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How do Workers Decide their Jobs? The Influence of Income, Wage and Job Characteristics

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This paper provides results on the economic decision-making process of Spanish workers, who decide their jobs from the effects of variations in the non-wage income, the wage and the prices of non-pecuniary job characteristics. To that end, we formulate a non-separable generalization of the Linear Expenditure System (NLES) as a joint model of labor supply and job characteristics demand, estimated separately for both males and females, using a 1991 Spanish survey. The main results show that: (i) some job characteristics have a positive effect on the wage, whereas others have a negative effect; (ii) the average percentage effect of employer size and the complexity index are higher for males than for females, with the fatal accident risk displaying similar values; (iii) if the non-wage income of every worker increases, these individuals will prefer to devote less hours to work, and will also prefer jobs in smaller companies and with a lower risk; and (iv) if the wage and hedonic prices of non-pecuniary job characteristics increase, then both males and females will prefer to reduce their labor supply, and devote their available time to jobs in bigger firms, with a higher risk and complexity. Copyright © 1999 John Wiley & Sons, Ltd.

INTRODUCTION

This paper examines one way in which firms can better adapt to the labor market. In particular, we calculate the effects of the non-wage income, the wage and the hedonic prices of non-pecuniary job characteristics on the labor supply and job characteristics demand of workers. This analysis will enable firms to be aware the behavior of such workers when they decide their jobs and, therefore, to adapt to the labor market by offering the particular vector of wage and job characteristics that individuals demand.

For the worker, it is evident that the complete assessment of every job must include the wage as well as the non-pecuniary job characteristics. These job characteristics are usually studied using the theory of equalizing differences, which postulates that workers are induced to accept less attractive jobs by compensating differences in their wage rates (Rosen, 1974, 1986). In other words, this theory establishes the existence of a trade-off between the wage and the non-pecuniary job characteristics, which implies that every employee has a wage which depends on the values of the human capital variables and, second, that the wage differences among workers with identical human capital valuations are due to the different job characteristics.

The economic literature devoted to the analysis of wage differences has specified several important non-wage job characteristics: bad working conditions (e.g. Duncan, 1976; Hamermesh, 1977; Lucas, 1977; Brown, 1980; Woittiez, 1991); high risk of injury or death (see Thaler and Rosen, 1976; Viscusi, 1978, 1993; Marin and Psacharopoulos, 1982; Arnould and Nichols, 1983; Herzog and Schlottmann, 1990; Kniesner and Leeth, 1991; Albert and Malo, 1995); employer size (e.g. Weiss, 1966; Masters, 1969; Hamermesh, 1977;

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Miller, 1981; Mellow, 1982; Oi, 1983; Podgursky, 1986; Even and MacPherson, 1994); job complexity (see Sattinger, 1975; Hartog, 1988; Van Ophem *et al.*, 1993) and the private or public character of the job (e.g. Smith, 1976; Gunderson, 1979; Hartog and Oosterbeek, 1993). A common feature of all these papers is the use of joint information on both males and females, which is a limitation if one wishes to obtain detailed conclusions on males and females individually (see Schumann *et al.*, 1994).

The aim of this paper is to provide relevant results on the economic decision-making process of workers who must choose a job that is characterized by a particular vector of labor market variables, namely the wage and some non-pecuniary job characteristics. To that end, we formulate the Linear Expenditure System (NLES) functional form as a joint model of labor supply and job characteristics demand, which is estimated using a 1991 Spanish survey. We first use hedonic methods in order to analyze either the positive or negative effects that the job characteristics have on both male and female wages. This analysis is carried out by dividing the sample size into three education levels: low, intermediate and high. Once these characteristic prices have been evaluated, we estimate the NLES joint model separately for both males and females, deriving the non-wage income and the Marshallian and Hicksian price elasticities. The results allow us to determine the effects of the non-wage income, the wage and the hedonic prices of some job characteristics on the decision-making process of workers who search for their jobs in a labor market characterized by a high rate of unemployment.

The paper is organized as follows. In the second section we explain the NLES model as a particular functional form of the labor supply and job characteristics demand. The data are described in the following section. The fourth section is dedicated to the estimation method and the empirical results and, finally, in the fifth section, we summarize the most important conclusions of the paper.

THE LABOR SUPPLY AND JOB CHARACTERISTICS DEMAND MODEL

Following Atrostic (1982), we assume that the individual utility function depends on the total monetary income (X), on leisure (l) and on the job characteristics vector (c), $u = u\ (X, l, c)$. The maximization of this utility function is subject to two restrictions: the habitual budget restriction, $Y = \omega T + y = \omega l + X$, with Y, ω, T and y being the full income, wage, time endowment and non-wage income, respectively; and the hedonic wage equation, $\omega = g(c, \mathrm{HC})$, where HC is a human capital variables vector. This hedonic wage equation represents the equilibrium choices of the worker's utility functions and market demand curves. Thus, the problem can be expressed as $\max u = u(l, X, c)$ subject to $\omega T + y = \omega l + \mathrm{X}$ and $\omega = g(c, \mathrm{HC})$. Solving this problem allows us to derive the labor supply function, $h = T - l\ (y, \mathrm{HC})$, and the monetary income and job characteristics demand functions, $X = X(y, \mathrm{HC})$ and $c_i = c_i(y, \mathrm{HC})$ $(i = 1, \ldots, n)$, respectively.

The particular specification we use is a generalization of the Linear Expenditure System (Blundell and Ray, 1982), which permits non-separable preferences (NLES). According to the dual approach of the utility theory, the NLES model with linear Engel curves, when considering the total monetary income as an aggregated consumption good, q, is obtained from the following expenditure function:

$$\begin{aligned} C(\omega, P, u) &= \gamma^*_{00}\omega + \gamma^*_{0q}\omega^{1/2} + \sum_{i=1}^{n} \gamma^*_{0i}\omega^{1/2}p_i^{1/2} + \gamma^*_{qq} + \gamma^*_{q0}\omega^{1/2} \\ &\quad + \sum_{i=1}^{n} \gamma^*_{qi}p_i^{1/2} + \sum_{i=1}^{n}\sum_{j=1}^{n} \gamma^*_{ij}p_i^{1/2}p_j^{1/2} \\ &\quad + \sum_{i=1}^{n} \gamma^*_{i0}p_i^{1/2}\omega^{1/2} + \sum_{i=1}^{n} \gamma^*_{iq}p_i^{1/2} + \omega^{\beta_0}\prod_{i=1}^{n} p_i^{\beta_i}u, \end{aligned} \tag{1}$$

with u being the utility, γ^*_{ij} and β_i being the parameters, and with P being the characteristics price vector which is obtained from a previous estimation of the hedonic wage equation, i.e. $p_i = \partial\omega/\partial c_i$ $(i = 1, \ldots, n)$.

From the expenditure function (1), we derive the corresponding indirect utility function. Thereafter, by applying Roy's lemma, we first derive the leisure demand function, from which we directly obtain the labor supply function; second, we derive the characteristics demand functions as follows:

$$
\begin{aligned}
h = \frac{1}{\omega}\Bigg[& \bar{\gamma}_{00}\omega - \gamma_{0q}\omega^{1/2} - \sum_{i=1}^{n} \gamma_{0i}\omega^{1/2}p_i^{1/2} \\
& - \beta_0\Bigg(y + \bar{\gamma}_{00}\omega - \gamma_{0q}\omega^{1/2} - \sum_{i=1}^{n} \gamma_{0i}\omega^{1/2}p_1^{1/2} - \gamma_{qq} \\
& - \gamma_{q0}\omega^{1/2} - \sum_{i=1}^{n} \gamma_{qi}p_i^{1/2} - \sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij}p_i^{1/2}p_j^{1/2} \\
& - \sum_{i=1}^{n} \gamma_{i0}p_i^{1/2}\omega^{1/2} - \sum_{i=1}^{n} \gamma_{iq}p_i^{1/2} \Bigg)\Bigg]. \qquad \text{(2a)}
\end{aligned}
$$

$$
\begin{aligned}
c_i = \frac{1}{p_i}\Bigg[& \gamma_{ii}p_i + \gamma_{iq}p_i^{1/2} + \gamma_{i0}p_i^{1/2}\omega^{1/2} + \sum_{j \neq i} \gamma_{ij}p_i^{1/2}p_j^{1/2} \\
& + \beta_i\Bigg(y + \bar{\gamma}_{00}\omega - \gamma_{0q}\omega^{1/2} - \sum_{j=1}^{n} \gamma_{0j}\omega^{1/2}p_j^{1/2} - \gamma_{qq} \\
& - \gamma_{q0}\omega^{1/2} - \sum_{j=1}^{n} \gamma_{qi}p_j^{1/2} - \sum_{k=1}^{n}\sum_{j=1}^{n} \gamma_{kj}p_k^{1/2}p_j^{1/2} \\
& - \sum_{j=0}^{n} \gamma_{j0}p_j^{1/2}\omega^{1/2} - \sum_{j=1}^{n} \gamma_{jq}p_j^{1/2} \Bigg)\Bigg] \\
& (i = 1, \ldots, n). \qquad \text{(2b)}
\end{aligned}
$$

where $\gamma_{ij} = (\gamma^*_{ij} + \gamma^*_{ji})/2$ $(i, j = 0, 1, \ldots, n, q)$, and, for labor, $\bar{\gamma}_{00} = T - \gamma_{00}$. The theoretical hypotheses are formulated in terms of the parameters of the model, adding-up, $\Sigma\,\beta_i = 1$, and symmetry, $\gamma_{ij} = \gamma_{ji}$.

