

**Applied Research on Portuguese Labour
Supply and Earnings: A Survey**

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**Working Paper n° 291
April, 1997**

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Abstract

The aim of this study is to analyse the applied research on the Portuguese labour market. We focus on labour supply and earnings. We show that the results of several research studies are similar, that is, they are robust to different data sets, equation specification and estimation procedures. Additionally, the reader has the opportunity to get a deeper view about the labour market behaviour in Portugal. The estimation results come from three sets of functions: earnings; participation decision in the labour market; and hours of work supplied to the market. The estimation of individual's earnings holds results that are similar, not only in the signs of the variables' influence on earnings but also in the values obtained for the associated coefficients. Concerning the participation decision and hours of work, we have two different types of results. When we consider the male's behaviour, the findings are scarce and it is difficult to come to conclusions. If the female's behaviour is the aim of the research, the results are robust to the different estimation settings.

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** Support by PRAXIS XXI

1. Introduction

The aim of this study is to analyse certain applied research into the Portuguese labour market. We focus on labour supply and earnings and we endeavour to verify if the results of several research studies are similar, that is, if they are robust to different data sets, equation specification and estimation procedures. Additionally, we have the opportunity to gain some deeper insight into the behaviour of the labour market in Portugal.

The estimation results come from three sets of functions: earnings or market wage; participation decision in the labour market; and hours of work supplied to the market. The unit of observation in the data sets is the individual.

The estimation of individual's earnings shows results that are similar, not only in the signs of the variables' influence on earnings but also in the values obtained for the associated coefficients. Years of education, experience and tenure have positive estimated coefficients that hold the same magnitude when we go from one study to another. Education is the variable with the highest influence on earnings of the three. Regularities can also be found in the influence of individual's age, firm size, job qualification and region. The associated coefficients are hard to compare in value due to different estimation settings, but hold the same sign. The first three variables have positive coefficients. Concerning the regional influence on earnings: when the individual works in the region of Lisbon his/her earnings are higher than if he/she works in another region of Portugal, and the reverse is true for the North and Centre of Portugal. The decomposition of the earnings differential by gender in price effects and attribute effects leads to the conclusion that the former effect is the strongest one.

Concerning the participation decision and hours of work we have two different types of results. When we consider the male's behaviour, the findings are thin and it is difficult to arrive at conclusions. If the female's behaviour is the aim of the research, the results are richer. Years of education and age have positive effects on the female's participation and supply of hours. Other income, age squared and the presence of children have negative effects.

The paper is organised as follows. The second section introduces the aims of the research papers analysed. The third section describes the several data sets used. The fourth section goes through the estimation procedures that can be found in the research. The estimation results for earnings, labour market participation and hours of work are analysed in the fifth part of the present work. Finally, we make some concluding comments.

2. Introduction to the Research

We present below a brief description of the applied research papers analysed in this survey.

In Mendes *et al.* (1995) the aim is to make a thorough probe into the Portuguese family in the 1990s, namely on issues such as fertility, parents' investment in children and time allocation within and outside the family. The authors also work through an individual's behaviour when facing AIDS and drug addiction. We focus on the results concerning male and female participation and hours supplied in the labour market.

Mendes and Pereira (1989) study the time allocation of the Portuguese families, not only between work at home and in the market but also on child care, religious activities, sports, social activities and transportation. Mendes and Pereira (1990) extend the results of the previous paper in order to include the analysis of regional differences in the time allocation of Portuguese families.

Santos (1995), Kiker and Santos (1991), Martins (1991) and Psacharopoulos (1981) study earnings functions for Portugal. The role of education and experience as a human capital accumulation is discussed throughout their influence in wage formation. Wage differentials by gender are analysed in Kiker and Santos (1991) and Martins (1991), namely the decomposition in "attribute effects" and "price effects". Kiker and Santos (1991) estimate this decomposition considering the earnings differences by sector of employment in addition to gender. In the work of Santos (1995) the influence of over and under-education on earnings is fully elaborated - a topic also studied in Kiker and Santos (1991). In both studies the regional differences in the labour market and the role of tenure are discussed as well. Santos (1995) also follows the generalisation of the human capital model to include the role of occupation. This work applies an estimation method with earnings functions corrected by individual's allocation to a job level.

The role of education and human capital in general is analysed in Silva (1985). The author surveys several education systems and relates them to the labour demand. The applied research is implemented through the estimation of wage equations. São Pedro and Baptista (1992) also study the role of education as an accumulation of human capital and discuss the impact of education on labour productivity. The private sector and the public administration sector are analysed separately.

