from a data set based on Personnel Records (Quadros de Pessoal) collected by the Portuguese Ministry of Labor. Each year in March, all firms with more than one paid employee are required to complete a questionnaire on the firm's employment situation. Information on workers' characteristics such as sex, age, educational attainment, skill-qualification level, occupation, years with the firm, hours worked, and earnings is reported by the employer. Additional information about the firm is also required: type of industry, geographic location of employment, firm and plant size, type of management, and legal form of ownership.

A random sample of 50,000 individuals was drawn from the 1991 Quadros de Pessoal. Agricultural and mining workers, employees in public administration, the self-employed, and military personnel are excluded from the Personnel Records. The public sector consists of all firms owned by the government. Moreover, workers under 14-yrs-old, part-time workers, unpaid family workers, apprentices, and those who are simultaneously owners and executives are excluded from the data set. After excluding observations with missing values or inconsistencies for the selected regressors, over 30,000 individuals remained in the working sample. The large sample size and the availability of so many control variables in the Portuguese data set make it particularly attractive compared to many other data sets used in the empirical research on over- and undereducation. Unfortunately, a panel of individual observations cannot be constructed from the yearly waves of the Quadros de Pessoal because of lack of an individual identifier in the data set.

The fundamental basis for the analysis that follows is the estimation of earnings regressions. While the present data set does not provide information for all factors theoretically relevant for inclusion into the earnings model (namely proxies for ability, school quality and family background), it includes most of the variables that are typically employed in earnings regressions. In addition, it contains some variables, such as firm size, that have been found to be important empirically, but often are not available in empirical studies.[3] The definitions of the variables are given in Table 1, and Table 2 contains the descriptive statistics.

The natural logarithm of gross monthly earnings in escudos (ln Y) is the dependent variable. Independent variables include education, which is proxied by the number of years of completed schooling. Except for those with fewer than 4 yrs of education, educational attainment of workers is collected in the data set by completed grades. The variable is reported in the Quadros de Pessoal in the following groups: (1) completed 5 yrs of college; (2) completed 3 yrs of college; (3) completed 12 yrs of education (3 yrs of professional training beyond the 9th yr, usually for nurses and elementary-grade teachers); (4) completed 11 yrs in the (a) academic, (b) vocational (commercial, industrial and agricultural) and (c) professional (art and ministry) tracks; (5) completed 9 yrs; (6) completed 6 yrs; (7) completed 4 yrs; and (8) completed less than 4 yrs of education. These groups were converted to a quantitative variable

Table 1. Definition of variables

Variables	Description
ln Y	Natural logarithm of total monthly earnings in escudos
EDUC	Number of years of education completed
TENURE	Number of years of tenure in the current job
$TENURE^2$	TENURE squared
EXPER	Number of years of presumed work experience in firms other than the current one (age—education—tenure—six)
$EXPER^2$	EXPER squared
EDUCTEN	Interaction term (EDUC*TENURE)
EDUCEXP	Interaction term (EDUC*EXPER)
ln HOURS	Logarithm of total monthly hours worked
MALE	Dummy variable, 1 if male, 0 otherwise
OVERED	Dummy variable, if worker is overeducated, 0 otherwise
UNDERED	Dummy variable, if worker is undereducated, 0 otherwise
ADSCHOOL	Number of years of adequate schooling
OVERSCH	Number of years of overeducation
UNDERSCH	Number of years of undereducation
ADSTEN	Interaction term (ADSCHOOL*TENURE)
ADEXP	Interaction term (ADSCHOOL*EXPER)
OVTEN	Interaction term (OVERSCH*TENURE)
OVEXP	Interaction term (OVERSCH*EXPER)
UNDTEN	Interaction term (UNDERSCH*TENURE)
UNDEXP	Interaction term (UNDERSCH*EXPER)
PUBLIC	Dummy variable, 1 if in a public firm, 0 otherwise
OC0	Dummy variable, 1 if a professional, 0 otherwise
OC1	Dummy variable, 1 if in a upper-level highly skilled non-manual job, 0 otherwise
OC2	Dummy variable, 1 if in a highly-skilled manual job, 0 otherwise
OC3	Dummy variable, 1 if in a skilled or semi-skilled non-manual job, 0 otherwise
OC4	Dummy variable, 1 if in a skilled or semi-skilled manual job, 0 otherwise
OC5	Dummy variable, 1 if in a non-skilled job, 0 otherwise
FIRM4	Dummy variable, 1 if firm has ≤ 4 employees, 0 otherwise
FIRM99	Dummy variable, 1 if number of employees in the firm is >4 and ≤ 99, 0 otherwise
FIRM499	Dummy variable, 1 if number of employees in the firm is >99 and ≤ 499, 0 otherwise
FIRMBIG	Dummy variable, 1 if number of employees in the firm is ≥ 500
NORTH	Dummy variable, 1 if in the Northern region, 0 otherwise
CENTER	Dummy variable, 1 if in the Central region, 0 otherwise
LISBON	Dummy variable, 1 if in the Lisbon-and-Tagus-Valley region, 0 otherwise
ALENT	Dummy variable, 1 if in the Alentejo region, 0 otherwise
ALGAR	Dummy variable, 1 if in the Algarve region, 0 otherwise
TEXTILE	Dummy variable, 1 if in a textile firm, 0 otherwise
FOOD	Dummy variable, 1 if in a food firm, 0 otherwise
WOOD	Dummy variable, 1 if in a wood firm, 0 otherwise
PAPER	Dummy variable, 1 if in a paper firm, 0 otherwise
CHEMICAL	Dummy variable, 1 if in a chemical firm, 0 otherwise
NONMETAL	Dummy variable, 1 if in a non-metal firm, 0 otherwise
MACHINE	Dummy variable, 1 if in a machine firm, 0 otherwise
PUBUTIL	Dummy variable, 1 if in a public utility firm, 0 otherwise
CONSTRU	Dummy variable, 1 if in a construction firm, 0 otherwise
WHOLE	Dummy variable, 1 if in a wholesale firm, 0 otherwise
RETAIL	Dummy variable, 1 if in a retail firm, 0 otherwise
RESTHOT	Dummy variable, 1 if in a restaurant or hotel firm, 0 otherwise
TRANSP	Dummy variable, 1 if in a transportation firm, 0 otherwise
FINANCE	Dummy variable, 1 if in a financial firm, 0 otherwise
SERVICE	Dummy variable, 1 if in a service firm, 0 otherwise

(EDUC) by assigning years of education to the individuals in the groups as follows: The number of years of education completed for the first seven categories are 16, 14, 12, 11, 9, 6, and 4, respectively; in the eighth category, less than 4 yrs of education, the value of 0 was assigned to illiterates and a value of 3 to the others. Since the 12th yr of education was required to attend college only after 1976, most of the college graduates in the sample had 11 yrs of education prior to entering college.

