DOES THE REPRESENTATION OF FAMILY DECISION PROCESS MATTER? A COLLECTIVE MODEL OF HOUSEHOLD LABOUR SUPPLY FOR THE EVALUATION OF A PERSONAL TAX REFORM IN SPAIN

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ABSTRACT

This paper presents an application of the collective model of labour supply, allowing for labour participation and non-linear budget sets. To identify the model, some preference parameters are estimated, while some other key parameters are calibrated so as to replicate as best as possible observed labour supplies under the 1994 personal tax system in Spain. The model is used to simulate the important reform of the tax system introduced in 1999. It is seen that the reform induces important behavioural changes through two channels: changes in the budget constraint, and changes in the bargaining power of the spouses within couples. The reform leads to a decrease in average tax rates, a larger redistributive effect on the before tax income distribution than the 1994 tax system, and an increase in social welfare defined on the after tax, or disposable income distribution. In addition, the reform induces an increase in the female's power index, utility gains for all females, and utility losses for almost all males in the sample of couples.

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INTRODUCTION

The incidence of the tax system on labour supplies is a classical topic in the evaluation of fiscal policy. This paper studies the impact of an important reform of the personal income tax in Spain using a collective model of household labour supply.(1) The reform was introduced in 1999 by the center-right government that came into power in 1996 after 14 years of socialist governments. The main novelties of the 1999 tax system are the reduction in the number of tax brackets, the lowering of marginal tax rates, and the introduction of a large standard deduction from the tax base depending on family composition.

In the unitary model, it is assumed that, regardless of their composition, households behave as single decision making units. In this way, standard tools of consumer analysis can then be applied at the household level. Observable joint household consumption and individual labour supplies in multi-person households are assumed to result from the maximization of a single utility function representing household preferences. In the overall budget constraint, household income results from the pooling of all household members' incomes. In this set-up, where households are treated as a "black box", the intra-household redistribution of resources cannot be reconstructed. Consequently, nothing is said about the individual welfare enjoyed by each household member.

It has been known for some time that the strong implication of the unitary model about the symmetry of the Slutsky matrix is regularly rejected on household data (see, for instance, Blundell, 1988, Blundel *et al.*, 1993, and Browning and Meghir, 1991). More recently, there is mounting empirical evidence rejecting the "income pooling" property of the unitary model (see, for instance, the papers quoted in Browning and Chiappori, 1998).

As an alternative to the methodological and empirical shortcomings of the standard approach, a new literature on household economics has developed during the last twenty years (see, for instance, Manser and Brown, 1980). Its main feature is the recognition that a household is formed by several individuals, possibly with different preferences, who engage in some form of intra-household bargaining process to arrive at all household decisions. In this paper, only the so-called "collective approach" to household behaviour, originating in Chiappori (1988, 1992) will be considered.(2) The assumption that characterizes this approach is that household decisions are Pareto efficient. This assumption alone has testable implications upon household demand functions that can be seen as a generalization of the Slutsky symmetry and negativeness in the unitary case (Browning and Chiappori, 1998). Furthermore, within a collective framework household demands and labour supplies should be sensitive to the intra-household distribution of resources, and more generally to any environmental variable that may influence the decision process -the "EEP's" in McElroy's (1990) terminology or the "distribution factors" in Browning *et al.* (1994). Interestingly enough, the restrictions of different collective models have not been rejected in several empirical studies (see the references in Vermeulen, 2000).

Thus, the stage is set for the evaluation of policy measures according to a unitary or a collective model of the household. Ideally, one would have to estimate structural models under the two approaches and a common version of the base tax system. Then, the two sets of behavioural parameter estimates would be used to obtain predictions after a tax reform. Unfortunately, this strategy is not possible at this point. The estimation of household labour supply decisions is operational for unitary models of the household in the realistic case of discrete choices (see, for instance, Van Soest, 1995, Bingley and Walker, 1997, and Blundell *et al.*, 1998). However, the identification and the estimation of a full collective model of the household including labour non-participation, the presence of children, and non-linear taxation is in its infancy.(3)

To circumvent this problem, this paper proposes a simplified application of the collective approach. The methodology originates in Beninger and Laisney (2001), where fiscal reforms are simulated on an artificially created data set. The population of tax units consists only of singles and couples where labour supply decisions are treated as a discrete choice problem. Here a data set is created where couples' behaviour under the base line tax system results from a fully deterministic labour supply model that exhibits some fundamental ingredients of the collective approach. The "collective world" is constructed following a mixed strategy. Some preference parameters are estimated from the singles sample, while some other key parameters of the collective model are calibrated so as to replicate the observed data on couples' labour supply. A unitary model is then estimated in this collective world where household members behave according to collective rationality. In this way, it is possible to study whether the two models lead to substantially different predictions on household consumption and male and female labour supplies before and after a common tax reform.

The Spanish data come form the first three waves of the European Community Household Panel (ECHP), collected during 1994 to 1996. In line with the remaining countries in the international project to which this paper belongs, the sample selected consists of people 25-55 years of age, excluding the retired, the registered unemployed, the self-employed, and those working in the agricultural sector. Thus, the tax units selected are singles and couples, with or without children under 16, where the adults are either employed in a salaried job or non-participants in the labour market.