Vieira (1992) and Vieira and Pereira (1993) analyse the wage differential determinants in the Azores islands. The human capital earnings function is extended to include levels of qualification of the jobs as in Santos (1995). The authors also consider wage differentials by gender and decompose them in the "price effect" and "attribute effect" referred to above in order to assess the existence or not of discrimination by gender. In Hartog *et al.* (1995) the wage formation in the Azores islands is related to the wage bargaining settings and labour market institutions.

Vieira *et al.* (1997) study the wage structure and job level allocation in Portugal and their evolution during the 1980s and early 90s. The results of the research are matched with the transformations of the Portuguese economy during this period.

Lima *et al.* (1996) provide some results regarding the female's behaviour in the labour market. The determinants of the participation decision in the labour market and the supply of working hours are discussed. In addition a wage equation is estimated to identify the variables that affect the market wage rate. The problems that arise due to the classification of the earnings variable by categories and possible solutions are presented in the empirical analysis. The study from Martins (1996) is also about the female's behaviour in the labour market. The author proves that the estimation results are sensitive to the economic and statistical specification of the female's labour supply. Both papers consider married women.

Pereira and Lima (1996) estimate a market wage rate and hours of work functions. The study is carried out for both male and female partners in a couple. The same set of questions about him/her and about his/her partner was directed to only one member of the couple. The main point was to verify whether or not both sets of questions were coherent with the same model.

The tax system influence on the female's labour market participation is discussed in Marques and Pereira (1995a) and Marques (1993). Different fiscal simulations are carried out to study the women's sensitivity to the income tax. A human capital earnings function is estimated in order to compute an after-tax wage. Marques and Pereira (1995c) extend the results of their papers mentioned above in order to include the estimation of a labour supply function. Several estimation methods are implemented and discussed.

3. Data Sets

The data sets are all cross sectional. In Portugal there is a scarcity of data, and although some papers use more than one year of data, it is impossible to track the individual from one year to another.

The survey, *Quadros de Pessoal*, that the Ministry of Employment annually collects from the Portuguese firms is the data source used in: Kiker and Santos (1991), the year 1985; Santos (1995), the years 1985 and 1991; Martins (1991), (uses mean values of the individual observations), and Psacharopoulos (1981), the year 1977; Silva (1985), the year 1983; Vieira (1992) and Vieira and Pereira (1993), the year 1989; Vieira *et al.* (1997), the years 1982, 1986 and 1992. These surveys include the data collected in questionnaires that are sent to Portuguese firms every year. Every firm with more than one employee gives information about workers' personal characteristics and firm characterisation. The firm is required by law to respond the survey.

The data set studied in Mendes *et al.* (1995), Lima *et al.* (1996) and Pereira and Lima (1996) comes from a survey ordered by the *Direcção-Geral da Família*, in 1994. The total sample has 706 couples with at least one child under 18 years old living at home and is fully analysed in Mendes *et al.* (1995). It is a sample stratified by region and populational

dimension by place, and obtained by direct interview in the residence of the individuals. At least one of the couple members is between 25 and 54 years of age.

Mendes and Pereira (1989,1990) also use data provided by the *Direcção-Geral da Família*, from a survey conducted in 1987. The sample was constructed by "random route" to choose the household. It has 725 families with at least one child under 15 years of age living at home.

In Marques and Pereira (1995a), Marques (1993) and Marques and Pereira (1995b) the data set is *Inquéritos aos Dados do Emprego*, 1990, third quarter, from the Portuguese national institute of statistics, (*Instituto Nacional de Estatística*). In the sample used, only married women whose husbands participate in the labour market are considered. The same type of data set is used by Martins (1996) but for 1991.

São Pedro and Baptista (1992) use two sets of data. One of the sets is for public servants from a survey conducted by the *Direcção Geral da Administração Pública* in 1988. The other is for workers in the private sector from two surveys, both conducted in 1988: *Quadros de Pessoal* mentioned above; and *Inquéritos Anuais às Empresas* from the Portuguese national institute of statistics, (*Instituto Nacional de Estatística*).

Table A1 in the Appendix shows the samples' size by gender and survey year.

4. Estimation Procedure

Mendes *et al.* (1995) estimate a probit function for participation probability in the labour market for men and women separately. The hours supplied to the labour market are estimated through a tobit function. The same procedure is used in Mendes and Pereira (1990,1989). A criterion to assess the existence of regional differences in the pattern of the individual's labour supply is applied by Mendes and Pereira (1990).