Table 1 includes the expressions of the income and Marshallian and Hicksian price elasticities for labor supply and job characteristics demand, which are obtained from functions (2a) and (2b).

DATA

We employ one Spanish cross-section corresponding to 1991 in order to estimate the hedonic equations and the NLES models. The statistical information is obtained from the survey *Encuesta de Estructura, Conciencia y Biografía de Clase* (*ECBC*) which includes 1601 feasible observations for males (725, 399 and 477 for low, intermediate and high education levels, respectively) and 1037 for females (363, 231 and 443, as above).

In Table 2 we present the denomination, the average and the S.D. of all the variables for both the males and the females, as well as for the total of all three education levels. We include the nominal wage (ω) measured in pesetas per hour, the number of hours worked per week (h), the years in the labor market (EXP), four seniority dummies (SEN1: <2 years, SEN2: 2–5 years, SEN3: 6–20 years, SEN4: >20 years), eight education variables (EDU1: 0 years, EDU2: 1–8 years, EDU3: 9–10 years, EDU4: 11–14 years, EDU5: 15 years, EDU5: 16 years, EDU7: 17 years, EDU8: 18–20 years), marital status (MARITAL: 1 if the individual is married and 0 otherwise), household size (HSIZE), six housing area variables (NORTH, EAST, CENTER, MADRID, ISLANDS, SOUTH), employer size (ESIZE), three contract dummies (STABLE, TEMPORARY, NOCONTRACT), two sector variables (PUBLIC, PRIVATE), seven occupation dummies (PROFESSIONAL: members of liberal and technical professions or similar professionals; MANAGER: management-level employees in the public administration sector, as well as managers in private sector firms; ADMINISTRATIVE: consisting of middle-management, administrative and secretarial staff; SALES: sales and similar staff; SERVICE: hotel and catering staff, security service employees, domestic help and similar; AGRICULTURE: individuals dedicated to farming, forestry and fishing; INDUSTRY: employees involved mining, the preparation and treatment of intermediate materials, the manufacturing, assembly and maintenance of machinery and installations, the construction sector and transport), the probability of promotion (PROMOTION),

Table 1. Elasticities of the NLES Model

	Labor supply	Job characteristics demand
Income	$E_0 = \dfrac{-\beta_0 y}{\omega h}$	$E_i = \dfrac{\beta_i y}{p_i c_i}$
Marshallian price	$E_{00} = \dfrac{\bar{\gamma}_{00}(1-\beta_0) - \gamma_{0q}\dfrac{1}{\omega^{1/2}}\left(\dfrac{1}{2}\beta_0\right) - \sum_{i=1}^{n}\gamma_{0i}\left(\dfrac{p_i}{\omega}\right)^{1/2}\left(\dfrac{1}{2}-\beta_0\right)}{h} - 1$	$E_{ii} = \dfrac{\gamma_{ii}(1-\beta_i) - \gamma_{0i}\left(\dfrac{\omega}{p_i}\right)^{1/2}\left(\dfrac{1}{2}-\beta_i\right) + \gamma_{iq}\dfrac{1}{p_i^{1/2}}\left(\dfrac{1}{2}-\beta_i\right) + \sum_{j\neq i}\gamma_{ij}\left(\dfrac{p_j}{p_i}\right)^{1/2}\left(\dfrac{1}{2}-\beta_i\right)}{c_i} - 1$
Hicksian price	$E^c_{00} = \dfrac{\bar{\gamma}_{00}(1-\beta_0) - \gamma_{0q}\dfrac{1}{\omega^{1/2}}\left(\dfrac{1}{2}\beta_0\right) - \sum_{i=1}^{n}\gamma_{0i}\left(\dfrac{p_i}{\omega}\right)^{1/2}\left(\dfrac{1}{2}-\beta_0\right)}{h} - 1 + \beta_0$	$E^c_{ii} = \dfrac{\gamma_{ii}(1-\beta_i) - \gamma_{0i}\left(\dfrac{\omega}{p_i}\right)^{1/2}\left(\dfrac{1}{2}-\beta_i\right) + \gamma_{iq}\dfrac{1}{p_i^{1/2}}\left(\dfrac{1}{2}-\beta_i\right) + \sum_{j\neq i}\gamma_{ij}\left(\dfrac{p_j}{p_i}\right)^{1/2}\left(\dfrac{1}{2}-\beta_i\right)}{c_i} - 1 + \beta_i$

