COMBINING ECONOMETRIC AND MULTIOBJECTIVE PROGRAMMING TECHNIQUES TO EVALUATE JOB SATISFACTION

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Abstract

This article addresses the relationship between a set of socio-economic variables and the levels of different aspects of job satisfaction observed for Spanish workers, by means of a novel methodological approach. Specifically, we draw on the results stemming from econometric estimates to define a multiobjective programming model, whose solutions shed further insights on how achievable are the optimum satisfaction levels pursued by men and women. Using data obtained from a recent survey conducted in several European countries we show that exist some scope for male workers to increase most aspects of their job satisfaction, however in the case of women still persist labour market barriers bounding their actual opportunities to get higher in the job satisfaction scale.

Keywords. Job Satisfaction, Econometric estimates, Multiobjective Programming.

I. Introduction

Since the European Union was created numerous economic and social policy reforms have been implemented as a way of reaching some kind of socio-economic convergence among the member states of the Union. Many of these economic changes have been focused on the national labour markets (reform of the unemployment protection system, working time, minimum wage, etc…), in a attempt to make them more flexible, as the prevalent rigidities in these markets were thought to be the origin of the high unemployment rates observed across Europe in the last two decades. Regardless of the questionable success of many of these measures, what seems clear is the general lack of concern on job quality/satisfaction despite its potential link with (higher) worker's productivity, via (lower) absenteeism, (lower) turnover, (lower) tardiness and, broadly speaking, (higher) job performance and firm return.[1]

Ahead of this, job satisfaction is important in its own right as a part of social welfare. Moreover, measures of job satisfaction, as proxy for job quality, seem to be useful predictors of future labour market behavior. Workers' decisions about whether to work or not, what kind of job to accept or stay in, and how hard to work are all likely to depend in part upon the worker's subjective evaluation of their work, in other words on their job satisfaction. Most of the previous studies on job satisfaction have focused on the effect of earnings on different measures of job satisfaction [see, e.g., Clark (2005) and Gamero (2005)]. Recently some evidence has come out that demonstrates the existence of a number of factors of job quality that affect job satisfaction but are not correlated with earnings [e.g. Leontaridi and Sloane (2001], contrasting with the

[1] For example, Ostroff (1992) reports a link between levels of employee job satisfaction and organizational level performance. Likewise, studies such as Reichheld (1996) and Heskett et al. (1997) produced the first sets of hard data quantifying the links between employee satisfaction and customer satisfaction, productivity, and financial performance.

traditional belief of economists who thought on remuneration as the main approach to compute the value of jobs. In fact, job satisfaction acts as a summary measure of the different aspects of job quality, a number of which are difficult to observe or measure. As such, the use of the satisfaction information may help to explain workers' behavior better than data on, for example, pay and hours. For instance, Freeman (1978) using American panel data shows that job satisfaction is a strongly significant predictor of quits, even more in some cases than wages. We restrict our attention to job satisfaction as a subjective measure of worker's well-being, because although it is not necessarily the ideal instrument for capturing well-being, it is the best proxy available in the dataset.

Aside from that, and based on the previous comments, it seems clear that job satisfaction is not a single dimensional measure. Consequently, we concentrate on different aspects of job satisfaction as proxy for job quality in an attempt to quantify worker's individual preferences. More precisely we are trying to answer the following question: *What are the kind of workers reaching better satisfaction levels than the rest of the workforce?* On the other hand, may this information be used to design socio-economic policies in order to increase workers' satisfaction?. In other words, may policy makers affect workers´ satisfaction/job quality?

In order to answer these questions, the multidimensional aspect of the problem has to be taken into account. As previously commented, *job satisfaction* is a wide concept that comprises several conflicting aspects. Therefore, it does not seem appropriate to simply "maximize" job satisfaction. This is why, in our opinion, the use of the Multiobjective Programming approach is more suitable than classical single objective schemes. What is more, the application of multicriteria techniques to an econometric model allows us to obtain information and results that the usual

econometric techniques are not able to provide, like for example to identify “optimal workers” (in terms of job satisfaction). Furthermore, the post-optimization analysis could show to us how achievable are certain “ideals” satisfaction levels.

Nevertheless, we will not depart from the econometric analysis, as it can provide very useful modeling tools. In fact, the linear regression analysis is the basis of determination of the objective functions. Likewise, another novel aspect of this paper relies on the use of confidence intervals for the coefficients stemming from the econometric estimates to build up flexible constraints for the multiobjective problem.

Many are the multiobjective approaches that have been described in the literature (as commented in section 2). In our case, we want to establish certain satisfaction levels (namely, the “good Danish levels”) as reference or target values for the satisfaction objective functions. That is why the Reference Point approach is the more appropriate technique for our case study. The use of this technique allows us to assure that the final solution will be weakly efficient (efficient in most of the cases), and the closest possible one to the reference levels. On the other hand, the constraints obtained from the econometric analysis correspond to dependencies observed in the data. But it is not accurate to assume that these dependencies will hold unaltered in the future. This is why a flexible framework that allows the (penalized) violation of certain constraints can give a better image of the possible future situation if certain decisions are made. Goal Programming is probably the most suitable multiobjective technique to deal with such soft constraints. For this reason the methodological framework used in this paper is a combined Reference point – Goal Programming scheme.

Therefore, we propose to analyse this problem in a two-steps procedure. Firstly, we will proceed with econometric estimates to obtain a causal relationship between workers´ satisfaction and an individual/contextual set of features. To address this issue

we use comparable survey data across eight different European countries containing records on seven job-related characteristics which workers say they value: earnings, job security, type of work, number of working hours, working times, working conditions/environment and how far the job is. These are all argued to be key correlates of a good job or of job satisfaction. At a second stage we will make use of multiobjective programming techniques to disentangle the extent to which those correlations may be affected to achieve a satisfactory solution to the problem. Namely, a reference point approach will be used to describe the profile of the "most satisfied" Spanish workers in the present time, according to the data of the survey. Then, a combined reference point – goal programming scheme will be used to determine possible policies in order to increase the workers' satisfaction levels.

The rest of the paper is organised as follows. In section II the basic concepts regarding multiobjective programming techniques, specifically reference point and goal programming, are given. The model is built in section III, using the econometric analysis of the data as the main basis. Section IV contains the solutions to the model, using two successive approaches. Finally, some concluding remarks are given in section V.

II. Basic Concepts of Multiobjective Programming

In this section, the basic definitions and notations regarding multiobjective programming are given. Let us consider the following general multiobjective problem:

$$\begin{aligned} &\max\ f(\mathbf{x}) = \left(f_1(\mathbf{x}),\ f_2(\mathbf{x}), \ldots\ldots, f_k(\mathbf{x}) \right) \\ &\text{s.t.:} \qquad\qquad \mathbf{x} \in X \end{aligned} \tag{1}$$

where $X \subset R^n$ is called the feasible region (constrained set of feasible solutions) defined by:

$$X = \left\{ \mathbf{x} \in R^n \,/\, g_j(\mathbf{x}) \le 0, \quad j = 1,..., m \right\}$$

and $Z = f(X)$ is the regarded as the criterion space. Let us assume that all functions $f_i(\mathbf{x})$ are continuously differentiable, and that X is a nonempty and compact set.

A decision vector $\mathbf{x}^* \in X$ is said to be efficient or Pareto optimal for problem (1) if there does not exist any other vector $\mathbf{x} \in X$ such that $f_i(\mathbf{x}^*) \le f_i(\mathbf{x}) \quad \forall i = 1,..., k$ and $f_j(\mathbf{x}^*) < f_j(\mathbf{x})$ for al least one index *j*. The corresponding objective vector $\mathbf{z}^* = f(\mathbf{x}^*)$ is called a non-dominated criterion vector. A decision vector $\mathbf{x}^* \in X$ is said to be weakly efficient or weakly Pareto optimal for problem (1) if there does not exist any other $\mathbf{x} \in X$ such that $f_i(\mathbf{x}^*) < f_i(\mathbf{x}) \quad \forall i = 1,..., k$. The efficient set of problem (1) will be denoted by E and $Z = f(E)$ is the set of non-dominated criterion vectors.