The variable tenure (TENURE), which purports to proxy specific on-the-job training, is measured by the number of years in the current job. Since actual experience is not available in the data set, the proxy used for labor experience in other than the current job (EXPER), which presumably reflects non-educational general training, is defined as follows: Age—Education—Tenure—Six.

Multiplicative interaction terms between years of education and years of experience and years of tenure

Table 2. Sample mean and standard deviation of variables, full sample and by gender, 1991

Variable	Full sample	Females	Males
EDUC	6.015	6.198	5.908
	(3.091)	(3.084)	(3.089)
TENURE	8.768	7.960	9.235
	(9.087)	(8.392)	(9.435)
EXPER	15.604	13.947	16.564
	(10.615)	(10.078)	(10.798)
ln HOURS	5.159	5.145	5.167
	(0.137)	(0.142)	(0.133)
MALE	0.633	–	–
PUBLIC	0.090	0.060	0.109
OC0	0.061	0.054	0.065
OC1	0.209	0.257	0.182
OC2	0.101	0.028	0.144
OC3	0.112	0.062	0.141
OC4	0.369	0.422	0.337
OC5	0.149	0.176	0.133
FIRM4	0.022	0.026	0.020
FIRM99	0.311	0.313	0.310
FIRM499	0.408	0.447	0.385
FIRMBIG	0.259	0.214	0.285
NORTH	0.388	0.421	0.369
CENTER	0.148	0.132	0.158
LISBON	0.404	0.394	0.410
ALENT	0.029	0.022	0.033
ALGAR	0.031	0.031	0.031
TEXTILE	0.175	0.320	0.092
FOOD	0.044	0.050	0.040
WOOD	0.036	0.025	0.043
PAPER	0.023	0.018	0.026
CHEMCIAL	0.034	0.027	0.039
NONMETAL	0.034	0.022	0.040
METAL	0.011	0.002	0.016
MACHINE	0.100	0.063	0.120
PUBUTIL	0.013	0.004	0.018
CONSTRU	0.100	0.016	0.146
WHOLE	0.084	0.069	0.093
RETAIL	0.077	0.093	0.068
RESTHOT	0.045	0.063	0.034
TRANSP	0.086	0.051	0.106
FINANCE	0.075	0.069	0.078
SERVICE	0.066	0.108	0.042
ln Y	11.167	10.981	11.275

are included in the models to test for complementary or substitution effects on earnings between experience or tenure and the level of education. If there is complementarity between education and the other forms of human capital reflected by EXPER and TENURE in their effect on earnings we would expect positive coefficients on the interaction variables. Diminishing returns to tenure and experience are captured by including quadratic terms on tenure ($TENURE^2$) and experience ($EXPER^2$) in the models. The variable Ln HOURS is entered into the analysis as a compensating factor.

Several additional variables usually appearing in earnings functions are included in the analysis as controls, but they are not reported in the regressions. (The full regressions are available upon request from the authors.) A dummy variable is entered to control for the type of firm ownership, whether public or private. Three dummy variables are added to adjust for the effects of firm size on wages. To account for wage differentials across Portuguese local labor markets, dummy variables for the region in which the plant is located are included as regressors; our classification follows the criterion employed by the Portuguese Government which aggregates counties into five major regions. Fourteen dummy variables representing sectors of business activity (for example, manufacturing, public utilities, financial services) and five occupational classifications (for example, managers, technicians, non-skilled) are included in the models as control variables.

2.1. Measures of Overeducation and Undereducation

Three alternative measures are used to denote the educational requirements of jobs: the Verdugo and Verdugo (1989) definition (VV), the modal procedure (Mode) which we believe is unique to this study, and

the qualification levels of workers (Qualif) (Rumberger, 1981; Hartog and Oosterbeek, 1988).

Regarding the first criterion for measuring over- and undereducation (VV), the definition of job requirements is based on the actual educational attainments of workers within occupations disaggregated at a 3-digit level. Workers whose education attainments fall within plus or minus one standard deviation of the mean value within the occupation are considered to be adequately educated. Overeducated workers (OVERED) are those whose educational attainments are greater than one standard deviation above the mean for the specific occupation. Workers whose educational attainments are more than one standard deviation below the mean are defined as undereducated (UNDERED).[4]

The second index (Mode) is also determined within 3-digit occupations. Adequately educated workers (ADSCHOOL) are those whose educational attainments equal the modal value within each occupation. Workers with educational attainments greater than the modal educational level for their specific occupation are defined as overeducated (OVERSCH); those whose educational attainments are below the mode in the occupation are defined as undereducated (UNDERSCH).[5] The variables OVERSCH and UNDERSCH are measured by the number of years of overeducation or undereducaton.