The estimation conducted in Lima *et al.* (1996) consists of three stages and uses data for women exclusively. First, an equation for the women's participation probability in the labour market is estimated using a probit function. The results of this estimation allow the computation of the so-called *inverse of Mill's ratio*, a selection bias variable. The constructed variable is included in the wage regression to correct the selection bias that arises from the non-observability of wages for those women that do not participate in the labour market. The wage estimation, using this selection bias corrected regression, is the second stage. The consistent estimates are obtained using an algorithm of the type proposed by Stewart (1983) to solve the grouped data problem of the wage variable. Third, the estimation of an equation for hours of work is carried out using a tobit function. The estimated wages for all women, participants and non-participants, are introduced in the right hand side of the hours equation. In Pereira and Lima (1996) the above analysis is extended to men.

The three stages described above are also applied in Martins (1996) and labelled as Heckman's model. This model is compared with a generalised model that specifies the participation decision separately from the hours of work decision given that there is no joint restriction between the set of regressors included in each decision equation. The two decisions are linked by the error term of each equation, alone. In this way, the total effect of a change in the regressors can be decomposed in the effect on participation and the direct effect on hours of work.

Marques (1993) and Marques and Pereira (1995a) specify a model where a market wage is estimated through a selection bias corrected regression for those women who do not participate in the labour market. The correction of the bias is achieved by the inclusion in the wage regression of the *inverse of Mill's ratio*, mentioned above. This variable is computed with the information provided by the estimation of a participation probability in the labour market through a probit function. The market wage, estimated for those who do not work, is then introduced in a logit function for the participation probability estimation. As the observed wage is after-tax and the aim of the paper is to simulate tax reforms, the authors have to calculate the gross wage and then apply the different tax systems. It is assumed that the relevant wage for the female's participation decision is the after-tax wage. The relation between the wage variable and working hours becomes non-linear due to the tax schedule. Therefore, the solution followed by the authors is to consider two specific points of the female's earnings budget constraint: the after-tax earnings at twenty and forty hours of work, for the participation probability and full-time participation probability, respectively. The earnings variable is grouped by categories. The middle point of each category is the definition of the dependent variable in the estimation of earnings equation.

Marques and Pereira (1995c) added to the above analysis the study of hours supplied to the labour market by females. To estimate the hours of work function the authors use a selection bias corrected regression as in the wage estimation. The errors terms of the wage function are included in the regression as an alternative estimation method. This procedure allows testing the hypothesis of wage exogeneity.

All the research papers use least squares to estimate the earnings equation with the exception of Lima *et al.* (1996) and Pereira and Lima (1996) due to the grouped data problem of the earnings variable.

Santos (1995), Vieira (1992), and Vieira and Pereira (1993) use a two-step estimation procedure to address the impact of job qualification (occupation) on earnings. First, a multinomial logit function for the allocation of workers to jobs is estimated. The goal is to estimate the probability of being assigned to a particular job level. The second step is to estimate earnings equations specific to each job level corrected for selectivity bias. We only observe the individual's wage given his job assignment. This selectivity can raise a problem of inconsistent least squares estimates. For this reason, in the second step the earnings

equation includes in the right hand side a variable that corrects the selectivity bias. This variable is computed using the results of the first step and the associated coefficient gives the correlation between earnings and the allocation probability for a specific job level. Vieira *et al.* (1997) also study the interaction between earnings and job level but in a different way. These authors estimate an ordered probit function for the workers' allocation to jobs, that is, the estimation of the individual worker's probability of being in a job level. Then, the marginal effects of several variables on the job allocation are calculated. In Kiker and Santos (1991) there is another way to tackle the problem. The job level or qualification variable is defined with the help of a continuous variable instead of a dummy set as in the previous papers. This variable is estimated through an equation where the set of regressors is of the same type used in the allocation probabilities estimation. A variable generated from the residuals of this equation is then included in the earnings estimation.

Kiker and Santos (1991) and Santos (1995) estimate the effects of under-education and over-education on individual's earnings. The variables that capture the individual's under-education and over-education are constructed. In essence they are generated through the difference between the individual's skills (education) and the skill requirement for his/her job. Santos (1995) provide several over(under)-education indexes and perform alternative earnings estimation with them.

The Tables A2, A3, and A4 in the Appendix have the variables used in the estimation of participation probability, hours supplied to the labour market and earnings, respectively, in each of the above-mentioned papers.