Table 2. Mean and S.D. of Variables

Variable	Male				Female			
	Total	Low	Intermediate	High	Total	Low	Intermediate	High
ω	951.02 (715.03)	664.89 (273.90)	927.67 (501.97)	1405.44 (1030.37)	861.08 (662.66)	587.57 (388.77)	712.87 (428.47)	1162.49 (803.71)
h	39.94 (6.96)	41.20 (5.85)	40.13 (6.99)	37.88 (7.96)	35.83 (8.81)	36.40 (10.82)	37.28 (7.31)	34.61 (7.43)
EXP	10.10 (9.82)	9.07 (9.77)	10.48 (9.83)	11.35 (9.77)	7.35 (7.71)	6.32 (7.14)	6.35 (7.14)	8.72 (8.24)
SEN1	0.04 (0.21)	0.05 (0.21)	0.04 (0.20)	0.05 (0.21)	0.09 (0.28)	0.07 (0.26)	0.12 (0.33)	0.08 (0.27)
SEN2	0.13 (0.34)	0.15 (0.35)	0.15 (0.36)	0.08 (0.28)	0.22 (0.42)	0.25 (0.43)	0.27 (0.45)	0.17 (0.38)
SEN3	0.43 (0.51)	0.36 (0.48)	0.50 (0.50)	0.47 (0.50)	0.47 (0.50)	0.40 (0.49)	0.47 (0.50)	0.52 (0.50)
SEN4	0.40 (0.49)	0.44 (0.50)	0.31 (0.46)	0.40 (0.49)	0.22 (0.42)	0.28 (0.45)	0.13 (0.34)	0.23 (0.42)
EDU1	0.03 (0.18)	0.07 (0.26)	—	—	0.02 (0.14)	0.06 (0.23)	—	—
EDU2	0.30 (0.46)	0.67 (0.47)	—	—	0.22 (0.42)	0.63 (0.48)	—	—
EDU3	0.12 (0.32)	0.26 (0.44)	—	—	0.11 (0.31)	0.31 (0.46)	—	—
EDU4	0.23 (0.42)	—	0.94 (0.24)	—	0.20 (0.40)	—	0.90 (0.30)	—
EDU5	0.01 (0.12)	—	0.06 (0.24)	—	0.02 (0.15)	—	0.10 (0.31)	—
EDU6	0.12 (0.32)	—	—	0.51 (0.50)	0.26 (0.44)	—	—	0.62 (0.49)
EDU7	0.15 (0.36)	—	—	0.08 (0.28)	0.15 (0.36)	—	—	0.36 (0.48)
EDU8	0.02 (0.16)	—	—	0.06 (0.25)	0.01 (0.11)	—	—	0.03 (0.16)
MARITAL	0.66 (0.47)	0.62 (0.48)	0.63 (0.48)	0.74 (0.44)	0.50 (0.50)	0.48 (0.50)	0.44 (0.50)	0.55 (0.50)
HSIZE	4.01 (2.92)	4.03 (1.48)	4.09 (4.99)	3.92 (2.14)	3.84 (3.33)	3.91 (1.49)	0.88 (1.50)	3.77 (4.79)
NORTH	0.17 (0.37)	0.13 (0.33)	0.22 (0.41)	0.19 (0.39)	0.16 (0.36)	0.09 (0.29)	0.19 (0.39)	0.19 (0.39)
EAST	0.25 (0.43)	0.28 (0.45)	0.23 (0.42)	0.23 (0.42)	0.28 (0.45)	0.35 (0.48)	0.25 (0.43)	0.23 (0.42)
CENTER	0.11 (0.31)	0.12 (0.33)	0.10 (0.30)	0.10 (0.30)	0.10 (0.30)	0.10 (0.30)	0.07 (0.26)	0.11 (0.31)
MADRID	0.27 (0.45)	0.27 (0.44)	0.27 (0.44)	0.29 (0.45)	0.29 (0.46)	0.29 (0.45)	0.33 (0.47)	0.28 (0.45)
ISLANDS	0.04 (0.20)	0.05 (0.21)	0.04 (0.20)	0.03 (0.17)	0.04 (0.20)	0.04 (0.19)	0.04 (0.20)	0.05 (0.21)
SOUTH	0.16 (0.36)	0.16 (0.37)	0.14 (0.35)	0.17 (0.37)	0.14 (0.34)	0.13 (0.34)	0.11 (0.31)	0.15 (0.36)
ESIZE	4339.06 (4737.65)	3217.51 (4767.77)	4881.18 (4752.05)	5590.25 (4740.59)	4392.78 (4827.70)	2882.94 (4378.26)	4318.85 (4747.42)	5668.53 (4867.71)
STABLE	0.76 (0.42)	0.66 (0.47)	0.77 (0.40)	0.89 (0.31)	0.65 (0.48)	0.52 (0.50)	0.59 (0.49)	0.78 (0.41)
TEMPO-RARY	0.22 (0.42)	0.32 (0.47)	0.19 (0.39)	0.10 (0.30)	0.33 (0.47)	0.43 (0.50)	0.39 (0.49)	0.21 (0.41)
NOCON-TRACT	0.01 (0.11)	0.02 (0.12)	0.02 (0.12)	0.01 (0.09)	0.02 (0.15)	0.05 (0.21)	0.02 (0.15)	0.01 (0.08)
PUBLIC	0.34 (0.48)	0.19 (0.39)	0.35 (0.48)	0.57 (0.49)	0.45 (0.50)	0.13 (0.34)	0.27 (0.44)	0.55 (0.50)
PRIVATE	0.66 (0.48)	0.81 (0.39)	0.65 (0.48)	0.43 (0.49)	0.55 (0.50)	0.19 (0.40)	0.35 (0.48)	0.71 (0.46)
PROFES-SIONAL	0.25 (0.43)	0.03 (0.16)	0.16 (0.36)	0.66 (0.47)	0.41 (0.49)	0.81 (0.40)	0.65 (0.48)	0.29 (0.46)
MANAGER	0.03 (0.17)	0.00 (0.06)	0.05 (0.21)	0.06 (0.24)	0.01 (0.09)	—	0.00 (0.07)	0.02 (0.12)
ADMIN-STRATIVE	0.21 (0.41)	0.14 (0.34)	0.35 (0.48)	0.19 (0.40)	0.28 (0.45)	0.24 (0.43)	0.59 (0.49)	0.15 (0.36)
SALES	0.05 (0.23)	0.06 (0.25)	0.08 (0.26)	0.02 (0.14)	0.08 (0.26)	0.15 (0.36)	0.07 (0.25)	0.02 (0.13)
SERVICE	0.08 (0.27)	0.12 (0.33)	0.08 (0.27)	0.02 (0.14)	0.13 (0.34)	0.32 (0.47)	0.09 (0.28)	0.01 (0.08)
AGRICUL-TURE	0.03 (0.16)	0.06 (0.23)	0.01 (0.09)	0.00 (0.04)	0.01 (0.11)	0.04 (0.19)	—	—
INDUSTRY	0.35 (0.48)	0.60 (0.49)	0.29 (0.45)	0.04 (0.20)	0.08 (0.27)	0.17 (0.38)	0.04 (0.19)	0.02 (0.12)

Table 2. (continued)

Variable	Male				Female			
	Total	Low	Intermediate	High	Total	Low	Intermediate	High
PROMOTION	0.43 (0.30)	0.41 (0.29)	0.48 (0.31)	0.41 (0.30)	0.39 (0.29)	0.35 (0.27)	0.46 (0.30)	0.39 (0.30)
FREE	0.20 (0.40)	0.10 (0.30)	0.22 (0.42)	0.33 (0.47)	0.14 (0.34)	0.12 (0.33)	0.14 (0.35)	0.15 (0.35)
CON1	0.33 (0.47)	0.30 (0.46)	0.29 (0.45)	0.42 (0.49)	0.42 (0.49)	0.40 (0.49)	0.34 (0.47)	0.47 (0.50)
CON2	0.26 (0.44)	0.20 (0.40)	0.27 (0.45)	0.36 (0.48)	0.27 (0.44)	0.19 (0.39)	0.30 (0.46)	0.31 (0.46)
CON3	0.03 (0.18)	0.03 (0.17)	0.04 (0.20)	0.03 (0.17)	0.03 (0.16)	0.02 (0.16)	0.02 (0.13)	0.03 (0.18)
CON4	0.27 (0.45)	0.36 (0.48)	0.29 (0.46)	0.13 (0.33)	0.20 (0.40)	0.26 (0.44)	0.24 (0.43)	0.13 (0.33)
CON5	0.01 (0.10)	0.01 (0.11)	0.01 (0.11)	0.01 (0.08)	0.01 (0.10)	0.02 (0.14)	0.01 (0.09)	0.00 (0.07)
CON6	0.09 (0.28)	0.11 (0.31)	0.09 (0.28)	0.06 (0.23)	0.08 (0.27)	0.11 (0.31)	0.10 (0.29)	0.05 (0.23)
FAI	0.98×10^{-4} (0.12×10^{-3})	0.12×10^{-3} (0.14×10^{-3})	0.98×10^{-4} (0.11×10^{-3})	0.63×10^{-4} (0.93×10^{-4})	0.37×10^{-4} (0.73×10^{-4})	0.44×10^{-4} (0.80×10^{-4})	0.37×10^{-4} (0.69×10^{-4})	0.32×10^{-4} (0.68×10^{-4})
DEC1	0.02 (0.13)	0.01 (0.07)	0.02 (0.12)	0.03 (0.18)	0.09 (0.09)	0.01 (0.07)	0.00 (0.07)	0.01 (0.12)
DEC2	0.11 (0.31)	0.03 (0.16)	0.11 (0.31)	0.23 (0.42)	0.08 (0.27)	0.08 (0.16)	0.07 (0.25)	0.12 (0.32)
DEC3	0.88 (0.33)	0.97 (0.18)	0.88 (0.33)	0.73 (0.44)	0.91 (0.28)	0.96 (0.19)	0.93 (0.26)	0.87 (0.34)
MET1	0.03 (0.18)	0.02 (0.13)	0.04 (0.18)	0.06 (0.23)	0.02 (0.15)	0.01 (0.10)	0.02 (0.15)	0.03 (0.18)
MET2	0.18 (0.38)	0.07 (0.26)	0.18 (0.38)	0.33 (0.47)	0.12 (0.32)	0.04 (0.21)	0.12 (0.33)	0.18 (0.38)
MET3	0.79 (0.41)	0.91 (0.29)	0.79 (0.41)	0.61 (0.49)	0.86 (0.35)	0.94 (0.23)	0.86 (0.35)	0.79 (0.41)
PROD1	0.02 (0.15)	0.01 (0.12)	0.03 (0.16)	0.04 (0.20)	0.01 (0.11)	0.01 (0.10)	0.01 (0.11)	0.01 (0.12)
PROD2	0.15 (0.36)	0.07 (0.25)	0.17 (0.37)	0.26 (0.44)	0.10 (0.31)	0.04 (0.19)	0.10 (0.29)	0.16 (0.37)
PROD3	0.82 (0.38)	0.92 (0.28)	0.81 (0.39)	0.70 (0.46)	0.88 (0.32)	0.95 (0.22)	0.89 (0.31)	0.82 (0.38)
CI	2.33 (4.43)	1.47 (2.96)	2.04 (3.52)	3.87 (6.23)	1.92 (4.34)	0.75 (2.51)	1.50 (4.04)	3.11 (5.29)

S.D. in parentheses.

hourly flexibility (FREE), six work control variables (CON1: without control, CON2: once a week, CON3: several times a week, CON4: once a day, CON5: several times a day, CON6: permanently), the fatal accident index (FAI: the annual number of fatal accidents per million workers),[1] three budgetary decision variables (DEC1: individual decision, DEC2: joint decision, DEC3: without decision), three work method decision dummies (MET1: individual decision, MET2: joint decision, MET3: without decision), three product decision variables (PROD1: individual decision, PROD2: joint decision, PROD3: without decision) and, finally, the complexity index (CI: derived from information on the time required for appropriately trained individuals to correctly carry out their work).