The third method of measuring over- and undereducation (Qualif) takes as a reference the observed distribution of workers by qualification levels and an exogenous definition of schooling requirements for each level based on the opinion of job analysts. The qualification levels, defined by the Portuguese Ministry of Labor, involve a broad classification of workers in eight distinct categories. These categories were designed by job analysts taking into account the training required for adequate job performance. Training encompasses all the skills acquired in school, the general and specific knowledge acquired in training programs, and learning by doing. These skills are translated into equivalent years of schooling (see Appendix A). Furthermore, the definition of the qualification levels takes into account the content of the job—regarding the difficulty of tasks performed and the degree of decision making required of the worker (Coelho *et al.*, 1982). Using both criteria, qualification levels are defined as described in Appendix B. These qualification levels are then assigned to workers by each employer. Managers and highly skilled technicians are in the same skill category. The equivalent years of education considered to be adequate for each category are indicated in the fourth column of Appendix B. Overeducated workers (OVERSCH) are defined as those whose educational attainments are above the educational job requirements for each qualification level, while undereducated workers (UNDERSCH) had educational levels below the required levels. Adequately-educated workers (ADSCHOOL) are those whose educational attainments just match the educational requirements of their jobs. As indicated above, each variable is quantitative.

2.2. On Data-Based Criteria

In proffering different methods for measuring over- and undereducation, one perhaps should suggest which measure might be preferred. Hence, before turning to the empirical analysis, consider a firm with a constant number of employees over time. At time 0, 1, 2,..., $t-1$, all workers have 12 yrs of schooling and are adequately educated (ADSCHOOL). At time t, a technological change takes place that has the effect of making college education (16 yrs) the required level thereafter. To accommodate the change in technology, the firm retrains the existing work force and replaces each old worker who leaves with a newly-hired college graduate. In this setting, note that the following are true: (1) All workers hired prior to t are undereducated (UNDERSCH) and all workers hired after t are adequately educated (ADSCHOOL). (2) The UNDERSCH, ADSCHOOL or OVERSCH status of a worker does not change over time after t. (3) The amount (number of years) of UNDERSCH or OVERSCH, if any, does not change over time after t.

If the Mode criterion is used to classify the firm's employees, for a number of years after t new entrants will be classified (erroneously) as OVERSCH and older workers will be classified (erroneously) as ADSCHOOL. When new entrants become the majority, the classification will change abruptly: all old workers will be classified (correctly) as UNDERSCH, all new workers will be classified (correctly) as ADSCHOOL.

The use of the VV criterion leads one along a similar path (from an erroneous assessment of OVERSCH to the correct recognition of UNDERSCH), but with two major quirks: First, as average education increases steadily over time from 12 to 16 yrs, a point may be reached (when average schooling approaches 14) at which either everybody in the firm will be classified (erroneously) as ADSCHOOL, or at which approximately half of the employees are classified (correctly) as UNDERSCH and the remaining are defined (mistakenly) as OVERSCH, with nobody in between. Whether the former or the latter will be the case depends on the standard deviation. In contrast to the Mode criterion where the change is abrupt, with VV the change is gradual and may produce more than a type of classification error before correcting itself. Use of the Mode criterion will always produce some fraction of workers who are ADSCHOOL, whereas VV may yield a result in which nobody in the occupation is adequately educated. Second, whereas under Mode the amount of OVERSCH or of UNDERSCH in the example is 4 yrs (as it should be) at all times after t, with the VV criterion the amount of OVERSCH or UNDERSCH is not constant over time. Close to t we have (adequately educated) workers with 3 yrs of (false) OVERSCH, then with 2 yrs of

OVERSCH and so on, until we begin having undereducated workers (with 4 yrs of deficit schooling) classified as 1 yr undereducated, then 2 yrs of UNDERSCH and so on.

The arguments given above bode strongly against the use of the VV criterion, albeit the second one does not apply fully because Verdugo and Verdugo refrained from using a quantitative measure of over- and undereducation and relied instead on the use of the OVERED/UNDERED dummies. The discussion above suggests that criteria such as Qualif (or the worker's own assessment of the education–job requirements match) may be preferred, particularly if adjustments can be made to changes in technological conditions and work-place organization. However, if a rigid Qualif criterion, fixed at time t, were used to classify the employees in the firm, the classification of workers over time would drift further and further away from the correct classification. In the limit, after the firm had replaced every high school graduate with a college graduate, all workers would be misclassified as overeducated if the criterion were not revised during the period. Hence, unless they are frequently updated, exogenously-defined criteria fail to have the potential for self correction that data-based criteria exhibit. If, however, one must select a data-based criterion, Mode may be superior to VV. Given that there are difficulties with any single criterion, and for comparison purposes, we offer empirical estimates of over- and undereducation based on all three criteria.

3. INCIDENCE OF OVEREDUCATION AND UNDEREDUCATION

The incidence of overeducation and undereducation for the full sample and by gender is shown in Table 3. The estimates reveal that over- and undereducation exist in the Portuguese labor market, with the extent varying across the measures used to define required (adequate) education. Based on the VV definition, the vast majority of workers in the sample had the education required to perform their jobs adequately. Overeducation and undereducation are the highest under the Qualif definition. The disparity of results according to the different criteria is not surprising given the computational procedures. Required education is defined as a range in the VV procedure and as the most frequent level in the Mode method, which should generate higher probabilities of classification as adequately educated than in the alternative measure. Since the definition of required schooling for each level of qualification is administratively defined and thus exogenous under the Qualif criterion, larger discrepancies between actual and required education are more likely to occur than in the other measures. In addition, if a measure such as Qualif becomes obsolete at some point in time, a larger percentage of workers will be classified as over- or undereducated than would be the case using data-based criteria which adjust continuously to changing conditions in technology and work-place organization.

While it would be useful to compare our results of the incidence of inadequate education with those for other European countries, available estimates for other European countries are drawn from data for years prior to 1991 and are taken from different measures of inadequate education than those presented in Table 3. However, we replicated the analysis upon which Table 3 is based using identical data from the Quadros de Pessoal for the year 1985. Using the Mode and Qualif criteria and the full sample, we found that (depending on the criterion used) between 18.0 and 26.0% of the Portuguese workers in 1985 were overeducated and 19.1 to 43.0% were undereducated. Alba-Ramírez (1992) reported that 17.0% of Spanish workers considered themselves overeducated in 1985, while 23.0% thought that they were undereducated for the job. Comparable estimates for Dutch workers in 1982 were 16.0 and 21.8%, respectively (Hartog and Oosterbeek, 1988).