The ideal and nadir vectors are defined as follows:

$$z_i^* = \max_{\mathbf{x} \in E} f_i(\mathbf{x}) = \max_{\mathbf{x} \in X} f_i(\mathbf{x}) \qquad \forall i = 1,2,..., k \qquad \mathbf{z}^* = \left(z_1^*, \ldots, z_k^*\right)^T$$

$$m_i^* = \min_{\mathbf{x} \in E} f_i(\mathbf{x}) \qquad \forall i = 1,2,..., k \qquad \mathbf{m}^* = \left(m_1^*, \ldots, m_k^*\right)^T$$

Ideal values are obtained easily by means of maximizing each objective function separately. On the other hand, nadir values are usually difficult to obtain. Unfortunately, no constructive way to calculate nadir values exists. Estimates of these values are antiideals values, obtained from a payoff matrix:

$$\begin{array}{c} \\ \mathbf{x}_1^* \to \\ \mathbf{x}_2^* \to \\ \cdots \\ \mathbf{x}_k^* \to \end{array} \begin{array}{c} \begin{array}{cccc} f_1 & f_2 & & f_k \end{array} \\ \begin{pmatrix} z_1^* & z_{12} & \cdots & z_{1k} \\ z_{21} & z_2^* & \cdots & z_{2k} \\ \cdots & \cdots & \cdots & \cdots \\ z_{k1} & z_{k2} & \cdots & z_k^* \end{pmatrix} \end{array}$$

$$z_i^* = \max_{\mathbf{x} \in X} f_i(\mathbf{x}) \qquad \forall i = 1,2,..., k \qquad \text{(ideals)}$$

$$m_i^* = \min_{j \in \{1,..k\}} z_{ji} \qquad \forall i = 1,2,..., k \qquad \text{(antiideals)}$$

$\mathbf{m}^* = \left(m_1^*, ..., m_k^*\right)^T$ is an estimation of nadir point

Multiobjective methods are traditionally classified into three groups, depending on how the decision maker (DM) provides his preferential information [see Steuer (1986), for further details]. If no information is available before hand, then we use a method without *a priori* information, whose aim is to generate a number of efficient solutions, in order to obtain an approximation of the efficient set (or, in the best case, to obtain the whole efficient set). The DM must choose a solution afterwards. The weighting method and the ε-constraint methods are examples of this class of algorithms. If the DM gives his preferences before solving the problem, then we use a method with *a priori* information, in order to search for the solution that is, in some sense, closest to the DM's wishes. Goal Programming and Reference Point algorithms are methods with *a priori* information. Finally, if the information is gradually given by the DM along the resolution process, and solutions are iteratively generated according to the preferences, we use interactive methods. There are plenty of interactive methods in the literature, which are usually classified attending to the kind of information requested to the DM at each step of the algorithm. In Miettinen (1999), a full survey of interactive methods can be found, while in Luque et al. (2006) some relations between the different kinds of information are derived.

In this paper, methods with *a priori* information are used, and more precisely, a combination of the Reference Point approach and Goal Programming has been chosen. Let us briefly describe both schemes. In the former case, a reference point, denoted by $\mathbf{q} = (q_1, ..., q_k)^T$, is given by the DM, and it indicated desirable values for each objective. Given these values, and a vector of weights $\mu = (\mu_1, ..., \mu_k)^T$, the so-called achievement scalarizing function is built [see Wierzbicki (1980)]:

$$s(\mathbf{q}, f(\mathbf{x}), \boldsymbol{\mu}) = \max_{i=1,...,k} \{ \mu_i (q_i - f_i(\mathbf{x})) \}$$

which is minimized over the feasible set:

$$\min_{\mathbf{x}\in X} \; s(\mathbf{q}, f(\mathbf{x}), \boldsymbol{\mu}) = \min_{\mathbf{x}\in X} \; \left\{ \max_{i=1,\ldots,k} \left\{ \mu_i \left(q_i - f_i(\mathbf{x}) \right) \right\} \right\},$$

which is equivalent to solve the following differentiable problem:

$$\begin{aligned} \min_{\mathbf{x},\alpha} \quad & \alpha \\ \text{s.t.} : \; & \mu_i \cdot \left(q_i - f_i(\mathbf{x}) \right) \le \alpha \qquad i = 1,..,k \\ & \mathbf{x} \in X \end{aligned}$$

The weights $\mu = (\mu_1,...,\mu_k)^T$ are generally instrumental, for example, normalizing weights. A widely used normalization is:

$$\mu_i = \frac{1}{m_i^* - z_i^*} \quad \forall i = 1,..,k$$

The use of this achievement scalarizing function assures to obtain a weakly efficient solution. Although there are other functions that guarantee efficiency, we have decided to keep this one for simplicity. The resulting single objective optimisation problem will be solved using the NAG library (Numerical Algorithms Group) for C language [see NAG (1996)]. The implementation has been carried out in C++ language by using the Microsoft Visual C++ compiler, and adapting the software PROMOIN ©, [for further details, see Caballero et al. (2002)].

On the other hand, the Goal Programming approach lets us modelize the so-called soft constraints, that is, constraints whose violation is allowed,[2] although penalized some way. Namely, given a set of hard constraints

$$g_j(\mathbf{x}) \le 0, \quad j = 1, \ldots, s$$

the following goals can be built:

$$g_j(\mathbf{x}) + n_j - p_j = 0, \quad j = 1, \ldots, s$$

[2] This will allow us to provide flexibility to certain constraints of our model, e.g. one establishing bounds on the weekly salary.

The corresponding non desired deviation variables (in our case, the positive deviation variables p_j) are minimized. In this case, Caballero et al. (1996) show that the negative deviation variable can be dropped, and the goal takes the form:

$$g_j(\mathbf{x}) - p_j \leq 0, \quad j = 1, \ldots, s$$

If the *minmax* approach is used, the Goal Programming problem is stated as follows:

$$\begin{aligned} \min_{\mathbf{x},\alpha} \quad & \alpha \\ \text{s.t. :} \quad & p_j \leq \alpha \qquad j = 1,.., s \\ & g_j(\mathbf{x}) - p_j \leq 0 \qquad j = 1,.., s \\ & \mathbf{x} \in X \\ & p_j \geq 0 \qquad j = 1,.., s \end{aligned}$$

As it will be explained in the next section, the reference point approach is used for the satisfaction objectives, taking as reference values the Danish satisfaction levels, while the Goal Programming scheme is used to allow some flexibility in several of the constraints on the original model.

III. Construction of the Model

The multiobjective model for this problem has been built following a sequence of steps. First, a series of data regarding the Spanish workers' satisfaction levels, as well as some of their personal characteristics, have been collected from an European survey. Then, an econometric analysis is carried out in order to find dependence relations of the satisfaction levels with respect to these data, as well as possible correlations among some data themselves. Some conclusions are obtained from this econometric analysis. Based on these results, we identify the significant decision variables of the problem, and the objective functions and constraints are built. Finally, a combined Reference Point –

Goal Programming scheme is used to solve the resulting multiobjective problem. Let us now describe in further detail each of these steps.

Data

The information analysed in this paper comes largely from the European Community Household Panel (ECHP)[3] for the period 1995-2001, in which workers provide information on a wide range of personal characteristics and job attributes.[4] This survey was conducted, under Eurostat supervision, across 15 European Community member states during the period 1994-2001. We have selected the data corresponding to Spain for our study, together with the satisfaction levels of Denmark's workforce (the highest ones in the study) as reference levels. We restrict the sample to those workers, working in the private sector, whose minimum age is 26. The reason for choosing this threshold age is that around this age is the time at which people start looking for a job.[5]

Workers in the ECHP were asked to evaluate seven different aspects of a job, on a scale from 1 to 6, where 1 is "not satisfied at all" and 6 is "fully satisfied". The job aspects presented were: earnings, job security, type of work, number of working hours, working times, working conditions/environment and distance to job. The precise wording of the questions was: *How satisfied are you with your present job in terms of …?* These categories are not exhaustive, but they serve to summarize many of the job

[3] Peracchi (2002) presents a summary of the main characteristics of the ECHP.

[4] The first wave of this panel survey (1994) is not considered in the analysis due to the lack of information on some of the relevant variables for the analysis.

[5] More precisely 90% of the workers surveyed report 26 as the age when the highest level of education was completed.

characteristics that workers find important. The mean values by country[6] for all those satisfaction variables are drawn in Figure 1.