We can see first that the male wage is higher than that of the female wage for the total sample, as well as for all three education levels and, second, that the highest wages correspond with the high education level, for both the male and the female. The same observations can also be made for the number of hours worked per week and for the years in the labor market. With respect to the seniority variables, we note that the highest values appear for SEN4 (>20 years) for the total male subsample, although the figures are higher for SEN3 (6–20 years) in the intermediate and high education levels, and in SEN3 for the total female subsample and for all three education levels. The eight education variables are divided into the three education levels, with the first three being included in the first level, the following two in the second and the final three in the third. For both the total male and total female samples, the highest values correspond to the SEN2 variable (1–8 years). The next variables are MARITAL and HSIZE, where for both cases we can note that the male figures are higher than those of the female, for both the total and for the three education levels. The six housing area variables indicate that the highest values appear in EAST for all four columns (the total and the three education levels), whereas the lowest figures appear in ISLANDS, once again for all columns. For employer size, we can observe that the male value is higher than that of the female. With respect to the three contract variables, we can note that the highest figures appear in STABLE, for both the males and the females. The private sector values are also higher than those corresponding with the public sector variables, for both the total samples and for all three education levels. With regard to the seven occupation dummies, we can observe that the highest figures are shown by the industry variable for the total male sample and by the PROFESSIONAL dummy for the total female sample. For both the probability of promotion and hourly flexibility, the male values are higher than those of the female, again for the total and for all three levels. With respect to the six work control variables, the highest figures appear for CON1, for both males and females, whilst the lowest appear in for CON5. For the FAI, we can also observe that the female figure is lower than that of the male. Thus, although we do not know the specific FAI by gender, it is implicitly considered given that within the sample we have high-risk occupations with a high proportion of males (e.g. miners), and other low-risk occupations carried out by a high proportion of females (e.g. domestic maids). As regards the three budgetary decision variables, the three work method decision variables and the three product decision variables, we can note that the highest figures appear in the third variable (DEC3, MET3 and PROD3, respectively) both for the males and the females. Finally, for CI, we can observe that the female value is higher than that of the male.

We also solve the equiprobability problems of the *ECBC* that results from two over-representations—namely the agents with intermediate and high education levels and the agents from the Madrid housing area—by using weights in all the calculus and estimations.

ESTIMATION AND EMPIRICAL RESULTS

With respect to the estimation, we first follow the two-stage Heckman (1979) method in order to solve the bias problem that results from estimating the wages using only the wage earners. In the first stage, we estimate one probit model for males and another for females, incorporating as explanatory variables the age, the education levels and the housing areas. The results appear in Table 3. For males, the first column of results shows that the significant variables are age, several education variables and the South. The negative signs indicate that the probability of participation in the wage earners group decreases with age and in the South, and increases with

Table 3. Estimation of Probit Models

Variable	Male				Female			
	Total	Low	Intermediate	High	Total	Low	Intermediate	High
C	1.774* (7.95)	1.457* (10.86)	−0.480* (−2.07)	1.144* (3.97)	0.888* (3.18)	0.460* (3.41)	−0.234 (−0.97)	0.412 (1.26)
AGE	−0.011* (−6.21)	−0.026* (−11.01)	−0.013* (3.67)	0.002 (0.45)	−0.018* (−9.32)	−0.027* (−10.69)	−0.008** (−1.85)	−0.002 (−0.53)
EDU1	−1.266* (−5.71)	−0.076 (−0.57)	—	—	−1.188* (−4.23)	−0.268* (−1.98)	—	—
EDU2	−0.774* (−3.76)	0.184* (2.05)	—	—	−0.954* (−3.59)	−0.194* (−2.21)	—	—
EDU3	−0.774* (−3.58)	—	—	—	−0.656* (−2.40)	—	—	—
EDU4	−0.777* (−3.73)	—	−0.873* (6.25)	—	−0.531* (−1.98)	—	0.302** (1.93)	—
EDU5	−1.742* (−7.28)	—	—	—	−0.893* (−2.98)	—	—	—
EDU6	−0.349 (−1.60)	—	—	−0.345 (−1.56)	0.095 (0.35)	—	—	0.037 (0.14)
EDU7	−0.470* (−2.22)	—	—	−0.449* (−2.08)	0.016 (0.06)	—	—	0.051 (0.18)
NORTH	0.065 (0.72)	0.133 (1.05)	−0.171 (−0.88)	0.221 (1.15)	0.239* (2.72)	0.388* (3.15)	0.090 (0.46)	0.135 (0.81)
EAST	0.055 (0.66)	0.125 (1.13)	−0.202 (−1.07)	0.151 (0.83)	0.429* (5.20)	0.545* (4.88)	0.301 (1.57)	0.294** (1.76)
MADRID	−0.006 (−0.07)	0.120 (1.03)	−0.312** (−1.68)	0.052 (0.30)	0.262* (3.17)	0.331* (2.87)	0.322** (1.70)	0.096 (0.60)
ISLANDS	−0.163 (−1.33)	−0.250 (−1.51)	−0.223 (−0.81)	−0.090 (−0.33)	0.183 (1.40)	0.107 (0.58)	0.042 (0.15)	0.404 (1.44)
SOUTH	−0.184* (−2.12)	−0.265* (−2.29)	−0.362** (−1.80)	0.041 (0.22)	0.018 (0.20)	−0.039 (−0.31)	0.207 (0.92)	−0.002 (−0.01)
Number of observations	3343	1648	813	882	3282	1874	619	789
R^2	0.08	0.14	0.09	0.01	0.17	0.12	0.02	0.01

t values in parentheses.
* Significant at the 5% level.
** Significant at the 10% level.

education level. For females, age and significative education levels exhibit a negative sign, whilst, by contrast, the North, East and Madrid areas display positive signs. Similar results are obtained for all three education levels.

In the second stage, we estimate the hedonic wage equations, the results of which appear in Table 4. However, before describing these results, three prior observations should be made. First, we estimate three wage equations, corresponding to the three educational levels, in order to introduce the variation across the sample into the estimated values of characteristics prices. This kind of market segmentation is a common feature in the literature on hedonic prices (see Atrostic, 1982; Bajic, 1993), with the objective, as the work of Brown and Rosen (1982) indicates, that the estimation of the labor supply model would not take the form of a replica of the estimation of the hedonic wage equations. The division by educational level is intuitively appealing, because the human capital subgroups are only affected by the trade-offs available to their subgroup (e.g. Borjas, 1979; Atrostic, 1982). The second observation refers to the functional form of the wage equation. According to the hedonic prices literature cited above, we estimate the Box–Cox model:

$$\omega^{(\mu)} = \beta_1 + \beta_2 D + \beta_3 Z^{(\pi)} + \varepsilon, \tag{3}$$

where μ, β_1, β_2, β_3 and π are parameters, D and Z are the dichotomic and continuous variables vectors, respectively, and ε is the error term. Finally, the third observation refers to the choice of characteristics. The selection procedure has been based on an individual significance criteria, thereby avoiding multicollinearity problems.

In order to select the transformation parameters, we have carried out different regressions, selecting the form which exhibits the highest explanatory power. The results show that the specification with the highest explanatory degree exhibits a null value for μ, in particular 0.004 (t value = 4.32) for males and 0.002 (t value = 3.18) for females. That is to say, the wage is expressed, as usual (see Mincer, 1974), in its semilogarithmic form. We have also detected a unit and significant value for all π vector elements, except for employer size, where this value is null in all cases, save for the group of males with a high education level. Moreover, Table 4 shows that experience, seniority, education, employer size, the public character of the job, hourly flexibility, the FAI and the CI for both males and females, as well as the probability of promotion, the North, East, Madrid and South areas for males and, finally, the Madrid and South areas for females, all have a significant positive effect on the wage. By contrast, the effect is negative when the employment contract is temporary, and for managers, for administratives and for workers in the service, sales, agriculture and industry sectors. The highest wage corresponds to professionals, whereas the lowest appears in the agricultural sector. Finally, we can note that, in general, the effects of job characteristics on wages increase with education level.