It is clear from Table 3 and the numbers given above that there has been a slight increase in the incidence of overeducation and decrease in the incidence of undereducation for the full sample from 1985 to 1991 in Portugal. The increase in the incidence of overeducation in Portugal for men between 1985 and 1991 was virtually the same as reported for the full sample; the increase in overeducation for women was larger over the period (25.3% in 1991 compared to

Table 3. Extent of overeducation and undereducation (%), full sample and by gender

Description	Full sample			Females			Males		
	VV	Mode	Qualif	VV	Mode	Qualif	VV	Mode	Qualif
Completed education = required education	85.6	57.5	29.4	88.4	56.0	33.7	83.8	58.4	27.0
Completed > required	9.4	25.5	33.1	6.9	25.3	40.0	10.9	25.5	28.8
Completed < required	5.0	17.0	37.5	4.7	18.7	25.9	5.3	16.0	44.2
Total	100	100	100	100	100	100	100	100	100

16.3% in 1985) and the decline in the percentage of undereducated was about the same.

We should point out that any observed discrepancies between job skill requirements and educational attainments may be temporary, however. Discrepancies could result from substitution among the various forms of human capital endowment. Indeed, overeducated workers may substitute education for the lack of previous job experience, accepting jobs requiring less education than they actually possess in order to acquire the necessary experience for job mobility. Under this view, the phenomenon of overeducation would be a transitory situation, with workers accumulating human capital that allows them to improve their job situation (Rosen, 1972). Undereducated workers may substitute experience for the lack of education, or undereducation may reflect a situation where workers and employers believe that the actual mix of schooling and experience is adequate. Undereducation would thus be a long lasting situation.[6]

An empirical consequence of this argument is that the incidence of overeducation would be higher among less experienced workers (whether with the same firm or otherwise) and undereducation would be more prevalent among more experienced workers. Using the three measures of over- and undereducation given above, the argument can be tested with a multivariate logit model where the likelihood of being overeducated or undereducated is a function of education (EDUC), tenure (TENURE), experience (EXPER), quadratic terms for tenure and experience, sex (MALE), and the several control variables enumerated earlier. The estimates of the multinomial logit model from the 1991 sample are shown in Table 4.[7]

In the table, P_0 denotes the probability that a worker is adequately educated, P_1 is the probability of being overeducated and P_2 is the probability that she is undereducated. Hence, P_1/P_0 (P_2/P_0) is related to the odds in favor of being overeducated (undereducated) rather than adequately educated. The multinomial logit model performed very well. The chi-squared test is significant for each of the measures, thus rejecting the null hypothesis that the coefficients are zero. With the VV criterion, the model predicts the correct category of education (relative to adequate education) in about 94% of the cases. For the Mode and Qualif measures, the percentage of correctly predicting the category continues to be high, but falls to 83 and 70%, respectively. The results indicate that a man is more likely than a woman to be overeducated and less likely to be undereducated, relative to having an adequate education. Estimated at the sample means of tenure and experience, the probability of being over- rather than adequately educated is higher for workers with fewer years of tenure and experience. With the exception of experience when using the VV measure, more years of tenure and experience increase the likelihood of being undereducated rather than adequately educated. Hence, overeducated workers appear to have lower amounts of on-the-job training and undereducated ones possess higher amounts of on-the-job training, after controlling for different observed characteristics. Given the manner in which experience is measured, the results imply that overeducated workers are more likely to be the young members of the employed labor force, while undereducated workers are more likely to be the older members.

This evidence supports somewhat the argument that overeducation may result from a trade-off between education and other forms of human capital. Accordingly, workers with different years of education, but with similar levels of human capital, may work in the same jobs.

Table 4. Multinomial logit estimates of job match: Full sample

	VV		Mode		Qualif	
Variables	log (P_1/P_0)	log (P_2/P_0)	log (P_1/P_0)	log (P_2/P_0)	log (P_1/P_0)	log (P_2/P_0)
CONSTANT	−11.656	−0.483+	−4.897	−3.441	−1.908	1.806
EDUC	1.249	−1.572	1.170	−0.442	0.431	−0.576
TENURE	−0.071	0.003+	−0.101	0.046	−0.079	0.012*
TENURE^2	0.001	0.0005+	0.001	−0.0003+	0.0001+	0.0006
EXPER	−0.032	−0.021**	−0.091	0.016	−0.068	0.064
EXPER^2	0.0002+	0.0005*	0.0009	0.0002+	0.0009	−0.001
MALE	0.843	−0.387	0.228	−0.462	0.149	0.651
% of correct predictions	93.5		83.0		70.0	
X^2 (66)	19538		25581		24526	

Notes: P_0 denotes the probability that a worker is adequately educated, P_1 is the probability of being overeducated and P_2 is the probability that she is undereducated. Unless indicated otherwise, all coefficients are statistically significant at the 1% level. Different levels of significance are denoted as follows: * (5% level), ** (10% level), + (not significant). Other variables included in the regressions are dummies for location, firm size, sector of activity, occupation, and public vs private status.

4. EFFECTS OF OVEREDUCATION AND UNDEREDUCATION ON EARNINGS

To test for the effects of overeducation and undereducation on earnings, basically two models have been presented in the literature. The first one, following Verdugo and Verdugo (1989), can be written as:

$$\ln Y = \delta + \mathbf{X}\Psi + \Phi_o \text{OVERED} + \Phi_u \text{UNDERED} + \mu, \quad (1)$$

where ln Y denotes the natural logarithm of earnings, OVERED and UNDERED are dummy variables for overeducation and undereducation, respectively, $\mathbf{X}$ is a vector denoting other explanatory variables—including education, Ψ is a vector of coefficients and μ is an error term.