The baseline personal tax system is the one of 1994. The available data permits the modeling of a 1994 stylized tax system, where married people are allowed to fill in either two individual tax returns or a joint return. The remaining features of the 1994 tax system can be summarized as follows: (i) certain deductions from wage earnings; (ii) two graduated tariffs for individual and joint returns, both consisting of 18 tax brackets with a minimum and a maximum marginal tax rate of 20 and 56 %, respectively; (iii) a minimum exempted income of, approximately, 2,405 euro for individual tax units and 4,810 euro for couples; and (iv) certain tax credits depending on the number of children and other circumstances of the tax unit.

The 1999 tax system also permits married people to fill in individual or joint returns, and maintains a deduction from wage earnings. The two distinctive features of the reform are the following: (i) the substitution of the tax credits by a standard deduction from the tax base of 3,307 euro per adult, plus 1,203 euro for the first and second child, and 1,803 euro for the third and remaining children; and (ii) a unique graduated tariff for individual and joint tax returns consisting of only 6 tax brackets with a minimum and a maximum marginal tax rate of 18 and 48 %, respectively.(4)

The first important finding of the paper is that the unitary model performs very badly on the data set constructed under the collective approach. This is partly due to the mistaken assumption that households behave as single decision makers when the data set has been constructed according to a collective model. The implication for future research is that it is justified to put more effort in making operational the collective approach.

Regarding the collective framework, the paper first evaluates the 1999 tax reform maintaining constant the behaviour predicted by the deterministic collective model. Consistently with other static exercises, it is found that the 1999 tax system leads to an increase in mean disposable incomes and a reduction of the redistributive effect on the pre-tax income distribution.(5)

The more interesting results take into account individuals' responses to changes in the tax system. An important finding is that the female's bargaining power depends, among other variables, on the earnings potential of the members of the couple. In turn, this variable partially depends on the tax system parameters. Thus, in the collective framework any tax reform affects the spouses' labour supplies through two channels. First, through changes in the overall budget constraint, the only channel available in a unitary world. Second, through changes in the female's bargaining power, a distinctive feature of the collective approach.

When the labour supplies are allowed to vary, the decrease in tax revenues and average tax rates is now smaller than in the static case, the redistributive effect is larger than in 1994, and there is a 14.8 social welfare increase, defined in the space of disposable incomes. Moreover, the issue of changes in the intra-household distribution of resources –about which the unitary model is silent - can also be analyzed within the collective approach. In particular, corresponding to the increase in females' power index induced by the tax reform, all females in the couples sample experience a utility gain, while essentially all men are seen to experiment a utility loss.

The rest of the paper is organized in seven sections. Section II discusses the sample selection and other data problems. Section III presents the baseline 1994 tax system. Section IV describes how to construct a collective world. Section V presents the results on the estimation of the singles model and the construction of the collective world for the Spanish economy. Section VI reports the estimation of the unitary model on the collectively generated data set. Section VII evaluates the tax reform in the collective world, and Section VIII concludes.

II. THE DATA

As indicated in the Introduction, data come form the ECHP. The main focus of this study is the evaluation of tax reforms through their impact on labour supply. It is well known that the labour behaviour of the registered unemployed, the self-employed, and those working in the agricultural sector is particularly difficult to estimate. Therefore, together with the retired, households containing persons of these characteristics are excluded from the analysis. Furthermore, the labour behaviour of those close to the normal retirement age of 65 years might be heavily influenced by the early retirement provisions, which are an important part of all the social security systems of the European countries participating in this study. Therefore, the tax units selected are households, with or without children under 16, where the adults are 25-55 years of age and either employed in a salaried job or voluntarily unemployed.

There are basically three problems with the type of information available in Spain and with the sample selected according to these criteria. First, three waves of the ECHP, conducted in 1994, 1995, and 1996, were available at the time of the project. In a given ECHP wave dated in year t, individual characteristics refer to the moment the interview is conducted, namely, during the last quarter of that year. However, annual income is reported in answer to a retrospective question that refers to the year $t - 1$. To overcome this discrepancy, individuals interviewed during two consecutive waves have been considered. In this way, individual characteristics recorded during the last quarter of year t can be matched with income information referred to this year, but recorded during the second wave, that is, during the last quarter of year $t + 1$.

Secondly, as in other Southern European countries, the percentage of people living in single person households and satisfying the above selection criteria is very low. In particular, among the people interviewed in 1994 for which information in the second wave is available there are only 70 females and 86 males in this situation. In an attempt to increase the sample size, new individuals in single person households in 1995 who had other living arrangements in 1994 have also been considered. Unfortunately, those for whom there is also information in 1996 about the income earned during 1995 are only 19 females and 20 males.(6) Finally, single parents with children under 16 are also considered. A total of 46 females and 3 males fulfill this condition. Therefore, the final sample of tax units consisting of single person households, with or without children under 16, consists of 135 females and 109 males. In the sequel, these tax units will be referred to as "singles".