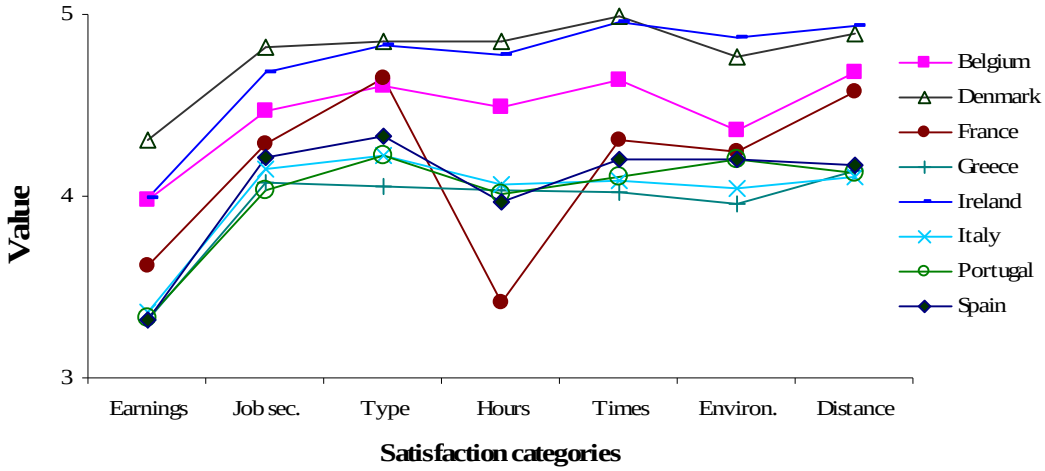

Figure 1. Mean satisfaction values, for sampled countries.[7]

The simple average provides a satisfaction index (the bigger the average, the most satisfied), which is comparable across the populations if we assume the linearity across responses. On the whole, there is a high degree of concordance across these mean values within each country; consequently we can establish somehow a ranking of countries in terms of satisfaction regardless of the particular satisfaction aspect evaluated. In this sense we found that Denmark keeps the highest job satisfaction (in most aspects, i.e., earnings, job security, employment type, working hours and working times) all over the period, and a higher average satisfaction (4.78). On the contrary Mediterranean countries such as Spain, Greece and Italy show the lowest satisfaction levels. Figure 1 illustrates that, with the exception of France, satisfaction with *earnings*

[6] We had to restrict the sample to just eight countries (Belgium, Denmark, France, Greece, Ireland, Italy, Portugal and Spain) due to the lack of information for the rest of countries in some waves on the relevant questions for our analysis.

[7] We do not report the whole satisfaction scale on the Y-axis for sake of presentation.

is ranked as the lowest-rated of the seven characteristics considered. The highest-ranked aspects (across all countries) are type of work, distance to job and working times.

With regard to the decision variables of our model, they have been listed in table A1; there are 4 continuous variables and the rest are binary. Besides, 7 instrumental year dummies have been used, in order to take into account effects due to the precise year when each survey was conducted. Summary statistics, distinguishing by gender, for the whole set of variables incorporated in the analysis are shown in table 1.

- *Table 1 here* -

The figures stated in table 1 disclose some well established differences between male and female workers. The proportion of female workers is much lower than male. Spain like some other Southern European countries (Greece and Italy), but Portugal, still has a much lower female participation rate than the Nordic countries and therefore patterns of women and men in the labour market are highly probable to differ between both groups. Consequently, we will run separate estimates for men and women. There is notable consistency between men and women with respect to satisfaction with different working aspects. Only in the case of working conditions and distance to work women state higher satisfaction levels than men (no longer than 6%). However, men tend to have much higher gross hourly wage (over 1.12 €, equivalent to 18.8%) than their male counterparts, despite having considerably lower education levels. This pattern fits with differences in the labour force participation rates and suggests a stronger relationship between education and labour market participation in countries with a low overall female participation rate (Spain, Italy and Greece).

We also control in our estimates for net family income (discounting worker's own income). This variable is trimmed by treating income observations below 1st and above 99th percentile of income as missing data, to avoid the blurring effects of extreme

values. Interestingly female employees enjoy higher net family income, reinforcing the previous argument that men get higher earnings. Regarding working hours, slightly more than 1 in 5 report being currently working more than forty hours a week, however the figure raise up to 37% for men. Likewise, supervisory or intermediate status are more likely among men. Being married or having young children is definitively a drawback for women to participate in the labour market as reflected by the figures in table 1, where can be seen that the proportion of married women and/or women having young children is substantially lower than men. Men report slightly lower unemployment spells (5 months on average), despite his lower formal qualification level, on average. Moreover, they are exposed to much lower regional unemployment rates. It deserves our attention the fact that the proportion of women working in the construction or transport sector is negligible as compared to men. This meaning that still persist some degree of segregation across occupations between male and female employees.

Econometric Analysis

We start the econometric analysis by estimating simple linear regression models in which our job satisfaction measures are regressed on hourly wage in actual job and the set of explanatory variables above reported, pooling all six years. Satisfaction is a discrete ordered variable categorized into one of six response codes. Thus we first run ordered discrete *probit* models, getting very close results to those showed by ordinary least squared estimations (OLS). For this reason, and in order to make more consistent the implementation of the Multiobjective Programming approach we decided to use the coefficients obtained from the linear regression model.

As previously outlined, we can proxy individual's well-being through different categories of "job satisfaction". The level for each of these satisfaction targets results from the combination of a set of individual and contextual features, unobservable factors and a random disturbance (ε). The idea behind the OLS estimator is to minimize the latter term in order to get rid, as much as possible, of the so called 'statistical noise'. Indexing individuals by *i* and the job satisfaction aspects analysed by *r*, this model can be represented by the following set of equations:

$$Satisfaction\ j_r = \hat{\alpha}^j + \hat{\beta}_1^j ghwg_r + \hat{\beta}_2^j edhigher_r + ... + \hat{\beta}_{30}^j fs500_r + \varepsilon_r^j$$

$$r = 1, ..., N; \quad j = 1,\ldots,7$$

where *Satisfaction* j_r is a measure of the satisfaction category *j* of individual *r*, $ghwg_r$, $edhigher_r,\ldots,fs500_r$, a group of explanatory variables, ε_r a random disturbance, β a vector of slope coefficients and α a fixed but unknown population intercept. The size of the sample is represented by the value *N*.

Tables 2 and 3 show the estimated coefficients on the key variables of interest. It also reports the *t* statistics and the significance levels for each coefficient. Results are presented for the Spanish workers considered in our sample. Since separate regressions for men and women are reported, we have computed tests for equal coefficients across estimates, in order to illustrate the significance for the observed differences between genders. The figures for these tests may be obtained from the authors upon request.

- *Table 2 here* -

- *Table 3 here* -

The estimated coefficients for the earnings variable show that all the constituent parts of job satisfaction are positively and significantly correlated with worker's hourly wage, regardless of the gender.

Surprisingly, job satisfaction appears to decrease with level of education. This is not a common result in the literature to date with a few exceptions; Clark and Oswald (1996) found greater satisfaction for the less educated in Britain in the early 1990s.

The effect of family income on job satisfaction varies quite substantially according to worker's gender. Men seem to be more conformist with earnings and job security as their family income increase, and, at the same time, are fussier with the type of work. On the other hand, women appear to be more dependent on family income to improve job satisfaction in any respect, except job security and distance to job. This would suggest some kind of differential psychological reference effect between sexes for the dependence on income.

Both, men and women, do better when they are young in terms of satisfaction, particularly when satisfaction with earnings and job security are under scrutiny.

The number of years continuously working for the same firm only keeps a straightforward correlation with satisfaction in terms of job security, which seems logical as the worker will have better prospects to stay in the firm as time goes. This is particularly relevant in Spain where the rate of temporary employment is one of the largest in Europe.

When we move into the working hours dummy variable two facts deserve our attention. On the one hand, those men and women working more than 40 hours per week report less satisfaction with number of working hours, working times, working conditions and distance to job than the reference workers (those working 40 hours or fewer). On the other hand, satisfaction with earnings and job security get higher for men who works over 40 hours per week, while it does not show a significant coefficient in the case of female workers. This observed difference might help to understand why men work longer hours than women and, consequently, devote less time to family

commitments. In recent years working hours has become an important policy issue in debates over both potential treats for Europe's high unemployment and overwork (mainly focused on the negative consequences on worker's health status). Accordingly it seems that working hours is a potentially useful policy instrument to change workers satisfaction.

Turning to our findings, we find a consistent positive effect of permanent contracts on job satisfaction. Similarly, being supervisor correlates positively with most job satisfaction sides, yet female workers behave slightly different on this. Above all, women with supervisory responsibilities are less satisfied with working hours as compared to those who do not supervise, possibly because they have to devote marginally longer hours to work and consequently are left with less time for family tasks.

Marital status coefficient is significant for men and women, when satisfaction with earnings is evaluated, although with opposite signs. This may respond to the fact that marital status is more linked to being the head of household for men than for women, which means a stronger pressure for men to get a higher wage if married. However both seem to be less satisfied with working hours than single people.

The last variable related to family status is a dummy variable to control for having children below school entry age. The coefficient is negative, and this reinforces the argument about the difficulties that couples find to reconcile professional and family life. On the contrary, being in good health increases workers' satisfaction.

It is noticeable that, *ceteris paribus*, longer previous unemployment spells tend to slightly reduce job satisfaction of male workers. This may be because the extent of this previous labour mismatch constrain workers' opportunities to sort themselves into the jobs which offer the rewards that they value most.

There is little variation by sex in the effect of regional unemployment rates. Higher surrounding unemployment makes workers more satisfied of being employed and consequently more satisfied with earnings and job security.

The final set of variables measures the size of the firm where the individual is currently working. Basically, small firms (family firms) grant workers higher levels of satisfaction.