5. Estimation Results

This section discusses the main estimation results of the research available.

5.1 Earnings

The findings related to the estimation of earnings equations are numerous as a result of the extended set of explanatory variables. We focus on the variables that appear through most of the studies and are different from zero at a reasonable significance level.

The dependent variable in the estimation of the earnings equation is the logarithm of individual's earnings. The individual receives these earnings from his/her supply of hours to the labour market. In the research we almost always have the monthly earnings. The exceptions are the works: Lima *et al.* (1996) and Pereira and Lima (1996) with the estimation of an hourly wage rate; Marques and Pereira (1995a,c) and Marques (1993) with the earnings estimation at 20 and 40 hours of work.

The variable pertaining to education mentioned below refers to attendance at formal schooling. Experience refers to the years of labour market experience in general (or otherwise specified) and tenure refers to the years of experience in the current firm.

Education, experience, tenure and age. The estimated coefficients associated with education, total working experience and tenure can be considered as being fairly robust, as demonstrated by their values in Tables 1, 2 and 3, respectively. Notice that the origin of the data that generated the results of the estimation is diverse and that the estimation procedure implemented is not always the same. Nevertheless, we must note some reservations. The results from Vieira (1992) are for the Azores islands; so we can presume a different labour market setting. The definition of the experience variable is not uniform across the several earnings equations estimated. In Pereira and Lima (1996) the variable is the total working years that the individual reported in the survey. In all of the other papers the lack of this variable in the data sets led to the construction of a variable defined as individual's age minus six (years) minus years of education, and, in Kiker and Santos (1991), Santos (1995), and Silva (1985), minus years of tenure. Pereira and Lima (1996) include the individual's age as an independent variable in the earnings equation because that variable captures additional information given that the individual's experience is directly observed. If we look to Tables 4 and 2, the lower coefficients associated with male's experience, when compared with the values obtained in other studies, can be highlighted with the coefficient associated with male's age. When the earnings equation is extended to include variables such as firm size, individual's occupational level inside the firm, and sector of activity, the coefficients associated with years of education are lower and fall in the interval [3.5%;6.5%]. This fact can explain the lower coefficients found in Vieira *et al.* (1997), where the earnings equation includes firm size, firm age and firm ownership in the set of explanatory variables. The specification of the earnings equation considered in Tables 1-4 is what we could label as basic, given that it only includes variables related to the individual's characteristics, and the major exception is the paper just mentioned. In Martins (1996) there is an interaction term between experience and education. The associated coefficient is used to compute the estimated coefficients associated with education and experience using the respective mean values.

The estimated coefficients from São Pedro and Baptista (1992) in Tables 1 and 2 are for workers in the private sector. When the data set with public servants is used, the coefficients are 5.7, 3.4, and -0.04, respectively.

The signs of the coefficients in Tables 1-4 are as expected. Education has a positive effect. The influence of the variables mentioned in Tables 2-3 is a quadratic one, indicating diminishing returns to on-the-job-training. Note also that the difference by gender between the coefficients is relatively consistent.

When we have *education levels* instead of education years the results are difficult to compare due to different level definitions and equation specifications. We can find some consistencies, however, such as: one more level completed leads to a wage increase; the higher wage increase is associated with the attendance at technical (baccalaureate, 3 years in the university) and university levels (5 years in the university); and during the 1980s and early 90s, the wage premium increased, especially in the case of those with higher levels of education, while the individuals with fewer years of education had a tendency toward lower wage premiums.

Santos (1995) and Kiker and Santos (1991) include in the earnings estimation variables that capture the individual's *under-education* and *over-education*. These variables are related to the matching between the individual's education and the skills requirement of his/her job. The results are as follows: an individual with an over-education earns less than if he/she was adequately assigned with respect to his/her educational skills; an over-educated individual earns more than individuals assigned to the same job but with the required level of education; the reverse is true for the under-educated workers.