A classical difficulty in studies of tax reform with micro data from household surveys is that the definition of a household need not coincide with the definition of a tax unit. Therefore, in line with the remaining countries in this international project, the second type of tax unit studied – which will be referred to as "couples"- consist of households which can be easily identified as tax units and satisfy the selected criterion already discussed, that is, households with two adults 25-55 years of age, either employed in a salaried job or voluntary unemployed, with and without children under 16. Households of more complex composition, with either additional older, younger members, or both, are excluded from the analysis. As in other Southern European countries, a large proportion of households in Spain belongs to this excluded category. Consequently, the ECHP sample of couples thus defined consists of only 975 observations.(7)

The third problem with the Spanish data has to do with the fact that most income information refers to income net of (i) withdrawals retained at the income source on account of the personal income tax, and (ii) the employee's contribution to social security. Withdrawals refer both to capital income, wage income, and some public transfers that are considered part of labour income. These public transfers include old-age and disability pensions, pensions granted to widows and orphans, the unemployment subsidy, and other minor public subsidies granted to needy families.(8)

Given the graduated tariff in the Spanish income tax, firms are instructed to practice withdrawals on wage income according to a complex formula that takes into account the number of dependent children. In addition, there is a single 25 % withdrawal rate on capital income, and a relatively small withdrawal rate on the public transfers described above. The employee's contribution to social security refers only to wage income, varies along a number of professional categories, and it is subject to a ceiling.

Fortunately, the *Instituto de Estudios Fiscales* (IEF) –a public organism in the Ministry of Finance devoted to research in fiscal matters and other activities- has a program to compute an estimate of gross income from the information available in the ECHP about the net income described above and the number of dependent children.(9) Table 1 summarizes the consequences of applying the IEF program to the singles and couples data sets. Taking into account a 4.75 inflation rate between 1994 and 1995, all incomes are expressed in 1994 euro.

Table 1 around here

The more remarkable features in Table 1 are the following. First, the average withdrawal rate on gross taxable income ranges from 14.2 to 17.8 % for participants (see row 16), and from 4.5 to 7.8 % for non-participants (see row h). Second, gross non-wage income of single male and female non-participants (see row l) is 5.3 and 6.1 times larger, respectively, than the corresponding figures for participants in the labour market (see row 18). Third, the participation rate among single and married females is 80.7 and 31.6 %, respectively. Among the first group, the percentages of females without children or with one child are 65.9 and 17.0 %, respectively, while among the second group these percentages are only 15.8 and 29.8, respectively. Gross wage earnings of single females is 17 % larger than for married females. Fourth, among participants in the labour market, gross total income of married males is 3.6 % larger than for single males, 12.2 % larger than for single females, and 36.7 % larger than for married females. Among non-participants, the highest income corresponds to single females, closely followed by married and single males.

III. THE BASELINE TAX SYSTEM

Data availability determines the baseline year for this paper and the features of the system that can actually be modeled. As explained in the data section, the baseline year is 1994. Data limitations in the ECHP preclude taking into account the following important features of the 1994 tax system: a) contributions to private pension funds, up to a maximum of 4,510 euro, are deductible from taxable income. b) 15 % of health expenditures are deductible; c) the following investments generate tax credits, with a ceiling of 30 % of the tax bill: housing acquisition, life insurance, and donations to different types of charities and non-profit institutions; and d) owner-occupiers must declare as taxable income 2 % of the housing value, while housing renters can deduct the minimum of 15 % of housing rent or 451 euro.

In view of the above, this paper must focus on a simplified 1994 tax system that includes the following elements: 1) the basic income exemption; 2) the deductions from gross wage income; 3) the graduated tariff on total taxable income; and 4) the tax credits. Differences in the taxation of singles and couples justify a separate treatment.

Gross labour income, *GW*, is the sum of wage earnings, wL (wage rate *w* times hours worked *L*), plus certain taxable public transfers, *O* (these include "social wages" paid by the Autonomous Communities, like financial assistance in cases of disability or widower's pensions). Gross taxable income, *GT*, is the sum of *GW* plus capital income and property income, *K*. Singles with gross income *GT* less than 2,405 euro need not fill in a tax return. For singles with gross income greater than this minimum there are two deductions from gross labour income. First the deduction of the employee's contribution to social security from wage earnings. This average deduction rate, denoted by *ss*, is taken from row 6 of Table1, namely, 6.5 % for females, 6.2 for single males and 6.1 for married men. The magnitude $wL(1 - ss) + O$, is called net labour income (that is, gross labour income net of social security contributions). Second, the minimum of 5 % of net labour income or 1,503 euro, denoted by *D*.

A Simplified Taxation Scheme for Singles	
Gross labour income	$GW = wL + O$
Gross taxable income	$GT = GW + K$
Taxable labour income	$W = wL(1 - ss) + O - D$
Taxable income	$I = W + K$
Gross tax liability	$T_g = T(I)$
Net tax liability	$T_n = T_g - C$
Non-wage income	$y = O + K + P$
Gross income, net of social security contributions	$g = wL(1 - ss) + y$
Disposable income	$x = g - T_n$

Taxable labour income, *W*, is equal to net labour income less *D*. Taxable income, *I*, is the sum of taxable labour income plus capital income and property income net of necessary expenses, *K*.[10] The graduated tariff for singles, which gives the gross tax liability $T_g = T(I)$ for any taxable income I, is described below.