So far, we have focused our attention on the econometric analysis of the data. This analysis has allowed us to find significant correlations between the different satisfaction levels and the variables considered, which in turn provide some interesting conclusions about the structure of the Spanish labour market. To follow, we consider the possibility of moving a step forward: the optimization phase. Namely, we would like to give answers to the two following questions: *what is the profile of the most satisfied Spanish worker?* and, *which policies can be carried out in order to increase the workers' satisfaction?* In order to answer these questions, a multiobjective model has been built, whose elements are defined in what follows.

Multiobjective Analysis

Data

Although not all the variables considered in the econometric study previously described are controllable by any decision maker, and in order to answer the first question stated above, we will consider all of them as decision variables for the multiobjective model. Therefore, the decision variables of the model are the 30 variables described in table A1, plus 6 instrumental year dummies. As earlier highlighted, 4 of these variables are continuous (*ghwg*, *netfipc*, *unemdur* and *regunem*), while the rest are binary.

Objective functions

The objective to be considered in this study is workers' satisfaction, which has been in turn divided into 7 satisfaction levels. On the other hand, the econometric study has allowed us to express these levels as functions of the variables, with the linear coefficients shown in tables 2 (for men) and 3 (for women). Therefore, if we rename the variables as x_i, $i = 1, \ldots, 36$ (only in this section, for the sake of clarity), $\hat{\beta}_i^j$ is the regression coefficient of variable i for satisfaction level j, and $\hat{\alpha}^j$ is the independent term of satisfaction level j, then we have the following 7 objectives:

$$ES_j(\mathbf{x}) = \hat{\alpha}^j + \sum_{i=1}^{36} \hat{\beta}_i^j x_i, \qquad j = 1, \cdots, 7$$

which measure the expected satisfaction levels (ES) with respect to earnings, job security, type of work, number of working hours, working times, working conditions/environment and distance to job, respectively.

Constraints

Let us now define the set of constraints of the model. In this section, only the values for men are shown, but the corresponding model for women has also been developed.[8] First, there is a set of technical constraints which assure that certain binary variables do not take the value 1 simultaneously. Let us remind that the reference value of each group (which is assumed to equal 1 if the rest equal 0) is not considered as a variable, and that is why the following constraints are inequalities:

- *Education level*:

[8] Available from the authors upon request.

$$edhigher + edsec \leq 1 \quad \text{(C1)}$$

- *Seniority in the firm*:

$$jobten34 + jobten59 + jobten1014 + jobten15 \leq 1 \quad \text{(C2)}$$

- *Occupational status*:

$$supervisory + intermediate \leq 1 \quad \text{(C3)}$$

- *Health status*:

$$goodhealth + fairhealth \leq 1 \quad \text{(C4)}$$

- *Industry*:

$$ind1 + ind3 + ind4 + ind5 + ind6 + ind7 \leq 1 \quad \text{(C5)}$$

- *Firm size*:

$$fs519 + fs2099 + fs100499 + fs500 \leq 1 \quad \text{(C6)}$$

- *Year dummies*:

$$year2 + year3 + year4 + year5 + year6 + year7 \leq 1 \quad \text{(C7)}$$

Next, three more constraints have been considered, based on logical and/or technical relations among some of the variables.

- *Age*, *seniority* and *unemployment duration*. The sum of the job seniority plus the unemployment duration cannot be greater than the worker's age minus 16, which is the minimum legal working age (note that *unemdur* is measured in months):

$$age - (3\,jobten34 + 5\,jobten59 + 10\,jobten1014 + 15\,jobten15) + \frac{1}{12}unmedur \geq 16 \quad \text{(C8)}$$

- *Salary* and *education level*. On the basis of the data, we have considered upper bounds on the salary: for the different education levels:

  (a) If $edsec = 0$ then $ghwg \leq 22.16$

  (b) If $edsec = 1$ then $ghwg \leq 17.64$

(c) If $edhig + edsec = 0$ then $ghwg \leq 12.38$

(d) If $edhig + edsec = 1$ then $ghwg \leq 22.16$

These bounds are reflected in the two following constraints:

$$ghwg + (22.16 - 17.64) \cdot edsecsec \leq 22.16 \quad \text{(C9)}$$

$$ghwg - (22.16 - 12.38) \cdot (edhigher + edsecsec) \leq 12.38 \quad \text{(C10)}$$

- *Salary* and *Occupational status*. Again, we have considered upper bounds on the salary for the different occupational status:

  (a) If $intermediate = 0$ then $ghwg \leq 26.09$

  (b) If $intermediate = 1$ then $ghwg \leq 18.35$

  (c) If $supervisory + intermediate = 0$ then $ghwg \leq 12.99$

  (d) If $supervisory + intermediate = 1$ then $ghwg \leq 26.09$

  These bounds are reflected in the two following constraints:

$$ghwg + (26.09 - 18.35) \cdot intermediate \leq 26.09 \quad \text{(C11)}$$

$$ghwg - (26.09 - 12.99) \cdot (supervisory + intermediate) \leq 12.99 \quad \text{(C12)}$$

Finally, some other constraints have been derived from linear regression analysis. Namely, we have chosen pairs of variables whose dependencies are stronger according to such analysis, and thus it is not realistic to let them take independent values. In order to build these two-sided constraints, we have used the 98% confidence intervals:

- Dependency between *edhigher* and *ghwg*. The linear regression is given by:

$$ghwg = \alpha \cdot married + \beta$$

where the confidence intervals of the coefficients are:

$$\alpha \in [2.787, 3.1514] \text{ and } \beta \in [6.285, 6.4564]$$

which implies:

$$ghwg - (3.1514 \cdot edhigher + 6.4564) \leq 0 \quad \text{(C13)}$$

$$ghwg - (2.787 \cdot edhigher + 6.285) \geq 0 \quad \text{(C14)}$$

- Dependency between *netfipc* and *married*. The linear regression is given by:

$$netfipc = \alpha \cdot married + \beta$$

where the confidence intervals of the coefficients are:

$$\alpha \in [-6.404, -5.779] \text{ and } \beta \in [9.503, 9.975]$$

which implies:

$$netfipc + 5.779 \cdot married - 9.975 \leq 0 \quad \text{(C15)}$$

$$netfipc + 6.404 \cdot married - 9.503 \geq 0 \quad \text{(C16)}$$

- Dependency between *married* and *age*. The linear regression is given by:

$$married = \alpha \cdot age + \beta$$

where the confidence intervals of the coefficients are:

$$\alpha \in [0.02603, 0.0279] \text{ and } \beta \in [-0.3733, -0.3076]$$

which implies:

$$married - 0.0279 \cdot age + 0.3076 \leq 0 \quad \text{(C17)}$$

$$married - 0.02603 \cdot age + 0.3733 \geq 0 \quad \text{(C18)}$$

- Dependency between *regunem* and *age*. The linear regression is given by:

$$regunem = \alpha \cdot age + \beta$$

where the confidence intervals of the coefficients are:

$$\alpha \in [-0.4082, -0.3741] \text{ and } \beta \in [26.7037, 27.9013]$$

which implies:

$$regunem + 0.3741 \cdot age - 27.9013 \leq 0 \quad \text{(C19)}$$

$$regunem + 0.4082 \cdot age - 26.7037 \geq 0 \quad \text{(C20)}$$

Therefore, the model has a total of 20 (8+4+8) technical constraints. Thus, the multiobjective problem to be solved is the following:

$$\text{Max} \quad \left(ES_1(\mathbf{x}), ES_2(\mathbf{x}), \cdots, ES_7(\mathbf{x})\right) = \left(\sum_{i=1}^{36} \hat{\beta}_i^1 \cdot x_i + \hat{\alpha}^1, \sum_{i=1}^{36} \hat{\beta}_i^2 \cdot x_i + \hat{\alpha}^2, \ldots, \sum_{i=1}^{36} \hat{\beta}_i^7 \cdot x_i + \hat{\alpha}^7 \right)$$

Subject to:

Constraints (C1) – (C20),

Variables bounds types defined in table A1.

IV. Resolution of the Problem

The multiobjective problem has been solved in two phases. First, we intend to detect the profile of the "most satisfied" Spanish worker. To this end, we have used a Reference Point approach, where the Danish mean satisfaction levels have been used as reference level, that is, for men:

$$q_1 = 4.31, \quad q_2 = 4.82, \quad q_3 = 4.85, \quad q_4 = 4.85, \quad q_5 = 4.99, \quad q_6 = 4.76, \quad q_7 = 4.89$$

and for women,

$$q_1 = 4.36, \quad q_2 = 4.74, \quad q_3 = 4.78, \quad q_4 = 4.76, \quad q_5 = 4.92, \quad q_6 = 4.80, \quad q_7 = 4.89$$

and the reference point problem solved in both cases is:

Min α

Subject to:

$$q_j - \sum_{i=1}^{36} \hat{\beta}_i^j \cdot x_i + \hat{\alpha}^j \leq \alpha$$

Constraints (C1) – (C20),

Variables bounds types defined in table A1.

Note that, given that all the satisfaction levels are specified in the same 1 – 6 scale, no normalization is necessary in this formulation. The solutions obtained for both men and women are shown in table 4.