According to this specification, over- and undereducated workers are compared to those who have similar observed characteristics (including years of education), but who work in jobs that require the years of education they actually possess. If productivity levels and wages are attached to actual levels of education, the coefficients on the over- and undereducation variables should be zero. Any number of years of education deviating from the required level of education for the job would be unproductive and the reward would be zero. If, on the other hand, productivity levels are flexible and a positive relation exists between educational level and worker productivity, then positive returns to years of overeducation and negative returns to years of undereducation would be expected. Overeducated workers would earn more than co-workers who have the required education in the particular job; however, they will earn less than workers who have the same education, but who work in jobs that require that higher educational level. Alternatively, undereducated workers would earn less than co-workers who possess the required education; they will earn more than those with the same level of education who work in jobs that require the educational level they actually have.

The second model, attributed to Duncan and Hoffman (1981), can be expressed as:

$$\ln Y = \alpha + \mathbf{Z}\beta + \phi_r \text{ADSCHOOL} + \phi_o \text{OVERSCH} + \phi_u \text{UNDERSCH} + \epsilon, \quad (2)$$

where $\mathbf{Z}$ is a vector of explanatory variables—excluding education, β is a vector of coefficients and ϵ is a disturbance term. Total years of education (EDUC) have been decomposed into the continuous variables: required years of education (ADSCHOOL), years of overeducation (OVERSCH), and years of undereducation (UNDERSCH). The following relations hold:

$$\text{EDUC} = \text{ADSCHOOL} + \text{OVERSCH} - \text{UNDERSCH}; \quad (3)$$

$$\text{OVERSCH} = \text{EDUC} - \text{ADSCHOOL}, \text{ if EDUC} > \text{ADSCHOOL}, = 0, \text{ otherwise}; \quad (4)$$

$$\text{UNDERSCH} = \text{ADSCHOOL} - \text{EDUC}, \text{ if ADSCHOOL} > \text{EDUC}, = 0, \text{ otherwise}. \quad (5)$$

The signs on the coefficients are expected to be $\phi_r > 0$, $\phi_o > 0$, $\phi_u < 0$ and $\phi_o < \phi_r$. The average return to years of required education is ϕ_r; ϕ_o is the return to an additional year of education beyond the educational requirement, relative to co-workers who have the required education, and ϕ_u is the loss of earnings due to a year of undereducation, relative to co-workers who have the required education. The model is estimated using indexes of overeducation based on the modal (Mode) and qualification (Qualif) values discussed above.

Estimates based on the Verdugo and Verdugo model (Table 5) suggest that overeducated workers (OVERED) in 1991 earn, on average, about 8.0% less than those with the same education who are working in occupations in which the educational requirements correspond to the actual level. The wages of overeducated women are 3.6% lower than those with the required education and the wages of men are 9.5% lower. Workers with less education than that required for the job (UNDERED) earn 16.3% more than similar workers with the same level of education who are employed in occupations in which the educational requirements correspond to actual educational attainments and the returns to undereducated workers are similar across gender (15.6% and 16.5% for women and men, respectively). The returns to TENURE and EXPER are positive and, as expected, exhibit diminishing returns. The interaction terms suggest that education and each of the other human capital variables are generally complementary in their effect on earnings. Note that the regression equations contained explanatory variables to account for the influence of location of employment, sector of activity, firm size, public vs private ownership, and occupation on earnings.

The Verdugo and Verdugo model does not allow one to obtain evidence on the returns to years of education that deviate from the level of schooling required by the job. However, estimation of Equation (2) should provide insight into this issue.

Tables 6 and 7 contain the estimates of the Duncan and Hoffman model using the Mode and Qualif measurement criteria for required education. The coefficients of required (ADSCHOOL)-, over (OVERSCH)- and undereducation (UNDERSCH) are statistically significant and have the expected sign. Using either criterion, the highest returns to an additional year of education were received by those with adequate schooling, while the yield to the unde-

Table 5. Estimated earnings coefficients: Verdugo and Verdugo model (VV), full sample and by gender

Variables	Full sample	Females	Males
CONSTANT	6.535	6.657	6.689
	(79.27)	(55.61)	(60.00)
EDUC	0.062	0.056	0.064
	(36.89)	(21.89)	(28.48)
OVERED	−0.080	−0.036*	−0.095
	(−9.08)	(−2.44)	(−8.48)
UNDERED	0.163	0.156	0.165
	(15.67)	(9.51)	(12.34)
TENURE	0.017	0.014	0.019
	(23.00)	(11.45)	(19.39)
$TENURE^2$	−0.0003	−0.0003	−0.0004
	(−17.02)	(−8.60)	(−14.29)
EXPER	0.015	0.015	0.016
	(18.31)	(11.48)	(14.58)
$EXPER^2$	−0.0002	−0.0003	−0.0002
	(−18.68)	(−12.19)	(−14.76)
ln HOURS	0.651	0.660	0.639
	(42.56)	(29.91)	(30.80)
EDUCTEN	0.001	0.001	0.001
	(15.53)	(11.99)	(10.88)
EDUCEXP	0.0002	−0.0001+	0.0003
	(2.09)	(−0.82)	(2.63)
R^2	0.587	0.575	0.550
Sample size	30336	11130	19206

Notes: *T*-ratios in parentheses. Unless otherwise denoted, all coefficients are statistically significant at the 1% level. Different levels of significance are denoted as follows: * (5% level), ** (10% level), + (not significant). Other variables included in the regressions are dummies for location, firm size, sector of activity, occupation, and public vs private status. The wage equation for the full sample includes the dummy variable MALE.

reducated was consistently negative. The coefficients on the interaction terms between tenure and experience and years of adequate-, over- and undereducation show mixed effects, suggesting that interaction effects might be important. A positive interaction (complementary effect) is found between tenure and years of adequate- and overeducation under both criteria: the adequately educated and overeducated are rewarded with a higher return to additional years of tenure with the firm. There is evidence that previous job experience and adequate- and overeducation are substitutes in their effect on earnings. While not strong, it appears that the interaction terms of undereducation with tenure and experience are opposite to those reported above: undereducation and tenure are substitutes in their effect on earnings, while undereducation and previous experience may be complementary. The fact that the interaction between tenure and undereducation may be negative suggests that employers may correct for previous hiring mistakes with relatively low earnings growth if the undereducated do not perform their jobs adequately.