1994 Graduated Tariff for Singles, $T_g = T(I)$, where I is measured in euro/year:

Taxable Income, I	Gross Tax Liability, T_g
$I <$ 2,404	0
$I <$ 6,010	(I - 2,404) 0.2
$I <$ 9,436	721 +(I - 6,010) 0.22
$I <$ 14,484	1,475 + (I - 9,436) 0.245
$I <$ 16,287	2,314 + (I - 14,484) 0.27
$I <$ 19,713	3,239 + (I - 16,287) 0.3
$I <$ 23,134	4,267 + (I - 19,7130) 0.32
$I <$ 26,566	5,363 + (I - 23,134) 0.34
$I <$ 29,990	6,528 + (I - 26,566) 0.36
$I <$ 33,416	7,761 + (I - 29,990) 0.38
$I <$ 36,842	9,063 + (I - 33,416) 0.4
$I <$ 40,268	10,433 + (I - 36,842) 0.425
$I <$ 43,694	11,889 + (I - 40,268) 0.45
$I <$ 47,119	13,431 + (I - 43,694) 0.47
$I <$ 50,545	15,041 + (I - 47,119) 0.49
$I <$ 53,971	16,720 + (I - 50,545) 0.51
$I <$ 57,397	18,467 + (I - 53,971) 0.535
$I >$ 57,397	20,299 + (I - 57,397) 0.56

Finally, tax credits C include three components: a) 120 euro per child; b) day care expenses for children up to 3 years of age, which equals the minimum of 15 % of expenses or 150 euro;(11) and c) a credit meant to favor wage earners which depends on net wage income and capital income as follows. If the individual has:

- net labour income greater than 10,824 euro or capital income greater than 12,026 euro, then the tax credit is set equal to a minimum 151.5 euro
- net labour income less than 6,013 euro and capital income less than 12,026 euro, then the tax credit is set equal to a maximum 409 euro
- net labour income between 6,013 and 10,824 euro, then the tax credit is computed according to the formula: 409 euro – 0.05 (net wage income – 6,013 euro).

Gross income net of social security contributions, g, is equal to wage earnings net of social security contributions, $wL(1 - ss)$, plus non-wage income $y = O + K + P$ -where P denotes public transfers not subject to the income tax (see note 8). Once tax credits are taken into account in the computation of net tax liability, disposable income, x, is seen to be equal to gross income net of social security contributions, g, minus net tax liability, T_n.

Couples are allowed to choose between two options: to fill in two separate tax returns, or to fill in a joint tax return integrating the incomes of the spouses. In the first case, each spouse can claim half of the tax credit for dependent children. In the second case, the new features are the following. First, the minimum exempted gross income for couples is 4,810 euro. Second, the couple is allowed to deduct the minimum of 5 % of their aggregate net labour income or 1,503 euro, denoted by D. Third, the graduated tariff is adjusted as follows.

1994 Graduated Tariff for Couples, $T_g = T(I)$, where I is measured in euro/year:

Taxable Income, I	Gross Tax Liability, T_g
$I <$ 4,808	0
$I <$ 12,020	(I - 4,808) 0.2
$I <$ 15,777	1,442 + (I - 12,020) 0.22
$I <$ 19,533	2,366 + (I - 15,777) 0.245
$I <$ 23,289	3,377 + (I - 19,533) 0.27
$I <$ 27,045	4,504 + (I - 23,289) 0.3
$I <$ 30,802	5,706 + (I - 27,045) 0.32

$I <$ 34,558	6,983 + (I - 30,802) 0.34
$I <$ 38,314	8,335 + (I - 34,558) 0.36
$I <$ 42,071	9,763 + (I - 38,314) 0.38
$I <$ 45,827	11,265 + (I - 42,071) 0.4
$I <$ 49,583	12,862 + (I - 45,827) 0.425
$I <$ 53,340	14,552 + (I - 49,583) 0.45
$I <$ 57,096	16,317 + (I - 53,340) 0.47
$I <$ 60,852	18,158 + (I - 57,096) 0.49
$I <$ 66,111	20.074 + (I - 60,852) 0.51
$I >$ 66,111	22,887 + (I - 66,111) 0.535

IV. THE CONSTRUCTION OF A COLLECTIVE WORLD

IV. 1. Efficient Household Allocations

The starting point of any collective model is the recognition that multi-person households consist of several individuals with preferences of their own. Together with singles, this paper focuses on one type of multi-person household, namely, couples consisting of two adults, each 25-55 years of age, with or without children under 16.