- *Table 4 here* -

The results presented in table 4 provide us with "taxonomy" of the most satisfied Spanish male and female workers. Both, men and women, need "high" real hourly wages to be classified in the group of the most satisfied. To be precise we refer to those workers in the top quartile of the earnings distribution. In the same vein, higher education seems to be the highest educational level required to enjoy this soaring satisfaction status. This link deserves special attention as it introduces an important nuance to the results stemming from the econometric analysis, where the satisfaction levels were observed to decrease with the education level. Therefore the multiobjective analysis has allowed us to clarify the relations between variables (in this case, salary and level of education), and the solution indicates that despite the negative relation between the level of education and the satisfaction levels the impact of the former on earnings leads the optimal profile to a worker with higher level.

Interestingly, attending to our results middle-aged workers are more satisfied than young and elderly people, maybe as a consequence of reaching certain degree of balance between physiological matureness (or working experience) and good enough physical conditions to enjoy their jobs.

Net family income above the mean is crucial to women job satisfaction, on the contrary men with net family income far below the mean are also among the most satisfied. This giving further support to the argument stated at the beginning of this section.

Regardless of workers' sex, to be working less than 40 hours, having a permanent contract and with supervisory responsibilities are all factors providing job satisfaction.

The last variable related to family status is a dummy variable to control for having children below school entry age. The coefficient is negative, and this reinforces the argument about the difficulties that couples find to reconcile professional and family life.

The solutions for the family status variables make clear that married people get higher in the job satisfaction scale but only married women having young children do. Due to the disadvantaged position of women as compared to men in the labour market, female workers accept worse levels of previous individual unemployment and actual regional unemployment as satisfactory.

Good health conditions are important for both, men and women, in order to enjoy their jobs, reinforcing the argument above mentioned on the importance of good mental and physical conditions. Finally, male workers apparently prefer big firms as opposed to small business, which is the case for women.

With respect to the satisfaction levels of the final solution, women achieve three of their seven reference levels (job security, type of work and working conditions), while men only achieve one (type of work). But, on the other hand, the highest unachievement corresponds also to women (0.64 in earnings level and working times), while for men the highest unachievement is 0.49 (working times). Thus, the final solution for women seems to be slightly more unbalanced, reflecting the general worse labour conditions faced by women in Spain.

Nevertheless, in this solution it can be observed that the constraints stemming from the linear regressions of the econometric analysis (C13-C20) are constraining

certain variables (namely, hourly wage, net family income and regional unemployment rate) to stay within the limits imposed by the current situation. Therefore, it would be interesting to let some relaxation in these constraints, so as to determine what kind of policies may be implemented to increase workers' satisfaction levels. Namely, the constraints to be relaxed are C13, C15 and C19, which are binding at the current solution. But the relaxation of these constraints is penalized, so that we are trying to find a trade-off between this relaxation, and its effect on the workers' satisfaction. To this end, a Goal Programming approach has been combined with the previous Reference Point scheme. Constraint 13 has been substituted by the two following constraints:

$$ghwg - (3.1514 \cdot edhigher + 6.4564) - p_{13} \leq 0 \qquad \text{(C13a)}$$

$$\frac{1}{31.3272} p_{13} \leq \beta \qquad \text{(C13b)}$$

That is, p_{13} is the non desired deviation variable, which measures how much has the constraint been violated. In C13b, p_{13} is normalized dividing it by the maximum observed value of *ghwg*, so that it can be afterwards included in the objective function. Using the same scheme, the following constraints are formulated:

$$netfipc + 5.779 \cdot married - 9.975 - p_{15} \leq 0 \qquad \text{(C15a)}$$

$$\frac{1}{136.2609} p_{15} \leq \beta \qquad \text{(C15b)}$$

$$regunem + 0.3741 \cdot age - 27.9013 - p_{19} \leq 0 \qquad \text{(C19a)}$$

$$\frac{1}{46.1} p_{19} \leq \beta \qquad \text{(C19b)}$$

In practice, violating constraint C13 means to increase the mean salary of the workers with higher education level, violating C15 means to increase the family income of married workers, and violating C19 means an increase of the regional unemployment rate.

Therefore, the problem to be solved at this second stage is:

$$\text{Min } \frac{1}{6}\alpha + \mu\beta$$

Subject to:

$$q_j - \sum_{i=1}^{36} \hat{\beta}_i^j \cdot x_i + \hat{\alpha}^j \leq \alpha$$

Constraints (C1) – (C12),

(C13a), (C13b)

(C14)

(C15a), (C15b)

(C16) – (C18)

(C19a), (C19b)

(C20)

Variables bounds types defined in table A1.

Note that the penalization on the undesired deviation variables has been included in the objective function, together with the achievement scalarizing function. To do this, α has been normalized by dividing it by 6, which is the maximum value of the satisfaction scale. This way, both terms means "proportion of the maximum value" and they can be combined. On the other hand, μ is a control parameter which lets us weight the relative importance of the violation of the constraints. This problem has been solved (for both men and women) considering several values of the parameter μ. The solution for $\mu = 1$ was the same as the one obtained before (table 4), which means that, if the same importance is given to the achievement of the reference values and to the violation of the constraints, it is not worth to relax such constraints in order to increase the

satisfaction levels. However, the solution changes for other values of μ. In particular, the solutions for μ = 0.7 and μ = 0.4 are reported in tables 5 and 6, respectively.

- *Table 5 here* -

In table 5, the following aspects can be highlighted. With respect to the satisfaction levels, men have increased all of them except the distance to work, which has decreased very slightly. Two reference levels are now achieved (job security and type of work), and the maximum unachievement is now 0.39 (working times). The situation for women, as compared with the solution showed in table 4, is slightly different. Type of work and working conditions are still achieved, but the reference level for job security are not achievable now, and only two satisfaction levels have been increased (earnings and working times), while the rest have been decreased. However, the maximum unachievement has decreased to 0.41 (earnings and working hours). This result means that the solution for women is now more balanced than the one obtained before. With respect to the values of the variables, for both men and women, salary (*ghwg*), net family income (*netfipc*) and regional unemployment rate (*regunem*) would have increased significantly. Besides, for women, the unemployment duration (*unemdur*) has also increased, not having children under 6 is now preferred, and the industrial sector has changed from sales, hotels and restaurants to manufacturing. All these results have been achieved with a small violation of the constraints (β equals 0.06 for men and 0.04 for women), which means that it should be possible to obtain with "small" structural changes.

It should be highlighted that some commentators may argue that increasing wage and family income are achievable, under particular economic conditions, and socially profitable targets. However, higher regional unemployment rates, although "easily" attainable, are totally unacceptable from the point of view of the Welfare State and the

related social policies. Obviously policy makers concerned with the use of the results stemming from these techniques should interpret them with caution in the case of macro-economic variables, as is the case of the regional unemployment rate. It is so because this variable is used just as a reference for workers that, due to the fact that they are employed people, feel themselves happier in a context of higher unemployment rates. However, no way it means that higher unemployment rates should be a target for the government.

On the other hand, the results displayed in table 6 can be regarded as "utopian", or, at least, targets for a long term horizon. In this case, the violations are much higher (β equals 0.25 for men and 0.15 for women), which means much deeper changes. In the final solution, all the reference levels of men have been achieved, while for women only two are not achieved (earnings and working times), but with very small gaps (0.05 and 0.04, respectively). With respect to the variables hourly wage (*ghwg*), net family income (*netfipc*) and regional unemployment rate (*regunem*), they have again been significantly increased. Besides, occupational status has changed from supervisory to intermediate and the option of having children under age 6 is again more desirable.

- *Table 6 here* -

In brief, the relaxation of some constraints may help to understand the scope for some flexibility in terms of achievable targets. In this sense it seems that male workers are in an outstanding position, as compare to women, to achieve relatively higher satisfaction levels. In other words, there are some idiosyncratic factors bounding women's opportunities to improve their satisfaction with earnings and working times that may be referred to as discriminatory factors in the labour market.

V. Concluding remarks

In this paper, a multiobjective analysis has been carried out as a complement of an econometric study regarding workers' satisfaction in the Spanish labour market. Once the econometric analysis has allowed us to determine the correlations between several variables and the workers' satisfaction levels, the ulterior multicriteria approach has enabled a further consideration of the conflicts among different satisfaction levels, and the impact on such levels of the most significant variables. This combination of methodologies has proved to be useful for the identification of the desirable profiles for Spanish workers, as well as the determination of policies that may be carried out in order to improve satisfaction. Also from the methodological point of view, the joint use of a Reference Point scheme and a Goal Programming approach has enabled us to maintain the original reference levels, while allowing certain flexibility on some of the original constraints, so as to determine which kind of structural changes should be carried out.