In order to ascertain the robustness of these results, the latter model was tested against alternative specifications (Hartog and Oosterbeek, 1988). According to the conventional human capital model, years of adequate-, over-, and undereducation should be rewarded equally, imposing the restriction that the coefficients of Equation (2) should be $\phi_r = \phi_o = -\phi_u$ and different from zero. According to the so-called job competition model (Thurow, 1975), only adequate schooling is rewarded, thus restricting the coefficients to $\phi_o = -\phi_u = 0$. Both sets of restrictions were rejected for each of the samples on the basis of computed *F*-statistics.

Finally, the coefficient estimates reported in the previous tables were used to compute estimates of private (Mincerian-type) rates of return to required-, over-, and undereducation. The rates for the average values of tenure and experience in the sample are reported in Table 8. (Appendix C contains the additional means required to calculate the rates of return in Table 8.) Overeducated individuals earned more, and undereducated workers less, than their coworkers with exactly the required level of education, given the other characteristics (experience, tenure, location, etc.). However, the overeducated (undereducated) earned less (more) than workers with the same educational attainment who hold jobs for which they are adequately educated. This result is obtained for the full sample and by gender irrespective of the measurement criterion used to define required schooling. Apparently, additional schooling beyond the required level is not completely unproductive, but the ability of workers to use fully their education is constrained by the skill requirements of their job.

While the full-sample rates of return reported in Table 8 for 1991 could be compared to similar rates calculated for Spain for the year 1985 (Alba-Ramírez,

Table 6. Estimated earnings coefficients: Duncan and Hoffman model, full sample and by gender (Mode)

Variables	Full sample	Females	Males
CONSTANT	6.440	6.561	6.568
	(78.45)	(55.32)	(59.09)
ADSCHOOL	0.076	0.067	0.081
	(39.63)	(22.59)	(31.48)
OVERSCH	0.048	0.056	0.044
	(23.31)	(17.21)	(16.52)
UNDERSCH	−0.056	−0.068	−0.052
	(−15.76)	(−13.51)	(−10.58)
TENURE	0.018	0.013	0.020
	(23.66)	(10.81)	(20.39)
TENURE^2	−0.0004	−0.0004	−0.0004
	(−18.17)	(−11.19)	(−14.70)
EXPER	0.016	0.015	0.017
	(18.69)	(11.19)	(15.20)
EXPER^2	−0.0002	−0.0003	−0.0002
	(−18.23)	(−12.25)	(−14.36)
ln HOURS	0.664	0.676	0.654
	(43.51)	(30.86)	(31.63)
ADSTEN	0.001	0.001	0.001
	(10.94)	(11.05)	(6.19)
ADEXP	−0.00004+	−0.00001+	−0.0001+
	(−0.51)	(−0.05)	(−0.61)
OVTEN	0.001	0.001	0.001
	(10.44)	(6.19)	(8.44)
OVEXP	0.0001	−0.001	0.0004
	(1.07)	(−3.72)	(2.74)
UNDTEN	−0.00004+	0.001	−0.0002+
	(−0.26)	(2.97)	(−1.10)
UNDEXP	0.0002**	0.001	0.00002+
	(1.68)	(3.97)	(0.09)
R^2	0.592	0.584	0.555
Sample size	30336	11130	19206

Notes: *T*-ratios in parentheses. Unless otherwise denoted, all coefficients are statistically significant at the 1% level. Different levels of significance are denoted as follows: * (5% level), ** (10% level), + (not significant). Other variables included in the regressions are dummies for location, firm size, sector of activity, occupation, and public vs private status. The wage equation for the full sample includes the dummy variable MALE.

1992, Table 3, Column 4), we replicated the rates of return reported in Table 8 using the 1985 data from the Quadros de Pessoal. The average rate of return to an adequately educated Portuguese worker in 1985 was 6.0% using the Mode, and 8.3% using the Qualif. criterion. The average rate of return to an adequately educated Spanish worker in 1985 was 5.8%. The returns to overeducation in Portugal were 5.1 (Mode) and 2.2 (Qualif)%; comparable returns to overeducation in Spain were 2.7%. The penalty for undereducation was 4.7% in the Spanish labor market in 1985 and around 3.8 (Mode) to 5.1 (Qualif)% in the Portuguese labor market. It is clear from Table 8 and the rates given above that the rewards for adequate- and overeducation have increased in Portugal from 1985 to 1991, and the penalty for undereducation has also increased. Since the Spanish and Portuguese labor markets are similar in that both have relatively low average educational levels and high proportions of workers without any higher education, we speculate that the situation in Spain has been similar.

5. SUMMARY AND CONCLUSION

Defining over- and undereducation as a divergence between the educational attainments of workers and the skill requirements of their jobs, some authors have constructed indices on the basis of information on skill requirements by job analysts (Rumberger, 1981, 1987), while others have based their measurements on the individual's self-evaluation of skill requirements (Duncan and Hoffman, 1981; Rumberger, 1981, 1987; Hartog and Oosterbeek, 1988; Sicherman, 1991; Alba-Ramírez, 1992; Cohn and Khan, 1995). In addition, indices of over- and undereducation have been constructed based on observed educational attainments of workers (Verdugo and Verdugo, 1989). The consensus of these studies is that the estimated returns to required education exceed those to overeducation, while the returns to undereducation are negative.