Table 1. Earnings equation: Education

	year	Years of Education (%)		
		Female	Male	All
Hartog <i>et al.</i> (1995)	1989	—	7.0	—
Kiker and Santos (1991)	1985	10.4	9.4	10.0
Santos (1995)	1985	9.6	9.0	9.5
Marques and Pereira (1995a)	1990	11.1	—	—
Martins (1991)	1977	8.0	7.3	—
Martins (1996)	1991	8.0	—	—
Silva (1985)	1983	9.1	8.9	9.1
São Pedro and Baptista (1992)	1988	—	—	8.3
Psacharopoulos (1981)	1977	8.4	7.5	9.1
Vieira (1992)	1989	8.9	10.8	9.6
Vieira <i>et al.</i> (1997)	1982	—	—	6.2
	1986	—	—	5.9
	1992	—	—	7.2

Table 2. Earnings equation: Experience

	year	Experience (%)			Experience Squared (%)		
		Female	Male	All	Female	Male	All
Kiker and Santos (1991)	1985	2.4	2.5	2.9	-0.04	-0.04	-0.05
Santos (1995)	1985	2.3	2.4	2.9	-0.04	-0.04	-0.05
Pereira and Lima (1996)	1994	3.4	1.7	—	-0.08	-0.04	—
Marques and Pereira (1995a)	1990	3.0	—	—	-0.03	—	—
Martins (1991)	1977	3.3	5.4	—	-0.04	-0.1	—
Martins (1996)	1991	3.7	—	—	-0.06	—	—
Silva (1985)	1983	3.0	3.6	3.7	-0.06	-0.07	-0.07
São Pedro and Baptista (1992)	1988	—	—	4.8	—	—	-0.06
Psacharopoulos (1981)	1977	—	—	5.1	—	—	-0.07
Vieira (1992)	1989	3.2	5.1	4.5	-0.05	-0.08	-0.07
Vieira <i>et al.</i> (1997)	1982	—	—	4.2	—	—	-0.1
	1986	—	—	3.9	—	—	-0.09
	1992	—	—	3.4	—	—	-0.07

Table 3. Earnings equation: Tenure

	year	Tenure (%)			Tenure Squared (%)		
		Female	Male	All	Female	Male	All
Hartog <i>et al.</i> (1995)	1989	—	1.0	—	—	—	—
Kiker and Santos (1991)	1985	3.3	3.7	3.5	-0.04	-0.05	-0.04
Santos (1995)	1985	3.4	3.7	3.6	-0.1	-0.1	-0.04
Silva (1985)	1983	5.4	5.5	5.2	-0.1	-0.1	-0.1
Psacharopoulos (1981)	1977	3.5	3.1	—	-0.06	0.05	—
Vieira (1992)	1989	1.4	1.1	1.9	—	—	—
Vieira <i>et al.</i> (1997)	1982	—	—	0.7	—	—	-0.04
	1986	—	—	0.8	—	—	-0.07
	1992	—	—	0.8	—	—	-0.08

Table 4. Earnings equation: Age

	year	Age (%)			Age Squared (%)		
		Female	Male	All	Female	Male	All
Hartog <i>et al.</i> (1995)*	1989	—	7.2	—	—	-0.08	—
Pereira and Lima (1996)	1994	2.8**	4.6	—	-0.03**	-0.04	—

Notes: * the equation does not include experience; ** not significant at any reasonable level

Region. The dummy variables for the different Portuguese regions are found in Kiker and Santos (1991), Santos (1995), and Vieira *et al.* (1997). The principal conclusions that can be drawn from the associated coefficients are: in Lisbon wages are higher than in the other regions of Portugal; in the North and Centre of Portugal we have the lowest wages, especially in the 1990s when compared with the mid 80s; in the South, (the regions of Alentejo and Algarve), there is an intermediate situation.

Kiker and Santos (1990) run one equation on each Portuguese region and find different coefficients for the same variables set leading to an interpretation that there is a regional imbalance.

Firm size. Firm size is defined in relation to the number of employees in each firm. The sets of dummies that characterise firm size included in the earnings estimations are all in one direction: the larger the firm is, the higher is the individual's wage. Vieira *et al.* (1997) and Hartog *et al.* (1995) use the logarithm of firm size and arrive at the same result. In Vieira *et al.* (1997), the logarithm of *firm age* is also included. The associated coefficient is negative.

Job qualification. In the surveys from the Ministry of Employment (*Quadros de Pessoal*) there is a classification of occupations (jobs) according to the task performed and skill requirement. From this classification is constructed a measure of the job complexity and responsibility, that is, the job qualification (level). We could consider each job level as a layer in a hierarchy defined in terms of increasing responsibility and task complexity. It is a variable defined in a point scale where each point corresponds to a job level as in Kiker and Santos (1991). It is also defined as a set of dummies, each dummy related with a job level. This last definition appears in all of the other papers that use job qualification mentioned in Table A4 in the Appendix. We have three sets of results for these papers: the coefficients associated with the variable job level on earnings; the coefficients associated with several variables on the allocation probabilities between the levels; and the coefficients of the specific earnings equation, one for each job level and corrected for the selectivity bias. We describe the results below.