Regarding the results obtained, it can be concluded that the profile of the most satisfied workers in Spain is a middle-aged person with high incomes (situated in the top quartile), and with higher education level. In this sense, it is important to point out that the multicriteria analysis has leaded us to the conclusion that while the education level, when considered independently from other variables, is a negative factor for the satisfaction, its impact on other variables makes higher education desirable. It is also worth to stress that family income is much more important for women satisfaction than for men.

The second phase of the multicriteria analysis has produced more balanced solutions, especially in the case of women, which means that the current situation of the Spanish labour market is to a large extent more negative for women, who need deeper

structural changes to increase their satisfaction. In general, higher incomes (salary and family income) are needed to achieve higher satisfaction levels, but there is another important factor: a great part of the current satisfaction levels is derived from the high unemployment rates. That is, workers are more satisfied for actually having a job in regions with a high unemployment situation. This conclusion has been especially evident in the second phase study and, as above indicated, it has to be cautiously interpreted.

A further implication of our results for government involvement in increasing worker's satisfaction is that, regardless of the flexibility of the model specifications, policy makers should be concerned with the number of working hours and type of contract of the workforce. In fact those working less than forty hours a week in a permanent position enjoy systematically higher levels of satisfaction. Therefore these are potentially useful policy instruments to change workers satisfaction.

Finally, let us indicate that, in our opinion, this kind of study would be a very useful tool in order to keep track of the evolution of the labour market, if carried out several times along a given planning period, because it can determine which factors are being more decisive for workers' satisfaction, which policies have been successful, and which ones should be reinforced.

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Appendix

Table A1. Decision Variables

Name	*Variable*	*Type*	*Values*	*Description*
ghwg	**Gross Wage**	Continuous	[0, ∞)	Gross Real Hourly wage (€)
	Education level:			Highest education level completed *(reference group: first level of secondary education or lower)*
edhigher	Higher education	Binary	0 or 1	Higher education
edsec	Secondary education	Binary	0 or 1	Secondary (2^{nd} level) education completed
netfipc	**Family income**	Continuous	[0, ∞)	Net Equivalent family income (10^3 €)
age	**Age**	Continuous	[26, 64]	Age (years)
	Job seniority:			Seniority in the company *(reference group:0-2 years)*
jobten34	Seniority 3-4	Binary	0 or 1	Seniority in the company (3-4 years)
jobten59	Seniority 5-9	Binary	0 or 1	Seniority in the company (5-9 years)
jobten1014	Seniority 10-14	Binary	0 or 1	Seniority in the company (10-14 years)
jobten15	Seniority 15+	Binary	0 or 1	Seniority in the company (15- years)
more40h	**Working hours:**	Binary	0 or 1	Working more than 40 hours per week
permcont	**Permanent contract**	Binary	0 or 1	Type of contract signed: permanent *(reference group: non permanent; i.e. fixed term, etc.)*
	Occupational status:			Job status *(reference group: non supervisory/intermediate)*
supervisory	Supervisory	Binary	0 or 1	Supervisory status
intermediate	Intermediate	Binary	0 or 1	Intermediate status
married	**Married**	Binary	0 or 1	Civil State
child6	**Children <6**	Binary	0 or 1	Having children younger than 6 *(ref. group: older than 5)*
unemdur	**Unemployment duration**	Integer	[0, 288]	Worker's unemployment duration (months)
	Worker's Health:			General health status *(reference group: bad or very bad)*
goodhealth	Good health	Binary	0 or 1	Health status (Good)
fairhealth	Fair health	Binary	0 or 1	Health status (Fair)
regunem	**Regional unemployment rate**	Continuous	[0, 100]	Regional unemployment rate
	Industry in current job:			Main activity in current job *(ref. group: Manufacturing)*
ind1	Mining and quarrying	Binary	0 or 1	Industry (Mining and quarrying)
ind3	Utilities and construction	Binary	0 or 1	Industry (Utilities and construction)
ind4	Sales hotel	Binary	0 or 1	Industry (Sales, hotels and restaurants)
ind5	Transport	Binary	0 or 1	Industry (Transport)
ind6	Finance property	Binary	0 or 1	Industry (Finance property)
Ind7	Other industry	Binary	0 or 1	Industry (Other industry)
	Firm size:			Number of employees in current job *(ref. group: less than 5)*
fs519	Firm size 5-19	Binary	0 or 1	Firm size (5-19 workers)
fs2099	Firm size 20-99	Binary	0 or 1	Firm size (20-99 workers)
fs100499	Firm size 100-499	Binary	0 or 1	Firm size (100-499 workers)
fs500	Firm size 500+	Binary	0 or 1	Firm size (>=500 workers)

Table 1. Descriptive Statistics by gender (Spanish workers).

	Both		Male		Female	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Satisfaction in terms of:						
Earnings	3.23	1.30	3.24	1.28	3.21	1.33
Job security	3.92	1.49	3.92	1.47	3.94	1.54
Type of works	4.19	1.29	4.22	1.25	4.13	1.35
Number of working hours	3.72	1.38	3.68	1.36	3.80	1.40
Working times	4.03	1.36	4.03	1.32	4.04	1.42
Working conditions	4.14	1.32	4.04	1.33	4.33	1.29
Distance to job	4.07	1.46	3.99	1.46	4.22	1.45
Gender (female=1)	0.36	0.48	-	-	-	-
Gross hourly wage	6.67	3.49	7.08	3.56	5.96	3.24
Education level:						
Higher education	0.26	0.44	0.22	0.42	0.31	0.46
Secondary education	0.23	0.42	0.21	0.41	0.25	0.44
Net Family Income (10^3 €)	7.27	7.87	6.24	7.47	9.07	8.24
Age	33.19	9.74	33.83	10.00	32.05	9.15
Job seniority:						
Seniority 3-4	0.17	0.37	0.17	0.37	0.16	0.37
Seniority 5-9	0.20	0.40	0.20	0.40	0.20	0.40
Seniority 10-14	0.11	0.32	0.12	0.33	0.10	0.31
Seniority 15+	0.04	0.20	0.05	0.21	0.03	0.17
Working + 40 hours/week	0.32	0.46	0.37	0.48	0.22	0.41
Permanent contract	0.53	0.50	0.54	0.50	0.51	0.50
Occupational status:						
Supervisory	0.07	0.25	0.08	0.27	0.05	0.21
Intermediate	0.14	0.35	0.16	0.37	0.12	0.32
Married	0.54	0.50	0.58	0.49	0.47	0.50
Children <6	0.17	0.38	0.20	0.40	0.13	0.33
Unemployment duration	65.85	69.04	61.04	59.51	74.34	82.55
Worker's Health:						
Good health	0.87	0.34	0.87	0.34	0.86	0.34
Fair health	0.11	0.32	0.11	0.32	0.11	0.32
Regional unemployment rate	17.95	10.75	13.94	8.35	25.02	10.88
Industry in current job:						
Mining and quarrying	0.01	0.12	0.02	0.14	0.00	0.05
Utilities and construction	0.16	0.37	0.24	0.43	0.02	0.14
Sales hotel	0.26	0.44	0.22	0.42	0.34	0.47
Transport	0.06	0.23	0.07	0.26	0.03	0.17
Finance property	0.11	0.32	0.09	0.28	0.16	0.37
Other industry	0.07	0.26	0.04	0.19	0.13	0.34
Firm size:						
Firm size 5-19	0.31	0.46	0.34	0.47	0.27	0.45
Firm size 20-99	0.27	0.44	0.28	0.45	0.24	0.43
Firm size 100-499	0.12	0.33	0.12	0.33	0.12	0.33
Firm size 500+	0.07	0.26	0.08	0.26	0.07	0.25
Year dummies:						
1995	0.13	0.34	0.13	0.34	0.13	0.34
1996	0.14	0.34	0.14	0.35	0.13	0.34
1997	0.14	0.35	0.14	0.35	0.15	0.35
1998	0.15	0.36	0.15	0.36	0.15	0.35
1999	0.15	0.36	0.15	0.36	0.16	0.36
2000	0.15	0.36	0.15	0.36	0.16	0.37
2001	0.13	0.34	0.13	0.34	0.13	0.34
Observations	**16165**		**10318**		**5847**	

Table 2. The Determinants of different aspects of job satisfaction (men).