With regard to the effects of over- and undereducation on earnings in Portugal, the evidence is in gen-

Table 7. Estimated earnings coefficients: Duncan and Hoffman model, full sample and by gender (Qualif)

Variables	Full sample	Females	Males
CONSTANT	6.436	6.412	6.633
	(81.36)	(56.17)	(61.83)
ADSCHOOL	0.101	0.104	0.100
	(53.35)	(34.48)	(40.90)
OVERSCH	0.033	0.030	0.034
	(15.19)	(9.70)	(11.08)
UNDERSCH	−0.048	−0.066	−0.039
	(−13.36)	(−10.70)	(−8.73)
TENURE	0.019	0.017	0.020
	(25.71)	(13.86)	(20.97)
$TENURE^2$	−0.0003	−0.0003	−0.0003
	(−16.38)	(−8.73)	(−13.51)
EXPER	0.014	0.015	0.015
	(17.45)	(11.33)	(13.94)
$EXPER^2$	−0.0002	−0.0002	−0.0002
	(−15.76)	(−10.99)	(−12.23)
ln HOURS	0.641	0.663	0.622
	(43.67)	(31.58)	(31.17)
ADSTEN	0.0003	0.0004*	0.0003
	(3.42)	(2.32)	(2.60)
ADEXP	−0.0003	−0.0004	−0.0003
	(−3.45)	(−2.98)	(−2.64)
OVTEN	0.001	0.001	0.0005*
	(5.69)	(6.32)	(2.29)
OVEXP	−0.0003*	−0.001	−0.00002+
	(−2.32)	(−3.79)	(−0.12)
UNDTEN	−0.001	0.0002+	−0.001
	(−4.39)	(0.75)	(−5.19)
UNDEXP	−0.0001+	0.001**	−0.0001+
	(1.10)	(2.50)	(−0.41)
R^2	0.621	0.615	0.583
Sample size	30336	11130	19206

Notes: *T*-ratios in parentheses. Unless otherwise denoted, all coefficients are statistically significant at the 1% level. Different levels of significance are denoted as follows: * (5% level), ** (10% level), + (not significant). Other variables included in the regressions are dummies for location, firm size, sector of activity, occupation, and public vs private status. The wage equation for the full sample includes the dummy variable MALE.

Table 8. Estimated rates of return to education: Full sample and by gender

	Full sample		Females		Males	
Description	Mode	Qualif	Mode	Qualif	Mode	Qualif
ADSCHOOL	0.083	0.100	0.078	0.101	0.086	0.098
OVERSCH	0.062	0.035	0.054	0.029	0.063	0.038
UNDERSCH	−0.053	−0.051	−0.052	−0.056	−0.054	−0.048

Notes: Derived from Tables 6 and 7, assuming that EXPER and TENURE are equal to their respective sample means.

eral agreement with that found for other countries. Overeducated workers earn more, and undereducated less, than their co-workers with exactly the adequate years of schooling and identical other characteristics. However, overeducated workers earn less and undereducated workers receive more than workers with the same educational attainment, but who hold jobs for which they are adequately educated.

Our evidence suggests that the existence of overeducation and undereducation could result from a trade-off between education and other forms of human capital. More educated workers may require less on-the-job training, while less educated workers may supplement their formal education with job experience, allowing workers with different years of education but similar levels of human capital to perform the same jobs. Under this view, the phenomenon of overeducation could be a transitory situation, with workers accumulating human capital that allows them to improve their job situation, and undereducation could be long lasting as education levels are fixed.

The analysis reported here supports prior findings that earnings are not uniquely determined on the basis of the educational attainment of workers. The place-

ment of the worker in a particular job plays a role in wage determination. Hence, estimates of the impact of education on earnings using the standardized human capital earnings model may be misleading, as estimates of the return to additional education beyond that required to perform the job may be lower than those associated with required education.

Accordingly, the findings of our study supplement the existing evidence confirming the nature of the overeducation phenomenon. Whether overeducation is a long-run phenomenon resulting from inflexible production technologies and/or high adjustment costs of firms, a consequence of trade-offs between different forms of human capital investments, or a temporary stage in a rational worker's career path is still unknown. If there is a trade-off between years of schooling and other forms of human capital, as our evidence suggests, then job mobility could result in a long-run match between educational attainment of workers and the skill requirements of jobs—implying a short-run discrepancy between educational attainments of workers and skill requirements of jobs. More light could be shed on these issues if data in the Quadros de Pessoal contained an individual identifier that would allow the same individual to be identified for a number of years.

As suggested earlier, the equations estimated here are "first generation" earnings equations. Paucity of data preclude correction for selectivitly biases (Heckman, 1976), consideration of the joint determination of non-market returns and non-market time (Kiker and de Oliveira, 1992), unobserved heterogeneity, measurement error and other factors (see, for example, Ashenfelter and Krueger, 1994).[8]

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NOTES

1. For a discussion of some difficulties with the Verdugo and Verdugo approach, see Cohn (1992), Gill and Solberg (1992) and Verdugo and Verdugo (1992). Other difficulties with this approach are reported in the text below.
2. Additional work in the general area of "overeducation" include Tsang and Levin (1985) who draw upon the industrial–psychology literature to establish theoretically the impact of overeducation on production, Tsang (1987) who investigates the impact of undereducation on productivity at the firm level, Groot (1993) who shows the relation between firm-provided training and overeducation (in formal schooling) and Robst (1995b) who examines the relation between college quality and overeducation. For a recent example of a related literature on overeducation, job match and job mobility, see Robst (1995a).
3. Because of data limitations, the equations estimated here are basically "first generation" wage equations. For a discussion of "second generation" and further-extended wage equations, see Kiker and de Oliveira, (1992).
4. While the choice of plus or minus one standard deviation is obviously subjectively imposed by the research analyst, the Verdugo and Verdugo technique avoids the possible subjectivity involved with evaluations of job requirements provided either by the job incumbent or job analyst. In addition, the use of actual attainments is more likely to incorporate any changes in educational requirements due to changes in technologies and forms of workplace organization.
5. While this criterion for measuring inadequate and adequate education allows for little variation in the quality of jobs within an occupation, it should be emphasized that disaggregation of this data set at the 3-digit level virtually equates the job and occupation. In the empirical work that follows, if more than one modal value was calculated, the lowest value was used in the analysis. Deletion from the analysis of the occupations for which this particular problem occurred did not alter the results.
6. Regarding the persistence of over- or undereducation, if inflexible production technologies and positive adjustment costs exist, employers may be unable to adjust easily to changes in the supply of educated workers. Furthermore, any decline in the relative wages of the more educated workers may not lead to adjustments of investment decisions. Individuals may continue to invest in education, since the rates of return can stay high relative to past rates or to returns on alternative investments. If overeducation is a persistent occurrence in the labor market, there are negative implications for allocative efficiency and an important tenet of human capital theory— the explanation of the link between education and earnings— is challenged.
   The underutilization of educational skills of workers in the labor market may be temporary, however (Sicherman and Galor, 1990; Sicherman, 1991). A divergence between actual and required educational skills may be explained within the context of job match theory or by the existence of temporary stages in workers' careers. Overeducation may result from a bad job match if workers' educational attainments are better suited elsewhere. While the wages of these workers may be lower than those in good job matches, wages would be expected to increase as a result of worker job mobility. Consistent with the human capital mobility framework (Rosen, 1972; Sicherman and Galor, 1990), new entrants into the labor market may accept jobs for which they are overeducated because they seek training and learning opportunities (Rosen, 1972). Accordingly, overeducation could correspond to an "ex-ante optimal" situation because workers may acquire training that will result in a promotion or better job within the firm, or in a move to a better job in another firm.
7. Using the Hauseman and McFadden (1984) technique, we tested the model for independence of irrelevant alternatives (IIA). The test reveals that inclusion of the three choices (over-, under-, and adequate education) do not lead to inconsistent results.
8. As suggested earlier in the text, unobserved heterogeneity may be important if individuals with less