Both spouses are assumed to have preferences represented by the following well-behaved direct utility functions:

$$u^i = v^i\,(c^i, l^m, l^f, \mathbf{d}),\ i = m, f,$$

where c^i is a Hicksian aggregate of private consumption goods consumed by agent i, l^i are leisure amounts, and $\mathbf{d}$ is a vector of household characteristics like the number of children and education level. Notice that public goods and consumption externalities are excluded from the model. However, the above utility functions allow for an externality with respect to the spouse's leisure.

Let y denote the household non-wage income that may include individual assignable non-wage incomes, y^m and y^f, and some component y^h that cannot be attributed to any of the spouses. Taking the private consumption good as the numeraire, the household budget constraint requires that household consumption $c = c^m + c^f$ does not exceed the household disposable income:

$$c \leq w^m L^m\,(1 - ss^m) + w^f L^f (1 - ss^f) + y - g(\,w^f, L^f, w^m\,, L^m, y, \mathbf{d}),$$

where $w^i L^i\,(1 - ss^i)$ is individual i's wage earnings net of social security contributions, and τ is the function that gives the household 1994 net tax liability depending on gross wage earnings, non-wage household income, and certain household characteristics (see Section III for details).

The distinctive feature of the collective approach is that, independently of the bargaining process in which the two individuals may be engaged in, household allocations of consumption and leisure are assumed to be (Pareto) efficient. That is, observable household allocations should be such that no individual's welfare can be increased without decreasing the welfare of the spouse. Formally, a household allocation (c^m, c^f, l^m, l^f) is efficient if it is the solution to the following utility maximization problem:

$$\max_{\{c^m,\, c^f,\, l^m,\, l^f\}} \quad v^m\,(c^m, l^m, l^f, \mathbf{d}) \qquad (1)$$

subject to

$$v^f(c^f, l^f, l^m, \mathbf{d}) \geq u^f$$

$$c \leq w^m L^m\,(1 - ss^m) + w^f L^f (1 - ss^f) + y - g(w^m L^m, w^m L^m, y, \mathbf{d}),$$

$$l^i + L^i = 168,\ i = m, f,$$

where 168 is the maximum available number of hours per week, and u^f is some required utility level for individual f. Naturally, by varying u^f the set of efficient household allocations can be traced out.

An appropriate interpretation of u^f is that the variable represents female's bargaining power. In general, this bargaining power may depend on certain household characteristics, like the age difference between spouses, the wage earnings potential of both spouses, their non-wage incomes, and other factors. These variables are the so-called distribution factors referred to in the Introduction. Notice that changes in distribution factors will shift the bargaining power from one individual to his/her spouse, altering thereby the household decisions on consumption and leisure. In particular, as will be seen below, tax reforms may alter the earnings potential of both spouses; this may induce changes in individual f's bargaining power that, in turn, may affect labour supplies and the intra-household allocation of consumption and welfare.

IV. 2. Empirical Specification and Identification of the Collective Model

To make the efficiency problem (1) empirically tractable, the individual utility functions are assumed to be of the following form ($i = m, f$ and $i \neq j$):

$$u^i = \beta_c^i(\mathbf{d}) \ln(c^i - c^i(\mathbf{d})) + \beta_l^i(\mathbf{d}) \ln(l^i - l^i(\mathbf{d})) + \delta(\mathbf{d}) \ln(l^i - l^i(\mathbf{d})) \ln(l^j - l^j(\mathbf{d})). \quad (2)$$

where δ represents the cross leisure effect on the spouses' utiltities. The presence of δ means that we do not restrcit our attention to egoistic or caring agents. The preference parameters $c^i(\mathbf{d})$ and $l^i(\mathbf{d})$ capture subsistence or minimum consumption and leisure, and are assumed to depend on household characteristics. In particular, the parameter $l^i(\mathbf{d})$ can be interpreted as the time needed to sleep and to perform essential domestic tasks which increase with the number of children.

As pointed out in the Introduction, the identification and estimation of such a collective model in the presence of non-participation in the labour market and a non-linear budget constraint is beyond the scope of this paper. Instead, the following approach is pursued.

In the first place, to simplify matters labour supply is treated as a discrete choice problem. That is, individuals are assumed to choose among a limited number of working hours. The advantage of this assumption is that econometric problems related to non-participation and the shape of the budget constraint can be conveniently dealt with.(12)

Nevertheless, even in this simplified context the following question must be addressed: how can the parameters $c^i(\mathbf{d})$, $l^i(\mathbf{d})$, $\beta_c^i(\mathbf{d})$, $\beta_l^i(\mathbf{d})$, and $\delta(\mathbf{d})$, $i = m, f$ be identified given the mixed effects coming from individual preferences and the intra-household bargaining process reflected in u^f? The solution to this fundamental problem amounts to the construction of a collective world that will be carried on in two stages.