In addition to the above, we can calculate the percentage effect of some specific job characteristics on wages. To that end, we give individual consideration to the three continuous and most significant variables, i.e. ESIZE, FAI, and CI, and joint consideration to the rest of the characteristics, R. This composite variable is the average value of the remaining characteristics values, corrected for the implicit price of the variables. The implicit price of this residual variable was computed at each sample observation as the weighted mean of the implicit prices of the individual variables, using the means values as the weights (see Bajic, 1993). We can then rewrite the wage equation (3) as:

$$\omega = \exp(\alpha + \beta HC)\mathrm{ESIZE}^{\gamma_1}\exp(\gamma_2\mathrm{FAI})\exp(\gamma_3\mathrm{CI}) \times \exp(\gamma R), \tag{4}$$

where $\exp(\alpha + \beta HC)$ is the wage due to the human capital variables, whereas the other terms increase or decrease ω. The positive sign that these three variables exhibit in the wage equations implies a percentage increase in the wage, which can be seen in Table 5. In Table 5 the percentage effect of the ESIZE variable is the average value of $\mathrm{ESIZE}^{\gamma_1}$ calculated for each worker. The effects of the other characteristics are the average values of $\exp(\gamma_2\mathrm{FAI})$ and $\exp(\gamma_3\mathrm{CI})$. The results indicate that the most important effect for males is due to employer size, about 10%, whereas the FAI is the most important efect for females, close to 7%. However, these results do not apply to the high education level for males, or to low and intermediate levels for females. We can note that the higher risk premium corresponds to the male workers with a high education level, which means that these workers demand a higher remuneration than do workers with a low education level for

Table 4. Estimation of Hedonic Wage Equations

Variable	Male				Female			
	Total	Low	Intermediate	High	Total	Low	Intermediate	High
C	6.162* (47.80)	6.254* (27.78)	6.224* (29.60)	5.868* (17.57)	6.330* (26.17)	6.187* (14.53)	5.001* (4.47)	6.935* (3.93)
EXP	0.006* (4.94)	0.002 (1.23)	0.009* (3.43)	0.008* (3.30)	0.005* (2.54)	0.007** (1.69)	0.005 (0.90)	0.002 (0.62)
SEN2	0.120* (2.41)	0.132* (1.98)	0.044 (0.44)	0.039 (0.34)	0.015 (0.30)	−0.157** (−1.68)	0.177** (1.87)	0.171* (2.16)
SEN3	0.256* (5.50)	0.242* (3.83)	0.132 (1.43)	0.333* (3.17)	0.107* (2.12)	−0.100 (−1.08)	0.287* (2.73)	0.237* (2.98)
SEN4	0.264* (5.20)	0.239* (3.20)	0.190** (1.81)	0.332* (2.94)	0.101** (1.70)	−0.135 (−1.27)	0.145 (0.91)	0.268* (2.44)
EDU2	0.039 (0.67)	0.068 (1.10)	—	—	0.030 (0.30)	−0.005 (−0.05)	–	—
EDU3	0.139* (2.17)	0.177* (2.79)	—	—	0.157 (1.35)	0.120 (0.92)	—	—
EDU4	0.201* (3.27)	—	—	—	0.100 (0.84)	—	—	—
EDU5	0.194* (2.05)	—	−0.156 (−1.47)	—	0.239** (1.76)	—	−0.136 (−0.52)	—
EDU6	0.298* (4.10)	—	—	—	0.308* (2.21)	—	—	—
EDU7	0.406* (5.72)	—	—	0.075 (1.48)	0.380* (2.73)	—	—	0.079** (1.79)
EDU8	0.533* (5.62)	—	—	0.373* (3.48)	0.401* (2.24)	—	—	0.093 (0.80)
NORTH	0.123* (3.47)	0.016 (0.31)	0.161* (2.30)	0.260* (2.80)	0.054 (1.03)	0.034 (0.31)	0.090 (0.63)	0.09 (0.13)
EAST	0.127* (3.84)	0.112* (2.49)	0.123** (1.71)	0.162* (1.97)	0.044 (0.83)	0.093 (0.92)	0.391 (1.48)	−0.030 (−0.06)
MADRID	0.186* (5.69)	0.153* (3.40)	0.169* (2.33)	0.195* (2.78)	0.117* (2.37)	0.141 (1.54)	0.391 (1.40)	0.117 (0.69)
ISLANDS	−0.011 (−0.21)	−0.195* (−2.71)	−0.023 (−0.21)	0.176 (1.39)	0.108 (1.47)	0.174 (1.27)	−0.148 (−0.91)	0.076 (0.12)
SOUTH	0.086* (2.35)	0.044 (0.84)	−0.009 (−0.11)	0.150* (2.00)	0.117* (2.21)	0.367* (3.62)	0.357** (1.67)	0.072 (0.98)
ESIZE	0.012* (4.59)	0.023* (4.96)	0.027* (3.85)	0.11×10^{-4}* (2.43)	0.009* (2.15)	0.008 (1.00)	0.024* (2.36)	0.005 (0.73)
TEMPORARY	−0.093* (−3.55)	−0.150* (−4.65)	−0.085 (−1.63)	0.003 (0.05)	−0.057** (−1.82)	−0.051 (−0.96)	−0.016 (−0.24)	−0.055 (−1.08)
NOCONTRACT	0.031 (0.39)	−0.049 (−0.47)	0.142 (0.93)	0.162 (0.78)	−0.107 (−1.25)	−0.169 (−1.53)	−0.172 (−0.81)	0.886* (3.60)
PUBLIC	0.043** (1.81)	0.33×10^{-3} (0.01)	−0.016 (−0.37)	0.155* (3.26)	0.140* (4.17)	0.081 (1.16)	0.136** (1.93)	0.103* (2.17)
MANAGER	−0.154* (−2.61)	−0.155 (−0.72)	−0.232* (−2.32)	−0.105 (−1.07)	−0.031 (−0.21)	—	−1.411 (−2.66)	0.048 (0.30)
ADMINISTRA-TIVE	−0.173* (−5.43)	−0.149** (−1.79)	−0.090 (−1.64)	−0.269* (−4.33)	−0.198* (−5.00)	−0.299* (−3.11)	0.075 (0.99)	−0.358* (−5.96)
SALES	−0.244* (−5.00)	−0.224* (−2.41)	−0.247* (−3.05)	−0.199 (−1.45)	−0.409* (−6.76)	−0.459* (−4.26)	−0.192 (−1.54)	−0.627* (−4.37)
SERVICE	−0.252* (−5.81)	−0.250* (−2.91)	−0.160* (−2.02)	−0.147 (−1.11)	−0.361* (−6.37)	−0.413* (−4.16)	−0.153 (−1.33)	−0.116 (−0.51)
AGRICULTURE	−0.421* (−6.54)	−0.380* (−3.97)	−0.476** (−2.22)	−0.517 (−1.23)	−0.662* (−5.26)	−0.749* (−4.84)	—	—
INDUSTRY	−0.303* (−8.22)	−0.270* (−3.31)	−0.254* (−4.23)	−0.371* (−3.64)	−0.378* (−5.73)	−0.370* (−3.32)	−0.060 (−0.40)	−0.459* (−2.87)
PROMOTION	0.087* (2.79)	0.060 (1.34)	0.056 (0.96)	0.136* (2.06)	−0.056 (−1.26)	0.042 (0.49)	−0.061 (−0.63)	−0.059 (−0.93)
FREE	0.081* (3.12)	0.088** (1.86)	0.047 (0.97)	0.108* (2.41)	0.042 (1.08)	0.227* (3.13)	−0.079 (−0.90)	−0.043 (−0.77)
CON1	0.049 (1.40)	0.084** (1.86)	−0.097 (−1.42)	0.143** (1.69)	−0.099* (−2.04)	−0.075 (−0.97)	−0.084 (−0.82)	−0.181* (−2.20)
CON2	0.050 (1.38)	0.066 (1.36)	−0.076 (−1.09)	0.150** (1.74)	−0.070 (−1.38)	−0.033 (−0.38)	−0.074 (−0.72)	−0.162** (−1.91)
CON3	0.018 (0.30)	0.041 (0.50)	−0.167 (−1.63)	0.187 (1.39)	−0.167** (−1.91)	−0.175 (−1.12)	0.091 (0.42)	−0.289* (−2.31)
CON4	0.030 (0.85)	0.074** (1.70)	−0.096 (−1.42)	0.035 (0.37)	−0.180* (−3.47)	−0.225* (−2.82)	−0.037 (−0.35)	−0.236* (−2.47)
CON5	0.050 (0.54)	0.150 (1.26)	−0.186 (−1.10)	0.234 (0.94)	−0.068 (−0.52)	−0.285 (−1.62)	−0.102 (−0.35)	0.292 (1.02)
FAI	0.575* (6.68)	0.516* (5.13)	0.516* (2.75)	1.021* (3.64)	1.360* (7.43)	0.360 (1.17)	1.383* (3.04)	1.638* (4.99)
DEC1	−0.095 (−1.03)	−0.054 (−0.23)	0.011 (0.053)	−0.161 (−1.27)	0.060 (0.35)	−0.834** (−1.71)	−0.959** (−1.76)	0.467* (2.21)
DEC3	−0.084 (−0.92)	−0.056 (−0.25)	−0.035 (−0.17)	−0.107 (−0.85)	0.110 (0.67)	−0.012 (−0.03)	−0.864 (−1.58)	0.471* (2.27)
MET2	−0.003 (−0.04)	0.183 (1.25)	0.013 (0.10)	−0.056 (−0.59)	0.042 (0.38)	1.338* (3.23)	0.228 (0.72)	−0.133 (−1.01)
MET3	−0.069 (−1.00)	0.050 (0.33)	−0.024 (−0.18)	−0.114 (−1.07)	−0.036 (−0.33)	0.532 (1.61)	0.113 (0.37)	−0.181 (−1.33)
PRO2	0.019 (0.23)	−0.356* (−2.13)	0.036 (0.22)	0.196 (1.60)	−0.137 (−0.98)	−0.538** (−1.76)	−0.146 (−0.35)	−0.298* (−1.56)