ability require "overeducation" to attain and maintain their jobs. Or, if individuals who attend low quality schools need excess education to acquire and keep jobs (Robst, 1995a). The fact that there are several diffferent methods for measuring required education could lead to measurement error.

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Appendices — *overleaf*

APPENDIX A

Qualification levels, specific training, and formal education

Knowledge acquired during specific training	Knowledge acquired during formal training
Level A Scientific training: general scientific knowledge in planning and coordination of fundamental activities in the field requiring the study and investigation of problems of high responsibility and technical–scientific level.	*Level A* At university level in a highly specialized field.
Level B Scientific training: knowledge in planning and coordination of activities in a circumscribed field requiring scientific work.	*Level B* At university level.
Level C Technical training at an intermediate level required for planning and coordination functions in a specific field.	*Level C* At intermediate schooling level; commercial school or equivalent.
Level D Complete technical knowledge in a job with a specialization required for the execution of tasks of high technical level.	*Level D* At secondary schooling level; 11 yrs or equivalent.
Level E Complete knowledge in a job (either intellectual or manual); required to accomplish complex, diversified and non-repetitive tasks.	*Level E* At secondary level. General level; 9 yrs or equivalent.
Level F Knowledge in a limited field; required for the execution of tasks with a small degree of complexity.	*Level F* At 6 yrs of schooling or equivalent.
Level G Applied and elementary knowledge; required for execution of simple repetitive tasks.	*Level G* At basic education; 4 yrs of schooling or equivalent.
Level H Applied knowledge; possible to be acquired in a short period; required for execution of very easy tasks.	*Level H* At reading and writing basic level.

Source: Coelho *et al.* (1982)

APPENDIX B

Qualification levels—knowledge, education, and functional content

Level	Function (1)	Knowledge (2)	Years of education (3)
0 – Managers	Definition of the general policy of the firm; consultive functions.	Planning and coordination knowledge.	University level (14 or 16 yrs of schooling).
1 – Highly skilled technicians	Creative work.	Scientific training: general scientific knowledge in planning and coordination of fundamental activities.	University level (14 or 16 yrs of schooling).
2 – Technicians at intermediate level	Tasks of organization and execution of planning.	Technical training at an intermediate level required in planning and coordination functions.	11 or 12 yrs of schooling.
3 – Supervisors	Tasks of supervision of groups of workers.	Technical training in a specific field.	11 yrs of schooling.
4 – Highly skilled	Tasks of highly technical content.	Complete technical knowledge in a job with specialization at a specific level.	9 yrs of schooling.
5 – Skilled	Executive tasks; complex and non-repetitive tasks.	Complete specific training in a job (either intellectual or manual) implying theoretic and applied knowledge.	6 yrs of schooling.
6 – Semi-skilled	Simple and repetitive tasks.	Training in a specific field or applied and elementary professional knowledge.	4 yrs of schooling.
7 – Non-skilled	Very simple tasks.	Applied and elementary knowledge obtained in short period.	3 or less years of schooling.

Source: Coelho *et al.* (1982)

APPENDIX C

Means and standard deviations of interaction variables, full sample and by gender

	Full sample		Females		Males	
Variables	Mode	Qualif	Mode	Qualif	Mode	Qualif
ADSCHOOL	5.691	5.975	5.991	5.512	5.517	6.243
	(3.18)	(2.54)	(3.23)	(2.22)	(3.13)	(2.67)
OVERSCH	0.928	1.081	0.840	1.333	0.980	0.934
	(1.97)	(1.88)	(1.80)	(2.02)	(2.06)	(1.78)
UNDERSCH	0.605	1.041	0.632	0.647	0.589	1.270
	(1.64)	(1.69)	(1.61)	(1.30)	(1.66)	(1.84)
ADSTEN	52.259	56.228	49.422	45.312	53.903	62.553
	(71.80)	(72.33)	(66.65)	(57.30)	(74.58)	(79.07)
ADEXP	82.420	90.017	77.071	72.335	85.519	100.260
	(68.63)	(73.17)	(66.43)	(58.03)	(69.68)	(78.86)
OVTEN	5.510	6.326	4.056	7.665	6.353	5.550
	(21.21)	(18.43)	(16.73)	(20.14)	(23.38)	(17.32)
OVEXP	9.287	10.887	7.291	12.532	10.445	9.933
	(24.77)	(22.48)	(19.08)	(22.44)	(27.47)	(22.45)
UNDTEN	7.793	12.599	7.183	6.683	8.146	15.992
	(30.07)	(32.74)	(25.25)	(20.73)	(32.53)	(37.58)
UNDEXP	10.777	19.973	10.490	10.995	10.943	25.176
	(35.77)	(40.01)	(33.79)	(28.21)	(36.87)	(44.65)
Sample size	30336	30336	11130	11130	19206	19206

Note: Standard deviation in parentheses.