Firstly, when the individual moves to a higher job level, the higher the wage is that he/she receives. Secondly, education years have a positive effect on the individual's probability of being allocated to a higher job level. Experience and tenure have a weaker positive effect, although a conclusive statement is harder to assert. Finally, the coefficients associated with education years, experience and tenure are positive in all of the level-specific earnings equations. In the majority of the cases, the coefficients increase as we move to an earnings equation that corresponds to a higher job level. This is especially true concerning education years. The variable that corrects the selectivity bias has an associated coefficient that is, in most cases, not statistically significant. This means that the individual's probability of being allocated to a specific job level is not correlated with the error term of the earnings equation for that level.

Sample selection bias. The fact that we only observe wages for those individuals that participate in the labour market leads to a sample selection bias in the wage estimation. This bias is more pronounced when we have a participation probability far less than one, as is the case for women. As a result, a measure of this selection bias, the so-called *inverse Mill's ratio* or hazard rate, should be included in the right hand side of the earnings regression. The studies Lima *et al.* (1996), Lima and Pereira (1996), Marques (1993), Marques and Pereira (1995a,c) and Martins (1996) are the ones that include this variable in order to correct the sample selection bias in the female's earnings. The other studies do not use the selection bias corrected regression because the data sets contain only individuals who supply a positive amount of hours to the labour market. Nevertheless, the former studies mentioned are not conclusive: for example, Pereira and Lima (1996) and Marques and Pereira (1995c) both find positive coefficients, but in the former study the coefficient is not statistically significant while in the latter, is.

Hours of work. Hours of work is a variable used in the studies referred to in Table A4 of the Appendix. The variable is defined as logarithm of working hours. The estimated coefficients associated with this variable are positive and less than one. The only exceptions are the works Vieira (1992) and Vieira and Pereira (1993), where the coefficient is negative in the female's earnings equation. Note that this result is for the Azores islands.

Attribute and price effects. Earnings differential by gender can be decomposed into two effects: the proportion of the differential due to different endowments of personal attributes, the attribute effect; and the proportion of the differential due to different returns to the personal attributes, the price effect. Kiker and Santos (1991), Martins (1991), Vieira (1992) and Vieira and Pereira (1993) study this topic in addition to the earnings estimation. The results indicate that the price effect explains a higher proportion of the earnings differential. A possible interpretation can be the existence of discrimination against women in the Portuguese labour market. The analysis carried out in Martins (1991) is somewhat different but the results there indicate that the differential is due to different returns to experience and not from different returns to education.

5.2 Labour Market Participation

Portugal has one of the highest female labour market participation rates in Europe, (68% in 1991). At the same time, the male labour market participation, although remaining high, decreased during the 1980s (from 91% in 1980 to 80.6 % in 1990). The analysis of these facts, along with others such as the decreasing fertility rate, is well documented, among others, in: Cardoso (1993,1996); Marques and Pereira (1995b); Mendes *et al.* (1995).

As mentioned above, the applied research on this subject has followed the estimation of probit functions for the participation probability in the labour market. These functions include

in the right hand side variables that influence the market and reservation wages. They are, what we could label, reduced forms, given that the two wages mentioned are not directly included in the estimation. An exception must be made to the research made by Marques and Pereira (1995a,c) and Marques (1993). They estimated a logit function for the participation probability including a market wage among the independent variables.

Male's participation. Only Mendes *et al.* (1995) provide results for the male participation in the labour market. These results are not conclusive and only the *family income* significantly influences (positively) the male participation. The almost non-existence of results is a consequence of high participation rates along with few observations and, in addition, the scarcity of data about this variable in the surveys.

Female's participation. Table 5 shows the influence of several variables on female participation probability. The signs are as expected by the theory. We present only the variables whose associated coefficients are statistically different from zero with a level of 10% or less. As the results are not easily comparable, Table 5 does not show the values of the coefficients.