Table 4. (continued)

Variable	Male				Female			
	Total	Low	Intermediate	High	Total	Low	Intermediate	High
PRO3	−0.068 (−0.83)	−0.327** (−1.84)	−0.101 (−0.58)	0.092 (0.72)	−0.042 (−0.31)	−0.130 (−0.54)	0.025 (0.06)	−0.219* (−1.14)
CI	0.021* (9.49)	0.016* (3.54)	0.024* (4.47)	0.022* (6.83)	0.013* (4.35)	0.014 (1.58)	0.023* (2.40)	0.013* (3.65)
λ HECKMAN	0.085 (0.98)	0.184 (1.25)	0.506* (2.71)	1.1217 (1.55)	−0.060 (−0.60)	−0.032 (−0.22)	1.898 (1.64)	−0.567 (−0.18)
R^2	0.56	0.36	0.48	0.45	0.52	0.34	0.42	0.36
R^2 adjusted	0.55	0.32	0.42	0.40	0.50	0.27	0.32	0.31
F	46.90	10.29	9.17	9.67	25.37	4.64	4.09	6.43

t values in parentheses.
* Significant at the 5% level.
** Significant at the 10% level.
Heckman (inverse of the Mills ratio) indicates the effect on the sample wages from the non-observation of wages of non-workers.

Table 5. Average Effect of Job Characteristics on Wage (% and in pesetas)

Variable	Male				Female			
	Total	Low	Intermediate	High	Total	Low	Intermediate	High
ESIZE (%)	10.14	12.88	19.77	6.75	5.61	3.60	15.71	3.19
FAI (%)	6.19	6.83	5.44	7.19	6.86	1.63	6.72	6.11
CI (%)	5.62	2.52	5.53	10.13	2.82	1.12	3.97	4.64
ESIZE(pesetas)	96.4	85.6	183.4	94.9	48.3	21.2	112.0	37.1
FAI (pesetas)	58.9	45.4	50.5	101.1	59.1	9.6	47.9	71.0
CI (pesetas)	53.4	16.8	51.3	142.4	24.3	6.6	28.3	53.9

the same levels of risk. Obviously, this does not mean that all the workers assume the same levels of risk. In fact, the highest risk jobs are usually carried out by blue collar workers, who normally have the lowest education levels.

In Table 5 we also present the cost (in pesetas) which the employer must pay each type of worker for each hour worked, in the circumstances where the employer characteristics are the sample average values we have considered. Thus, the decision of the employer with respect to a hypothetical reduction in one negative characteristic will be efficient if the cost of such a reduction is less than the amount paid for this characteristic, in the circumstances where such a negative characteristic is maintained.

From the earlier results, we can propose three examples of partial changes in each of the three characteristics. First, let us assume the case of a female with an intermediate education level who works in a firm with 100 workers. She will receive an additional 12% of the wage due to her human capital variables, as we have shown in Equation (4), as a compensation for the firm size, $\text{ESIZE}^{\gamma_1} = 100^{0.024} = 1.12$. If the firm now increases the number of workers to 200, then it must increase this compensation by 2%. Therefore, the firm could consider the possibility of opening a new plant if this cost is lower than the corresponding cost of compensating for the increase in employer size.

Second, knowing that the risk level suffered by male miners with a low education level is 0.715×10^{-3} per million (Accidents at Work Survey, Albert and Malo, 1995), the effect of the FAI on the remuneration is $\exp(\gamma_2\text{FAI}) = \exp(0.516 \times 0.715) = 1.45$, i.e. such a risk increases the wage by 45%. Thus, if the mining firm is efficient, it will adopt more safety measures, with the objective of reducing the risk level, if the cost associated with these measures is lower than the additional remuneration paid to the miners.

Third, a male lawyer who needs a minimum of 3 years experience in order to properly carry out his job, obtains an additional remuneration for this difficulty of 7% of his wage, $\exp(\gamma_3\text{CI}) = \exp(0.022 \times 3) = 1.07$. By contrast, if he is transferred to another occupation where he needs 4 years experience, then the effect of this higher difficulty will be a further 2%, given that the total remuneration which he obtains for this difficulty is 9%, $\exp(\gamma_3\text{CI}) = \exp(0.022 \times 4) = 1.09$.

This kind of interpretation can obviously be extended to other cases which combine the three characteristics, by education level and gender, assuming that the hedonic locus is immutable from the perspective of the individual firm. Thus, when firms are making decisions on investments aimed at, for example, increasing the work force, or simplifying tasks, or reducing accident risk levels, they have to be aware of the effects of these decisions on wages, with these differing depending on the education level and gender of the workers.

If we compare our risk effect on the Spanish wage with the results of Viscusi (1993), we can observe that the Spanish levels are lower, due to, among other reasons, the high unemployment rate suffered by the Spanish economy. This reduces the remuneration of the negative characteristics, given that there are more workers who are willing to accept such characteristics of the job.

With respect to the estimation of the labor supply and job characteristics demand model, the first question is the choice of characteristics, given that it is impossible to include all of these due to estimation problems. We have, therefore, selected the three characteristics specified above, i.e. employer size, FAI and CI, grouping the rest into one single characteristic. Once the choice of variables has been made, the second problem is to formulate them into their positive sign, given that they constitute arguments in the individual utility function. Thus, in order to convert the negative sign of the three variables, we define the following new characteristics: first, the difference between employer size with respect to the maximum (ESIZE* = Max ESIZE − ESIZE); second, the probability of no fatal accident (FAI* = 1 − FAI); and third, the distance to the maximum complexity (CI* = MaxCI − CI).

It is evident that these changes in the definitions of the variables also modify the budget restriction. Thus, after approximating the initial budget restriction using the Taylor method in order to eliminate the non-linearity, we obtain

$$(\omega_0 + P_1\mathrm{ESIZE} + P_2\mathrm{FAI} + P_3\mathrm{CI} + P_4Z)h + y = M,$$

where M is the total monetary income. However, the introduction of the new characteristics allows us to express this restriction as

$$(\omega_0 + P_1\mathrm{MaxESIZE} + P_2 + P_3\mathrm{MaxCI})h + y$$
$$= M + (P_1\mathrm{ESIZE}^* + P_2\mathrm{FAI}^* + P_3\mathrm{CI}^* - P_4Z)h,$$

where $\omega_0^* = \omega_0 + P_1\mathrm{MaxESIZE} + P_2 + P_3\mathrm{MaxCI}$ is the capital human wage when the new job characteristics are null.