In Stage 1, the following crucial assumption is made: apart from the leisure interaction term in equation (2), singles and married individuals in couples share the same preferences. In the discrete case the single's utility maximization problem can be written as follows. For each $i = m, f$:

$$\max_{\{c^i,\, l^i\}} \quad \beta_c^i(\mathbf{d}) \ln(c^i - c^i(\mathbf{d})) + \beta_l^i(\mathbf{d}) \ln(l^i - l^i(\mathbf{d})) \quad (3)$$

subject to

$$c^i \leq w^i L^i (1 - ss^i) + y^i - g(w^i L^i, y^i, \mathbf{d}),$$

$$L^i \in \Psi^i,$$

$$l^i + L^i = 168,$$

where $y^i = O^i + K^i$ is the non-wage income of agent i, h is the function that gives the net tax liability (see Section III for a discussion), and Ψ^i is the set of alternatives among which individual i can choose his/her working hours.

This model can be estimated on data from the two samples of male and female singles discussed in Section II. Two remarks are in order. First, the estimation requires gross wages for all individuals. Thus, using information about their individual characteristics, standard techniques are used to predict non-participants' gross wages. Second, although in principle the minimum consumption and leisure terms $c^i(\mathbf{d})$ and $l^i(\mathbf{d})$, $i = m, f$, can be estimated from the data, for convenience they will be fixed according to the criteria explained in the next section. Thus, the outcome of Stage 1 consists of parameter estimates for $\beta_c^i(\mathbf{d})$ and $\beta_l^i(\mathbf{d})$, $i = m, f$ (see Section V for the results).

For couples, the minimum consumption and leisure terms are also set equal for both males and females and are fixed according to the criteria explained in the next section. At this point, the leisure interaction terms $\delta^i(\mathbf{d})$, and the individual's f bargaining power u^f remain to be identified. For this purpose, a calibration exercise is performed in Stage 2.(13)

This stage consists of two rounds. In the first one, for each couple the parameters δ^m and δ^f are made equal, $\delta^m = \delta^f = \delta$, and are allowed to vary in a grid of discrete choices denoted by Δ. For each δ in Δ, a number of utility pairs $(u_k^m(\delta), u_k^f(\delta))$, $k = 1,\ldots, K$, in the utility possibility frontier is computed for each couple. The utility pair whose associated allocation of consumption and leisures best fit the observed labour supplies is selected. This choice determines an estimate of the power index of individual f –denoted by μ– depending on the given δ. Finally, the δ which provides the best fit to labour supplies is selected. The outcome of the first round is an optimal household allocation and an optimal power index μ for each couple.

The power index thus calibrated is then regressed on the vector of demographic characteristics $\mathbf{d}$, and a vector $\mathbf{z}$ of explanatory variables that are interpreted as distribution factors, that is, exogenous variables that may affect the bargaining process but not the preferences or the budget constraint. Using the estimated power index for each couple, in the second round the above algorithm is redesigned to provide optimal values for δ^m and δ^f in each couple. Finally, the leisure interaction terms thus calibrated are regressed on the vector of household characteristics, $\mathbf{d}$.

The details of the first round are best explained in three steps for each couple. In Step 1, for each $\delta^m = \delta^f = \delta$ in Δ, a number of utility pairs $(u_k^m(\delta), u_k^f(\delta))$, $k = 1,\ldots, K$, in the utility possibility frontier is determined as follows. First, let $u_{min}^f(\delta)$ and $u_{max}^f(\delta)$ be the minimum and maximum utility level that f can obtain, respectively, considering all labour supply combinations $L^m \in \Psi^m$ and $L^f \in \Psi^f$, and all possible consumption shares between 0.1 and 0.9. Notice that these values will depend on the individual wages, the household non-labour income and demographic characteristics, and the tax system. Second, the K utility levels $u_k^f(\delta)$ are defined by

$$u_k^f(\delta) = u_{min}^f(\delta) + (k - 1)\,[u_{max}^f(\delta) - u_{min}^f(\delta)]/(K - 1),\ k = 1,\ldots, K.$$

Third, for each k, m maximizes his utility subject to the household budget constraint, f's required utility level $u_k^f(\delta)$, and the labour supplies being in the choice set:

$$\max_{\{c^m, c^f, l^m, l^f\}} \quad v^m(c - c^f, l^f, l^m, \mathbf{d}; \delta) \qquad (4)$$

subject to

$$v^f(c^f, l^f, l^m, \mathbf{d}; \delta) \geq u_k^f(\delta),$$

$$c \leq w^m L^m (1 - ss^m) + w^f L^f (1 - ss^f) + y - g(w^m L^m, w^m L^m, y, \mathbf{d}),$$

$$L^i \in \Psi^i,\ i = m, f,$$

$$l^i + L^i = 168,\ i = m, f.$$

For each k, this maximization procedure results in an efficient household allocation $(c^m(k, \delta), c^f(k, \delta), l^m(k, \delta), l^f(k, \delta))$, and a corresponding utility pair $(u_k^m(\delta), u_k^f(\delta))$ in the utility possibility frontier. Denote the set of all those allocations by $A(k, \delta)$.

In Step 2, given δ, select the allocation in $A(k, \delta)$ which minimizes the criterion

$$(l^m(k, \delta) - l^m)^2 + (l^f(k, \delta) - l^f)^2,$$

where l^i, $i = m, f$, is the individual i's observed labour supply. Denote the corresponding value of k by $k = k(\delta)$. An index for individual f's bargaining power can be defined as

$$\mu = k(\delta)/K = \mu(\delta).^{(14)}$$

The more this index approaches 1, the closer the utility of individual f approaches $u_{max}{}^f(\delta)$, and hence the greater is her bargaining power.