	Satisfaction in terms of :						
	Earnings	**Job security**	**Type of work**	**Number of working hours**	**Working times**	**Working conditions**	**Distance to job**
Gross hourly wage	0.116***	0.022***	0.023***	0.032***	0.035***	0.018***	-0.005
	(26.13)	(4.72)	(5.20)	(6.89)	(7.45)	(3.71)	(0.93)
Education level:							
Higher education	-0.153***	-0.224***	-0.106***	-0.159***	-0.184***	-0.033	-0.042
	(4.41)	(6.18)	(2.99)	(4.40)	(4.94)	(0.89)	(1.03)
Secondary education	-0.137***	-0.173***	-0.194***	-0.153***	-0.165***	-0.055	-0.016
	(4.29)	(5.19)	(5.97)	(4.59)	(4.83)	(1.60)	(0.44)
Net Family Income (10^3 €)	0.003*	0.004**	-0.004**	-0.000	0.003	0.001	-0.002
	(1.67)	(2.31)	(2.41)	(0.04)	(1.52)	(0.60)	(0.90)
Age	-0.011***	-0.008***	-0.001	-0.001	0.004**	0.002	-0.002
	(6.65)	(4.85)	(0.69)	(0.45)	(2.04)	(1.16)	(1.17)
Job seniority:							
Seniority 3-4	-0.132***	0.139***	0.009	-0.084**	-0.029	-0.017	0.033
	(3.55)	(3.58)	(0.23)	(2.16)	(0.73)	(0.43)	(0.74)
Seniority 5-9	-0.109**	0.225***	0.049	-0.032	0.024	-0.120**	0.171***
	(2.37)	(4.70)	(1.05)	(0.68)	(0.50)	(2.43)	(3.16)
Seniority 10-14	-0.084	0.299***	0.095	-0.063	0.063	0.000	0.382***
	(1.22)	(4.18)	(1.36)	(0.88)	(0.86)	(0.00)	(4.72)
Seniority 15+	-0.063	0.361***	0.327***	0.056	0.191*	0.123	0.467***
	(0.66)	(3.59)	(3.34)	(0.55)	(1.85)	(1.18)	(4.11)
Working + 40 hours/week	0.136***	0.091***	-0.009	-1.009***	-0.450***	-0.102***	-0.083***
	(5.28)	(3.38)	(0.35)	(37.69)	(16.42)	(3.69)	(2.74)
Permanent contract	0.149***	1.244***	0.199***	0.166***	0.075**	0.152***	0.228***
	(4.76)	(38.30)	(6.29)	(5.10)	(2.27)	(4.52)	(6.22)
Occupational status:							
Supervisory	0.170***	0.382***	0.461***	0.033	0.205***	0.286***	0.238***
	(3.46)	(7.48)	(9.27)	(0.64)	(3.91)	(5.42)	(4.13)
Intermediate	-0.005	0.159***	0.271***	-0.030	0.098***	0.028	-0.018
	(0.13)	(4.46)	(7.82)	(0.85)	(2.69)	(0.76)	(0.46)
Married	-0.151***	0.004	0.054	-0.106***	-0.081**	-0.013	-0.010
	(4.41)	(0.11)	(1.55)	(2.98)	(2.22)	(0.34)	(0.25)
Children <6	-0.016	-0.056	-0.012	-0.007	-0.023	-0.025	-0.075*
	(0.46)	(1.58)	(0.36)	(0.18)	(0.63)	(0.68)	(1.87)
Unemployment duration	-0.001*	0.000	-0.001**	-0.001**	-0.001*	-0.000	-0.001*
	(1.65)	(0.90)	(2.06)	(2.05)	(1.85)	(0.62)	(1.75)
Worker's Health:							
Good health	0.419***	0.333***	0.411***	0.373***	0.425***	0.466***	0.257**
	(4.69)	(3.58)	(4.54)	(4.01)	(4.46)	(4.85)	(2.44)
Fair health	0.226**	0.161	0.189**	0.221**	0.335***	0.114	0.090
	(2.39)	(1.64)	(1.97)	(2.25)	(3.33)	(1.12)	(0.81)
Regional unemployment rate	0.005**	0.002	0.000	-0.003	0.001	0.005***	0.003
	(2.51)	(0.90)	(0.16)	(1.51)	(0.73)	(2.63)	(1.35)
Industry in current job:							
Mining and quarrying	0.007	-0.031	-0.351***	-0.068	-0.112	-0.353***	-0.388***
	(0.08)	(0.35)	(4.07)	(0.76)	(1.24)	(3.86)	(3.88)
Utilities and construction	0.100***	-0.076**	-0.128***	0.074**	0.136***	-0.180***	-0.410***
	(2.86)	(2.09)	(3.64)	(2.04)	(3.67)	(4.80)	(10.02)
Sales hotel	-0.008	0.108***	-0.008	-0.013	-0.067*	0.284***	0.101**
	(0.23)	(3.00)	(0.22)	(0.36)	(1.81)	(7.60)	(2.47)
Transport	0.036	-0.086*	-0.023	-0.263***	-0.215***	0.102*	-0.191***
	(0.71)	(1.65)	(0.45)	(5.07)	(4.05)	(1.89)	(3.25)
Finance property	-0.038	0.014	0.021	-0.083*	0.005	0.309***	-0.084
	(0.81)	(0.29)	(0.43)	(1.70)	(0.10)	(6.09)	(1.51)
Other industry	0.190***	0.187***	0.056	0.211***	0.163**	0.320***	0.340***
	(2.92)	(2.75)	(0.85)	(3.11)	(2.35)	(4.56)	(4.44)
Firm size:							
Firm size 5-19	-0.068*	-0.046	-0.132***	-0.074**	-0.087**	-0.136***	-0.227***
	(1.95)	(1.27)	(3.74)	(2.05)	(2.35)	(3.65)	(5.56)
Firm size 20-99	-0.058	-0.068*	-0.173***	-0.033	-0.068*	-0.222***	-0.260***
	(1.56)	(1.77)	(4.63)	(0.86)	(1.72)	(5.59)	(6.01)
Firm size 100-499	-0.032	-0.072	-0.170***	0.022	-0.103**	-0.190***	-0.257***
	(0.70)	(1.51)	(3.64)	(0.47)	(2.10)	(3.84)	(4.76)
Firm size 500+	0.057	-0.044	-0.139**	0.027	-0.117**	-0.200***	-0.311***
	(1.05)	(0.78)	(2.54)	(0.48)	(2.04)	(3.45)	(4.91)
Year dummies	√	√	√	√	√	√	√
Constant	2.383***	2.898***	3.880***	3.929***	3.687***	3.546***	4.158***
	(18.09)	(21.12)	(29.06)	(28.66)	(26.25)	(24.99)	(26.82)
Observations	10318	10318	10318	10318	10318	10318	10318
R-squared	0.12	0.28	0.06	0.16	0.06	0.06	0.06

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%; OLS estimates.

Table 3. The Determinants of different aspects of job satisfaction (women).