Marques and Pereira (1995a,c) introduce the female's *market wage* in the estimation of the logit function to analyse the impact of several *tax reforms* on the female's participation in the labour market. The result indicates a small impact of the several tax reforms on the female's participation. Possibly, this is due to the small effect of the tax change on the female's after-tax wages. The reference tax system is the Portuguese one in 1990 and can be characterised as half-way between the joint taxation (splitting system) and the separate taxation of the couple. The results are: a move toward separate taxation increases the participation probability and a move toward joint taxation decreases it; a unique flat rate has only a minor effect on participation. The authors consider two types of participation: work more than zero hours; and work more than thirty hours (full-time). Fewer women participate in the labour market with the move toward the separate taxation when the participation defined as more than zero hours is considered. The other results are the same irrespective of the definition used for participation. The *wage elasticity of participation* is computed through two methods: using the mean values of wages; and calculating the average of individuals' elasticity after a one percent wage increase. The values are, respectively: 3.4 and 1.6 for the elasticity of participation; 0.9 and 0.6 for the elasticity of full-time participation.

Mendes and Pereira (1990) find that in the South *region* of Portugal (Alentejo and Algarve) females have a higher participation probability. Lima *et al.* (1996) find that if the female lives in a *city* with more than 10 000 inhabitants, her participation probability increases. This result is similar to that of Mendes and Pereira (1990) where the coefficient associated with the *place of living dimension* is positive.

Table 5. Female's Participation Probability and Working Hours Supply: Variables' Influence

	Participation probability	Working hours supply
Years of Education	+	+
Age	+	+
Age squared	-	-
Individual's Wage	+	-
Other Income	-	-
Children	-	-

5.3 Hours of Work

There are two estimation procedures of the female's labour supply function. The male's supply is estimated through ordinary least squares. This is not the case for female labour due to the existence of women who stay at home and do not participate in the labour market. One way to solve this censored data problem is the use of a tobit function. This function assumes that the labour supply schedule is a continuous one. The tobit function is used in: Lima *et al.* (1996); Pereira and Lima (1996); Mendes and Pereira (1990,1989); Mendes *et al.* (1995); and Martins (1996). Another way is to assume a discontinuous labour supply schedule and use a selection bias corrected regression as an estimation procedure. This procedure consists of two stages. A measure of the selection bias is first obtained with probit estimates for the participation decision and then this measure is included in the hours regression. Marques and Pereira (1995c) apply this last estimation procedure.

Male's hours of work. The variables that have a significant influence on the male's working hours are: the level of *education* that corresponds to six years of education completed (negative); the presence of *children* (positive); the *wife's income* (negative); the male's *age* (negative); and *wife's age* (positive).

The analysis carried out by Mendes and Pereira (1990) found no regional differences on the male's hours supply in Portugal.

Female's hours of work. In Table 5 we have a breakdown of the female's working hours changes with regard to the variables that have coefficients different from zero (at 10% level). As in the case of participation in the labour market, the signs are as expected by the theory. When the *education* is defined by levels, as in Pereira and Lima (1996), the coefficients are negative. A similar result is obtained for the male's working hours equation. We conjecture that this negative effect is due to the influence of the education levels on the market wage rate, a positive one. So a female with one level more of education has a higher wage but works fewer hours. It may also be due to contract clauses.

The presence of *children* has a negative influence on the female's hours supply (Table 5). This comes from the number of children under six years of age. The number of children between six and twelve years old also has a negative impact, but a smaller one.

The *dimension of place where the family lives* is a variable that has a negative effect on the female's working hours, a result from Mendes and Pereira (1990). The authors also find that working hours have the same pattern irrespective of the Portuguese *region* considered, as is the case for males.

The *individual's wage* in Table 5 has no sign. A positive coefficient, indicating a positive slope for the labour supply is found in Lima *et al.* (1996). The authors calculate the uncompensated *wage elasticity of working hours* at the mean of wages and the value is 0.6. Marques and Pereira (1995c) have the opposite result: a negative effect of wages on the labour supply. The residuals from the earnings equation were included as an independent variable in the hours equation. As the coefficient associated with this variable is significant, the earnings variable is endogenous. This fact can be an explanation for the backward bending labour supply schedule. The results for the *tax reforms* performed in this paper are in the same direction as those for the female's participation in the labour market. Martins (1996) also finds a negative wage effect on the hours supply. The wage elasticity is -0.04, a value very close to the one found in Marques and Pereira (1995c), which is -0.06.

6. Concluding Comments

The estimation results of the applied research on the Portuguese labour supply and earnings are robust. We have analysed studies that use different estimation settings. The data sets, equation specification and estimation procedures differ, but some important results for the labour market in Portugal are achieved. If the findings are the same in the various papers, then we are more confident that they are a true approximation of the real picture.