In Step 3, for each couple choose the value of δ in Δ which minimizes the criterion

$$(l^{m\prime}(\delta) - l^m)^2 + (l^{f\prime}(\delta) - l^f)^2,$$

where $l^{i\prime}(\delta) = l^i(k(\delta), \delta)$, $i = m, f$. This value of δ, denoted by δ^*, determines: (i) an allocation $(c^{m*}, c^{f*}, l^{m*}, l^{f*})$, where $c^{i*} = c^i(k(\delta^*), \delta^*)$, $l^{i*} = l^{i\prime}(\delta^*)$, $i = m, f$; (ii) a power index $\mu^* = \mu(\delta^*) = k(\delta^*)/K$; and (iii) a pair of utility functions with a common $\delta*$ parameter: $u^i = \beta_c{}^i \ln(c^i - c(\mathbf{d})) + \beta_l{}^i \ln(l^i - l(\mathbf{d})) + \delta^* \ln(l^m - l(\mathbf{d})) \ln(l^f - l(\mathbf{d}))$.

The second round consists of 5 steps. In Step 1, the power index calibrated in the first round is regressed on the vector of demographic characteristics $\mathbf{d}$, and a vector $\mathbf{z}$ of explanatory variables that are interpreted as distribution factors, $\mu^* = \varphi(\mathbf{d}, \mathbf{z})$.

In Step 2, for each couple j let

$$U_j{}^f = u_{min}{}^f + \mu^*[u_{max}{}^f - u_{min}{}^f]$$

where μ^* is the estimated value of the female's power index. Then, for *each* $(\delta^m, \delta^f) \in \Delta^m \times \Delta^f$ solve the problem

$$\max_{\{c^m, c^f, l^m, l^f\}} \quad v^m(c^m, l^f, l^m, \mathbf{d}; \delta^m) \tag{5}$$

subject to

$$v^f(c^f, l^f, l^m, \mathbf{d}; \delta^f) \geq u_j{}^f,$$

$$c \leq w^m L^m (1 - ss^m) + w^f L^f (1 - ss^f) + y - g(w^m L^m, w^m L^m, y, \mathbf{d}),$$

$$L^i \in \Psi^i, \; i = m, f,$$

$$l^i + L^i = 168, \; i = m, f.$$

This results in an allocation $(c^m(\delta^m, \delta^f), c^f(\delta^m, \delta^f), l^m(\delta^m, \delta^f), l^f(\delta^m, \delta^f))$. Denote the set of all those allocations by $A(\delta^m, \delta^f)$.

In Step 3, choose the allocation in $A(\delta^m, \delta^f)$ which minimizes the criterion

$$(l^m(\delta^m, \delta^f) - l^m)^2 + (l^f(\delta^m, \delta^f) - l^f)^2,$$

where, as before, l^i, $i = m, f$, is the individual i's observed labour supply. The parameters (δ^m, δ^f) thus calibrated for each couple are regressed on the vector $\mathbf{d}$ of household characteristics. Estimated parameters, say $\delta^m(\mathbf{d})$ and $\delta^f(\mathbf{d})$ close round two.

IV. 3. A Summary

In brief, the construction of a collective world for the Spanish economy proceeds as follows. First, in Stage 1 the subsistence parameters $c^m(\mathbf{d}) = c^f(\mathbf{d}) = c(\mathbf{d})$ and $l^m(\mathbf{d})$, $l^f(\mathbf{d})$ are fixed, while the parameters $\beta_c{}^i(\mathbf{d})$ and $\beta_l{}^i(\mathbf{d})$, $i = m, f$ are estimated using the samples of female and male singles. Second, in Stage 2 the subsistence parameters for couples are similarly fixed, while the female's bargaining power index $\mu = \varphi(d, z)$ is obtained via the first round calibration and the subsequent estimation of the calibrated power indices.

Third, the parameters $\delta^i(\boldsymbol{d})$, $i = m, f$ are obtained via the second round calibration and the subsequent estimation of these leisure interaction terms as a function of household characteristics. Finally, using the parameters thus identified, the collective world is constructed by taking the set of Spanish couples and replacing the observed labour supplies by the "collectively" determined labour supplies.

This data set obtained by means of a fully deterministic collective model is the one that, in principle, should be used in Section VI to estimate a unitary model of the household. In practice, the estimation of the calibrated leisure interaction terms leads to bad predictions of the hours worked by both males and females. Therefore, the data set used in the estimation of the unitary model in this version of the paper is the one resulting from the estimation of the female power index and the calibrated leisure interaction terms, which provide very good predictions of the hours worked by all individuals. This data set constitutes the baseline for the evaluation of the 1999 tax reform in Section VII.