The sociodemographic variables are only introduced into the labor supply parameters after a selection procedure which consists of choosing the significant variables. Thus, for both males and females we have, respectively,

$$\gamma_{00}(z) = \gamma_{00} + \gamma_{00n}\mathrm{NORTH} + \gamma_{00e}\mathrm{EAST} + \gamma_{00ma}\mathrm{MADRID} + \gamma_{00i}\mathrm{ISLANDS} + \gamma_{00s}\mathrm{SOUTH},$$

and

$$\gamma_{00}(z) = \gamma_{00} + \gamma_{00hs}\ln(\mathrm{HSIZE}) + \gamma_{00ms}\mathrm{MARITAL} + \gamma_{00n}\mathrm{NORTH} + \gamma_{00e}\mathrm{EAST} + \gamma_{00ma}\mathrm{MADRID} + \gamma_{00i}\mathrm{ISLANDS} + \gamma_{00s}\mathrm{SOUTH}.$$

We now estimate the NLES model (2a)–(2b), in its budget share form, after summing the error terms that capture taste shifts, measurement errors in the dependent variable and the effects of omitted variables, first for males and then for females. This estimation presents the identification problems analyzed in Bartik (1987), Epple (1987) and Kahn and Lang (1988). As the regressors used in estimating the structure of demand include the calculated hedonic prices, they will be stochastic. If the regressors were stochastically independent of the error terms in the demand characteristics and labor supply functions, this in itself would not pose a problem for consistent estimation. The non-linearity of the budget constraint implies a failure of such independence and, hence, a lack of consistency in the estimation.

This problem can be dealt with by using an instrumental variables approach, but the problem then becomes one of the selection of an appropriate set of instruments. In order to solve this, we have adopted the solution proposed by Cheshire and Sheppard (1998). We have selected a set of instruments which is based on the practice in time-series estimation of using lagged values of regressors as instruments in the estimation of an equation in which these regressors would normally enter contemporaneously. We use what could be considered as spatially lagged values of the regressors, i.e. the marginal price paid by similar workers, as instruments in the estimation. For each observation, we identify the two 'nearest' workers in the sample. In this case, the metric used to define proximity consists of a weighted combination of job characteristics. Using the two nearest workers in the sample, we take as instruments the mean of the variables associated with these two workers.

As noted in Bowden and Turkington (1984), the instruments will be admissible if they are asymptotically correlated with the regressors, asymptotically uncorrelated with the disturbance term, and of full rank. In the present context, the former and latter requirements are satisfied. The plausibility of the second condition may be argued based upon the independence of and variation in individual worker decisions with respect to the types and amounts of characteristics and the variability in worker characteristics.

The estimated parameters obtained by Full Information Maximum Likelihood (FIML) appear in Table 6. As we can see, the majority of coefficients are significant at the 5% level. With respect to the demographic variables, NORTH (γ_{00n}), EAST (γ_{00e}), MADRID (γ_{00ma}) and SOUTH (γ_{00s}) display positive signs for males. For females, HSIZE (γ_{00hs}) and MARITAL (γ_{00ms}) exhibit negative signs, and ISLANDS (γ_{00i}) a positive sign.

With regard to the five direct parameters corresponding to the four characteristics and the aggregated consumption good (γ_{ii}, $i = 1, \ldots, 4, q$), we detect positive signs for both males and females, with the highest values appearing in the consumption good coefficient. We also observe that the income parameters (β_i, $i = 0, 1, \ldots, 4, q$) present positive signs for labor and for the majority of specific job characteristics. Finally, note that the values of β_q are derived via the adding-up condition.

Table 7 shows the mean and S.D. of the income and price elasticities for males and females. As regards the labor supply effects, both income elasticities are negative but very close to zero. The Marshallian elasticities are, as expected, negative, indicating decreasing labor supply curves, with the effect corresponding to male wages being slightly higher than those corresponding to females. This suggests that an increase in the wage reduces the labor supply for males more than for females; in other words, males are more sensitive than females with respect to changes in their respective wages.

As regards new job characteristics, we can clearly note that ESIZE*, as well as FAI* and CI*, appear as normal variables, except CI* for females, with ESIZE* being a luxury characteristic for both males and females. This result indicates that if the non-wage income of individuals rises, the difference between the values of these variables will also increase with respect to their

Table 6. Estimation of the NLES Models

	Male			Female	
	Parameter	t value		Parameter	t value
γ_0	5.852*	5.12	γ_0	14.120*	8.89
γ_{00n}	0.425*	2.03	γ_{00hs}	-1.252*	-4.48
γ_{00e}	1.002*	2.56	γ_{00ms}	-3.069*	-9.09
γ_{00ma}	1.126*	3.02	γ_{00n}	0.215	0.77
γ_{00i}	0.103	1.15	γ_{00e}	-0.742*	-1.96
γ_{00s}	0.341*	1.98	γ_{00ma}	-0.825	-1.42
γ_{11}	0.085*	15.32	γ_{00i}	1.126**	1.85
γ_{22}	0.054*	41.25	γ_{00s}	-0.869**	-1.77
γ_{33}	0.789*	31.22	γ_{11}	0.312*	24.55
γ_{44}	0.003*	12.21	γ_{22}	0.052*	54.16
γ_{qq}	15.125*	6.30	γ_{33}	0.412*	18.82
γ_{01}	-0.016*	-5.97	γ_{44}	0.015*	9.06
γ_{02}	-0.42×10^{-3}*	-3.10	γ_{qq}	4.025*	6.52
γ_{03}	-0.085*	-5.85	γ_{01}	-0.02×10^{-3}*	-3.03
γ_{04}	-0.021	-9.12	γ_{02}	-0.41×10^{-4}	-0.65
γ_{0q}	0.089	1.12	γ_{03}	0.012	0.23
γ_{12}	0.43×10^{-5}*	7.85	γ_{04}	-0.031*	-5.08
γ_{13}	0.156*	18.63	γ_{0q}	-0.259	-1.39
γ_{14}	-0.052*	-6.52	γ_{12}	-0.24×10^{-4}*	-1.99
γ_{1q}	-0.185*	-13.25	γ_{13}	0.21×10^{-3}**	1.45
γ_{23}	-0.22×10^{-3}*	-2.31	γ_{14}	0.45×10^{-5}*	2.52
γ_{24}	0.58×10^{-4}*	3.03	γ_{1q}	-0.03×10^{-3}*	-3.25
γ_{2q}	-0.025*	-4.74	γ_{23}	0.63×10^{-3}*	3.52
γ_{34}	0.069*	4.52	γ_{24}	-0.10×10^{-3}	-1.12
γ_{3q}	-0.741*	-9.15	γ_{2q}	-0.12×10^{-3}*	-3.45
γ_{4q}	-0.152*	-12.51	γ_{34}	0.015*	9.33
β_0	1.005*	15.02	γ_{3q}	-0.052*	-3.09
β_1	0.09×10^{-4}	1.036	γ_{4q}	0.012*	4.12
β_2	0.005*	3.02	β_0	1.001*	356.20
β_3	0.52×10^{-3}*	4.11	β_1	0.45×10^{-4}*	15.26
β_4	-0.99×10^{-3}*	-15.12	β_2	0.21×10^{-5}*	3.02
β_q	-0.010	–	β_3	-0.04×10^{-2}*	-8.36
Log L 75 265			β_4	-0.002*	-4.25
Observ. 1601			β_q	-0.001	–
			Log L 52 038		
			Observ. 1037		

* Significant at the 5% level.
** Significant at the 10% level.