	Satisfaction in terms of :						
	Earnings	**Job security**	**Type of work**	**Number of working hours**	**Working times**	**Working conditions**	**Distance to job**
Gross hourly wage	0.148***	0.042***	0.048***	0.050***	0.042***	0.019***	0.021***
	(22.45)	(6.13)	(7.02)	(7.26)	(5.76)	(2.82)	(2.84)
Education level:							
Higher education	-0.259***	-0.196***	-0.050	-0.134***	-0.122**	-0.071	-0.059
	(5.63)	(4.08)	(1.04)	(2.76)	(2.39)	(1.53)	(1.12)
Secondary education	-0.219***	-0.099**	-0.091**	-0.101**	-0.163***	-0.104**	-0.060
	(5.07)	(2.20)	(2.03)	(2.22)	(3.40)	(2.38)	(1.22)
Net Family Income (10^3 €)	0.005**	0.002	0.004*	0.004*	0.008***	0.006***	0.002
	(2.42)	(0.97)	(1.66)	(1.93)	(3.38)	(2.87)	(0.97)
Age	-0.012***	-0.010***	-0.008***	-0.001	0.003	0.001	-0.008***
	(4.78)	(3.61)	(2.90)	(0.50)	(1.11)	(0.46)	(2.62)
Job seniority:							
Seniority 3-4	-0.135***	0.174***	0.040	-0.087*	-0.004	-0.133***	0.059
	(2.70)	(3.33)	(0.77)	(1.65)	(0.07)	(2.62)	(1.02)
Seniority 5-9	-0.242***	0.263***	0.084	-0.108*	-0.035	-0.155***	-0.000
	(4.45)	(4.64)	(1.49)	(1.90)	(0.59)	(2.82)	(0.00)
Seniority 10-14	-0.109	0.286***	0.053	0.008	-0.034	-0.091	0.162**
	(1.54)	(3.85)	(0.72)	(0.11)	(0.43)	(1.27)	(1.99)
Seniority 15+	-0.103	0.122	0.103	-0.048	0.023	-0.221*	0.225*
	(0.91)	(1.03)	(0.87)	(0.41)	(0.19)	(1.93)	(1.74)
Working + 40 hours/week	0.066	0.001	0.042	-1.046***	-0.517***	-0.160***	-0.100**
	(1.62)	(0.02)	(0.99)	(24.27)	(11.35)	(3.86)	(2.14)
Permanent contract	0.139***	1.326***	0.250***	0.208***	0.076	0.098**	0.103**
	(3.31)	(30.18)	(5.72)	(4.69)	(1.62)	(2.30)	(2.15)
Occupational status:							
Supervisory	0.207**	0.322***	0.388***	-0.285***	-0.062	0.101	0.050
	(2.51)	(3.76)	(4.55)	(3.30)	(0.68)	(1.22)	(0.54)
Intermediate	-0.071	0.210***	0.312***	-0.012	0.038	0.122**	0.021
	(1.33)	(3.77)	(5.62)	(0.22)	(0.64)	(2.26)	(0.34)
Married	0.076**	0.044	0.057	-0.019	-0.085**	-0.042	0.006
	(1.97)	(1.09)	(1.45)	(0.48)	(1.99)	(1.09)	(0.15)
Children <6	-0.104**	-0.065	-0.036	0.077	0.064	0.012	-0.088
	(1.96)	(1.18)	(0.66)	(1.37)	(1.08)	(0.22)	(1.45)
Unemployment duration	0.000	0.001***	-0.000	0.000	0.000	0.001**	0.001
	(1.43)	(3.34)	(0.01)	(0.21)	(0.41)	(2.23)	(1.64)
Worker's Health:							
Good health	0.308***	0.224*	0.349***	0.172	0.425***	0.529***	0.440***
	(2.62)	(1.82)	(2.87)	(1.39)	(3.26)	(4.46)	(3.28)
Fair health	0.152	0.074	0.100	0.054	0.249*	0.217*	0.140
	(1.22)	(0.57)	(0.78)	(0.41)	(1.80)	(1.73)	(0.98)
Regional unemployment rate	0.006***	0.004*	0.003	0.002	0.006***	0.006***	-0.001
	(3.08)	(1.77)	(1.61)	(1.06)	(2.83)	(2.81)	(0.24)
Industry in current job:							
Mining and quarrying	0.344	0.454	-0.328	0.026	-0.337	-0.482	-0.831**
	(1.09)	(1.38)	(1.00)	(0.08)	(0.96)	(1.52)	(2.31)
Utilities and construction	0.134	0.366***	0.412***	0.169	-0.294**	0.277**	0.281**
	(1.07)	(2.81)	(3.19)	(1.29)	(2.12)	(2.21)	(1.97)
Sales hotel	0.032	0.223***	0.035	-0.083*	-0.230***	0.194***	-0.066
	(0.66)	(4.46)	(0.70)	(1.66)	(4.33)	(4.02)	(1.22)
Transport	-0.195*	0.029	0.038	-0.079	-0.211*	0.089	-0.414***
	(1.86)	(0.26)	(0.35)	(0.72)	(1.81)	(0.84)	(3.46)
Finance property	-0.199***	0.085	-0.161***	-0.126**	-0.248***	0.052	-0.368***
	(3.50)	(1.43)	(2.73)	(2.11)	(3.93)	(0.91)	(5.67)
Other industry	-0.145**	0.219***	-0.157**	-0.188***	-0.099	0.284***	-0.275***
	(2.28)	(3.30)	(2.39)	(2.81)	(1.40)	(4.43)	(3.80)
Firm size:							
Firm size 5-19	-0.044	-0.246***	-0.095**	-0.130***	-0.066	-0.217***	-0.219***
	(0.96)	(5.13)	(1.99)	(2.69)	(1.29)	(4.68)	(4.17)
Firm size 20-99	-0.125**	-0.297***	-0.281***	-0.153***	-0.211***	-0.297***	-0.349***
	(2.56)	(5.81)	(5.53)	(2.97)	(3.88)	(6.01)	(6.25)
Firm size 100-499	-0.069	-0.380***	-0.362***	-0.195***	-0.337***	-0.370***	-0.502***
	(1.16)	(6.09)	(5.84)	(3.10)	(5.07)	(6.13)	(7.36)
Firm size 500+	-0.154**	-0.307***	-0.374***	-0.045	-0.257***	-0.484***	-0.516***
	(2.10)	(4.01)	(4.91)	(0.58)	(3.16)	(6.54)	(6.16)
Year dummies	√	√	√	√	√	√	√
Constant	2.506***	2.967***	3.736***	3.876***	3.612***	3.732***	4.329***
	(13.38)	(15.16)	(19.22)	(19.68)	(17.35)	(19.74)	(20.23)
Observations	5847	5847	5847	5847	5847	5847	5847
R-squared	0.12	0.28	0.09	0.13	0.05	0.05	0.04

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%.; OLS estimates.

Table 4. Solutions for the Multiobjective problem using a Reference Point approach

Decision Variables		
Names	***Solution***	
	Men	**Women**
Gross hourly wage	9.61	7.98
Higher education	1	1
Secondary education	0	0
Net Family Income (10^3 €)	4.2	9.5
Age	48	51.61
Seniority 3-4	0	0
Seniority 5-9	0	0
Seniority 10-14	0	0
Seniority 15+	0	0
Working + 40 hours/week	0	0
Permanent contract	1	1
Supervisory	1	1
Intermediate	0	0
Married	1	1
Children <6	0	1
Unemployment duration	0	38
Good health	1	1
Fair health	0	0
Regional unemployment rate	9.95	16.79
Mining and quarrying	0	0
Utilities and construction	0	0
Sales hotel	0	1
Transport	0	0
Finance property	0	0
Other industry	1	0
Firm size 5-19	0	0
Firm size 20-99	0	0
Firm size 100-499	0	0
Firm size 500+	1	0

Objective functions				
Satisfaction with:	**Men**		**Women**	
	Value*	**Reference***	**Value***	**Reference***
Earnings	3.93	4.31	3.72	4.36
Job security	4.74	4.82	4.94	4.74
Type of works	4.85	4.85	5.16	4.78
Number of working hours	4.45	4.85	4.48	4.76
Working times	4.50	4.99	4.28	4.92
Working conditions	4.69	4.76	5.04	4.80
Distance to job	4.54	4.89	4.86	4.89

*Figures on a 1-6 scale.

Table 5. Solutions for the Goal Programming approach combined with the Reference Point scheme, and $\mu = 0.7$.

Decision Variables		
Names	***Solution***	
	Men	**Women**
Gross hourly wage	11.54	9.33
Higher education	1	1
Secondary education	0	0
Net Family Income (10^3 €)	12.61	19.53
Age	48.00	51.61
Seniority 3-4	0	0
Seniority 5-9	0	0
Seniority 10-14	0	0
Seniority 15+	0	0
Working + 40 hours/week	0	0
Permanent contract	1	1
Supervisory	1	1
Intermediate	0	0
Married	1	1
Children <6	0	0
Unemployment duration	0	43.00
Good health	1	1
Fair health	0	0
Regional unemployment rate	12.79	19.22
Mining and quarrying	0	0
Utilities and construction	0	0
Sales hotel	0	0
Transport	0	0
Finance property	0	0
Other industry	1	0
Firm size 5-19	0	0
Firm size 20-99	0	0
Firm size 100-499	0	0
Firm size 500+	1	0

Objective functions

Satisfaction with:	**Men**		**Women**	
	Value*	**Reference***	**Value***	**Reference***
Earnings	4.2	4.31	3.95	4.36
Job security	4.82	4.82	4.72	4.74
Type of works	4.87	4.85	4.9	4.78
Number of working hours	4.5	4.85	4.35	4.76
Working times	4.6	4.99	4.66	4.92
Working conditions	4.74	4.76	4.85	4.80
Distance to job	4.52	4.89	4.71	4.89

*Figures on a 1-6 scale.

Table 6. Solutions for the Goal Programming approach combined with the Reference Point scheme, and $\mu = 0.4$.

Decision Variables		
Names	***Solution***	
	Men	**Women**
Gross hourly wage	17.38	12.67
Higher education	1	1
Secondary education	0	0
Net Family Income (10^3 €)	32.87	36.60
Age	48.00	51.61
Seniority 3-4	0	0
Seniority 5-9	0	0
Seniority 10-14	0	0
Seniority 15+	0	0
Working + 40 hours/week	0	0
Permanent contract	1	1
Supervisory	1	0
Intermediate	0	1
Married	1	1
Children <6	0	1
Unemployment duration	0	43.00
Good health	1	1
Fair health	0	0
Regional unemployment rate	21.39	25.25
Mining and quarrying	0	0
Utilities and construction	0	1
Sales hotel	0	0
Transport	0	0
Finance property	0	0
Other industry	1	0
Firm size 5-19	0	0
Firm size 20-99	0	0
Firm size 100-499	0	0
Firm size 500+	0	0

Objective functions				
Satisfaction with:	**Men**		**Women**	
	Value*	**Reference***	**Value***	**Reference***
Earnings	4.7	4.31	4.31	4.36
Job security	5	4.82	5.08	4.74
Type of works	5.18	4.85	5.33	4.78
Number of working hours	4.89	4.85	4.92	4.76
Working times	5.21	4.99	4.88	4.92
Working conditions	5.27	4.76	5.29	4.80
Distance to job	4.98	4.89	4.89	4.89

*Figures on a 1-6 scale.