Years of education, experience, tenure, age, firm size and job qualification are all variables with a positive influence on the individual's earnings. The region where the individual lives has a precise influence: earnings increase if the worker lives in Lisbon and decrease if he/she lives in the North and Centre of Portugal, other things being equal. The squares of experience, tenure and age have a negative impact on earnings. The different rewards for the individual's attributes are more important in explaining higher male earnings than the different individual's endowments of attributes.

Male's labour supply is a topic that needs further research in order to arrive at more-robust results. The same is not true for the female's participation and supply of hours. Years of education and age have a positive influence; other income, age squared and the presence of children have a negative influence.

We think that these results are an encouragement to do future research. A comparison with other countries shows the need to pursue the study of the Portuguese labour market. There is much to be done.

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Appendix

Table A1. Sample Size

	<i>year</i>	<i>Female</i>	<i>Male</i>	<i>Total</i>
Hartog <i>et al.</i> (1995)	1989	—	7 891	7 891
Kiker and Santos (1991)	1985	10 346	21 823	32 169
Santos (1995)	1985	10 116	21 742	31 858
	1991	11 130	19 206	30 336
Lima <i>et al.</i> (1996)	1994	480	—	480
Pereira and Lima (1996)	1994	431	431	862
Marques (1993)	1990	2 322	—	2 322
Marques and Pereira (1995a,c)	1990	2 322	—	2 322
Martins (1991)	1977	308	392	700
Martins (1996)	1991	2 100	—	2 100
Mendes and Pereira (1989,1990)	1987	359	359	718
Mendes <i>et al.</i> (1995)	1994	706	706	1412
Psacharopoulos (1981)	1977	8 756	39 454	42 347
Silva (1985)	1983	85 445	202 988	288 433
São Pedro and Baptista (1992)*	1988	—	—	844 694
	1988	—	—	226 891
Vieira (1992)	1989	1 900	2 094	3 994
Vieira and Pereira (1993)	1989	1 900	2 094	3 994
Vieira <i>et al.</i> (1996)	1982	—	—	57 737
	1986	—	—	55 175
	1992	—	—	54 307

Note: * first row, private sector and second row, public administration.

Note: The following tables present all of the variables used in the papers. It does not mean that they were all included in the same equation at the same time.

Table A2. Participation Probability Function: Variables Included

	Lima <i>et al.</i> (1996)	Marques and Pereira (1995a,c), Marques (1993)	Martins (1996)	Mendes <i>et al.</i> (1995)	Mendes and Pereira (1990,1989)
Age	x	x		x	x
Age squared	x	x			
Experience	x		x		
Experience squared	x		x		
Years of Education	x	x	x	x	
Levels of Education					x
Individual's Wage		x			
Other Income	x	x	x	x	x
Children	x	x	x	x	x
Family Background	x				
Region	x			x	x
Other			x		x

Table A3. Labour Supply Function: Variables Included

	Lima <i>et al.</i> (1996), Pereira and Lima (1996)	Marques and Pereira (1995c)	Martins (1996)	Mendes <i>et al.</i> (1995)	Mendes and Pereira (1990,1989)
Age	x	x	x	x	x
Age squared	x	x			
Years of Education			x	x	
Levels of Education	x				x
Individual's Wage	x	x	x		
Other Income	x	x	x	x	x
Children	x	x	x	x	x
Family Background	x				
Region				x	x
Other					x

Table A4. Earnings Function: Variables Included

	Hartog <i>et al.</i> (1995)	Kiker and Santos (1991), Santos (1995)	Lima <i>et al.</i> (1996), Pereira and Lima (1996)	Marques (1993), Marques and Pereira (1995a,c), Martins (1996)	Martins (1991)	Silva (1985)	São Pedro and Baptista (1992)	Psacharopoulos (1981)	Vieira (1992), Vieira and Pereira (1993)	Vieira <i>et al.</i> (1996)
Age	x		x			x				
Age squared	x		x			x				
Years of Education	x	x		x	x	x	x	x	x	x
Levels of Education	x		x			x	x	x	x	x
Experience		x	x	x	x	x	x	x	x	x
Experience squared		x	x	x	x	x	x	x	x	x
Tenure	x	x				x		x	x	x
Tenure Squared		x				x		x	x	
Job Qualification		x							x	x
Log Working Hours		x				x	x	x		x
Sector Public/Private		x								x
Firm Size	x	x							x	x
Region		x	x							x
Sector of Activity/Industry	x	x								x
Other	x	x	x	x	x					x
Select. Bias Correction		x*	x**	x**		-			x*	x*

Notes: *job level allocation (analysis not made by Kiker and Santos (1991)); **labour market participation