Table 7. Income and Price Elasticities

Variables	Male			Female		
	Income	Marshallian	Hicksian	Income	Marshallian	Hicksian
LABOR	-0.002 (0.001)	-1.001 (0.001)	0.001 (0.50×10^{-3})	-0.003 (0.002)	-0.998 (0.002)	0.001 (0.001)
ESIZE*	9.023 (34.745)	-3634.515 (7753.263)	-3242.398 (8978.202)	8.526 (22.152)	-3055.236 (3563.448)	-2348.211 (2895.23)
FAI*	1.24×10^{-6} (2.65×10^{-6})	-0.37×10^{-3} (0.22×10^{-3})	0.002 (0.26×10^{-3})	1.64×10^{-7} (2.44×10^{-7})	-2.012 (0.17×10^{-3})	-2.001 (0.11×10^{-3})
CI*	0.18×10^{-3} (0.33×10^{-3})	-2.444 (1.236)	-2.377 (1.058)	-0.21×10^{-3} (0.26×10^{-3})	-2.111 (0.098)	-2.143 (0.205)
R	-0.001 (0.005)	-0.310 (2.225)	-0.286 (2.274)	-0.365 (3.320)	-12.189 (38.597)	-14.752 (39.425)

S.D. in parentheses.

maximums; i.e. male and female workers will prefer jobs in smaller firms and, according to previously published evidence (e.g. Viscusi, 1978), with lower risk ahead of income variation. Moreover, male workers will also prefer jobs with lower complexity levels. On the other hand, the negative signs of the price Marshallian and Hicksian effects show that a rise in hedonic prices implies a fall in the demand for the three new job characteristics. In summary, these results show that the non-wage income and hedonic prices act in the same direction with respect to the labor supply, but in the opposite direction with respect to the demand for the non-pecuniary job characteristics included in this analysis.

SUMMARY AND CONCLUSIONS

In this paper we have provided results on the economic decision-making process of Spanish workers, who decide their jobs on the basis of the detected effects of variations in the non-wage income, the wage and the prices of non-pecuniary job characteristics. To that end, we have first estimated the hedonic wage equations, which allowed us to determine the wage share corresponding to the monetary compensations resulting from the different job characteristics, as well as the price of these variables. Thereafter, we have estimated one labor supply and characteristics demand model for males and another for females. These estimations have allowed us to calculate income and price elasticities.

With respect to the estimation of the hedonic wage equations, we have determined that experience, seniority, education, employer size, the public character of the job, hourly flexibility, the fatal accident risk, the complexity and the probability of promotion have a positive effect on the wage. By contrast, the influence is negative when the employment contract is temporary, and for managers, administratives and workers in the service, sales, agriculture and industry sectors. Moreover, the average percentage effect of employer size and the complexity index are higher for males than for females, with the fatal accident risk displaying similar values. The monetary assessment of life varies for males and females, and also by education levels, with the highest values appearing for females, particularly at the high education level.

The estimation of the labor supply and job characteristics demand model shows the expected results. The income elasticities are very low, with negative signs for labor and positive signs for employer size and risk; i.e. if the non-wage income of individuals increases, these male and female workers will prefer to devote less hours to work and will also prefer jobs in smaller companies and with lower risk. The own-price elasticities are also negative for both labor and job characteristics, which indicates that if the wage and the hedonic prices increase, individuals will prefer to reduce their labor supply, devoting their available time to jobs in bigger firms with higher risk and complexity.

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NOTES

1. The fatal accident index (FAI), derived from the Accidents at Work Survey (Albert and Malo, 1995), corresponds to 1991 and assigns an index to each occupation.

REFERENCES

C. Albert and M. A. Malo (1995). Diferencias salariales y valoración de la vida humana en España. *Moneda y Crédito*, **201**, 89–125.

R.J. Arnould and L.M. Nichols (1983). Wage-risk premiums and workers' compensation: a refinement of estimates of compensating wage differential. *Journal of Political Economy*, **91**, 332–340.

B.K. Atrostic (1982). The demand for leisure and non-pecuniary job characteristics. *The American Economic Review*, **72**, 428–440.

V. Bajic (1993). Automobiles and implicit markets: an estimate of a structural demand model for automobile characteristics. *Applied Economics*, **25**, 541–551.

T.J. Bartik (1987). The estimation of demand parameters in hedonic price models. *Journal of Political Economy*, **95**, 81–88.

R. Blundell and R. Ray (1982). A non-separable generalisation of the linear expenditure system allowing non-linear Engel curves. *Economics Letters*, **9**, 349–354.

G. Borjas (1979). Job satisfaction, wages and unions. *Journal of Human Resources*, **14**, 21–40.

R.J. Bowden and D.A. Turkington (1984). *Instrumental Variables*, Cambridge: Cambridge University Press.

C. Brown (1980). Equalizing differences in the labor market. *Quarterly Journal of Economics*, **94**, 113–134.

C. Brown and S. Rosen (1982). On the estimation of structural hedonic price models. *Econometrica*, **40**, 737–747.

P. Cheshire and S. Sheppard (1998). Estimation the demand for housing, land, and neighbourhood characteristics. *Oxford Bulletin of Economics and Statistics*, **60**, 357–382.

G. Duncan (1976). Earnings functions and non-pecuniary benefits. *The Journal of Human Resources*, **11**, 462–482.

D. Epple (1987). Hedonic prices and implicit markets: estimating demand and supply functions for differentiated products. *Journal of Political Economy*, **95**, 59–80.

W.E. Even and D.A. MacPherson (1994). Employer size and compensation: the role of worker characteristics. *Applied Economics*, **26**, 897–907.

M. Gunderson (1979). Earnings differentials between the public and private sectors. *Canadian Journal of Economics*, **12**, 228–242.

D. Hamermesh (1977). Economic aspects of job satisfaction. In *Essays in Labor Market and Population Analysis* (edited by O. Ashenfelter and W. Oates), New York: John Wiley.

J. Hartog (1988). An ordered response model for allocation and earnings. *Kyklos*, **41**, 113–141.

J. Hartog and H. Oosterbeek (1993). Public and private sector wages in the Netherlands. *European Economic Review*, **37**, 97–114.

J.J. Heckman (1979). Sample selection bias as a specification error. *Econometrica*, **47**, 153–161.

H.W. Herzog and A.M. Schlottmann (1990). Valuing risk in the workplace: market price, willingness to pay, and the optimal provision of safety. *Review of Economics and Statistics*, **72**, 463–470.

S. Kahn and K. Lang (1988). Efficient estimation of structural hedonic systems. *International Economic Review*, **29**, 157–166.

T.J. Kniesner and J.K. Leeth (1991). Compensating wage differentials for fatal injury risk in Australia, Japan, and the United States. *Journal of Risk and Uncertainty*, **4**, 75–90.

R. Lucas (1977). Hedonic wage equations and psychic wages in the returns to schooling. *The American Economic Review*, **67**, 549–558.

A. Marin and G. Psacharopoulos (1982). The reward for risk in the labor market: evidence from the United Kingdom and a reconciliation with other studies. *Journal of Political Economy*, **90**, 827–853.

S.H. Masters (1969). An interindustry analysis of wages and plant size. *Review of Economics and Statistics*, **51**, 341–345.

W. Mellow (1982). Employer size and wages. *The Review of Economics and Statistics*, **64**, 495–501.

E. Miller (1981). Variation of wage rates with size of establishment. *Economics Letters*, **8**, 281–286.

J. Mincer (1974). *Schooling, Experience and Earnings*, New York: Columbia University Press.

W.Y. Oi (1983). Heterogeneous firms and the organization of production. *Economic Inquiry*, **21**, 147–171.

M. Podgursky (1986). Unions, establishment size, and intraindustry threat effects. *Industrial and Labor Relations Review*, **39**, 277–284.

S. Rosen (1974). Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of Political Economy*, **82**, 34–55.

S. Rosen (1986). The theory of equalizing differences. In *Handbook of Labor Economics* (edited by O. Ashenfelter and R. Layard), Amsterdam: North-Holland.

M. Sattinger (1975). Comparative advantage and the distributions of earnings and abilities. *Econometrica*, **43**, 455–468.

P.L. Schumann, D.A. Ahlburg and C. Brown (1994). The effects of human capital and job characteristics on pay. *The Journal of Human Resources*, **25**, 481–503.

R.S. Smith (1976). *The Occupational Safety and Health Act, Its Goals and Its Achievements*, Washington: American Enterprise Inst.

R. Thaler and S. Rosen (1976). The value of saving a life: evidence from the labor market. In *Household Production and Consumption* (edited by N.E. Terkeckyj), New York: Columbia University Press.

H. Van Ophem, J. Hartog and W. Vijverberg (1993). Job complexity and wages. *International Economic Review*, **34**, 853–872.

W. Viscusi (1978). Wealth effects and earnings premiums for job hazards. *Review of Economics and Statistics*, **60**, 408–416.

W. Viscusi (1993). The value of risks to life and health. *Journal of Economic Literature*, **31**, 1912–1946.

L. Weiss (1966). Concentration and labor earnings. *The American Economic Review*, **56**, 96–117.

I. Woittiez (1991). *Modelling and Empirical Evaluation of Labour Supply Behaviour*, Berlin: Springer Verlag.