V. ESTIMATION RESULTS

V. 1. The Singles Model

Table 2 contains descriptive statistics for singles about age, education, marital status, number of children, region of residence, and labour participation. Figures 1 describes in more detail the distribution of observed labour supplies for females and males, respectively

Table 2 and Figure 1 around here

It should be stressed that the relative small samples for singles in the Spanish case limits the applicability of the project's approach in this country.

V. 1. 1. Missing Wages

As can be seen in Table 2, approximately 20 % of both males and females do not participate in the labour market. In order to impute missing wages to non-participants, a log wage equation has been estimated separately for male and female participants. Heckman's two step estimation procedure was applied (see, for instance, Greene, 1997). However, the null hypothesis of no sample selection could not be rejected. Therefore, wages were simply estimated by means of OLS. Regression results and wage predictions are presented in Table 3.

Table 3 around here

The age variables are significant for both males and females. To have a secondary education and, above all, a College education has a positive impact on wages. To live in Madrid has a positive but barely significant effect on wages. The presence of children has a negative but insignificant effect on female wages. The adjusted R^2 is 0.39 and 0.09 for males and females, respectively. As expected, predicted wages have a lower variance than actual wages. Actual and predicted wages for participants are slightly greater for females. Predicted wages for non-participants, especially for females, are lower than wages for participants.

V. 1. 2. Marginal Propensities

As explained in the previous section, the identification of the collective model parameters is achieved in two stages. In stage 1, the marginal propensities for consumption and leisure for both males and females, $\beta_c^i(\boldsymbol{d})$ and $\beta_l^i(\boldsymbol{d})$, $i = m, f$, respectively, where $\boldsymbol{d}$ is a vector of demographic characteristics, are estimated from the corresponding samples for singles.

Singles $i = m, f$ are assumed to solve the utility maximization problem in (3):

$$\max_{\{c^i,\, l^i\}} \quad \beta_c^i(\boldsymbol{d}) \ln(c^i - c^i(\boldsymbol{d})) + \beta_l^i(\boldsymbol{d}) \ln(l^i - l^i(\boldsymbol{d}))$$

subject to

$$c^i \leq w^i L^i (1 - ss^i) + y^i - g(w^i L^i, y^i, \boldsymbol{d}),$$

$$L^i \in \Psi^i,$$

$$l^i + L^i = 168,$$

where $c^i(\mathbf{d})$ and $l^i(\mathbf{d})$ are parameters denoting minimum subsistence consumption and leisure, respectively. We do not impose the constraint $\beta_c^i + \beta_l^i = 1$ in the estimation, but check that the estimates are positive, which allows a posteriori to rescale the utility function by $\beta_c^i + \beta_l^i$. According to the budget constraint, consumption is required to be less than or equal to disposable income under the simplified 1994 personal tax system which is possible to model given the available information in the ECHP (see Section III for details). Disposable income is equal to wage income net of social security contributions, $w^iL^i\ (1 - ss^i)$, plus non-wage income, y^i – including capital income, property income, and public transfers subject and not subject to the personal tax- less net tax liability after all deductions and credits are taken into account, $T_n = g(w^iL^i, y^i, \mathbf{d})$. It is assumed that the set Ψ^i consists of 5 discrete choices for hours worked per week, L^i, $i = m, f$, according to the following scheme [(15)]:

Discretization of Weekly Working Hours

Female Choices: Observed	Female Choices: Assumed	Male Choices: Observed	Male Choices: Assumed
0 – 14	0	0 – 14	0
15 – 25	20	15 – 24	20
26 – 35	30	25 – 34	30
36 – 44	40	35 – 44	40
45 and more	50	45 and more	50

For estimation, and skipping the indices for male and female preferences to keep notation simple, the utility derived by individual *j* at the *h*-th labour supply choice is given by:

$$u_{jh} = \beta_c(\mathbf{d}_j)ln(c_{jh} - c(\mathbf{d}_j)) + \beta_l(\mathbf{d}_j)ln(l_{jh} - l(\mathbf{d}_j)) + \varepsilon_{jh},$$

where ε_{jh} is an individual unobserved heterogeneity preference component independently and identically distributed with type I extreme value distribution.

Although the minimum consumption and leisure can be estimated in principle, we chose to calibrate them. In order not to produce infinite disutility, the minimum consumption is calibrated as the lowest disposable income over all possible labour supplies in the sample minus 2. The latter number was obtained by a grid search for the value that maximizes the likelihood. The minimum amount of time for sleeping and domestic tasks is fixed at $l^m(\mathbf{d}) = 80$ and $l^f(\mathbf{d}) = 87$ hours per week for males and females, respectively.

For the estimation of the preference parameters we use a multinomial logit model with mass points on the consumption coefficients in order to account for unobserved heterogeneity (see Hoynes, 1996). Thus, preference parameters are assumed to be of the following form:

$$\beta_c(\mathbf{d}_j) = \theta_j + \beta'_{c1}\mathbf{d}_j,$$

and

$$\beta_l(\mathbf{d}_j) = \beta_{l0} + \beta'_{l1}\mathbf{d}_j.$$

In the empirical exercise it is assumed that θ_j can only take two values, θ_1 and θ_2, with probabilities p^1 and $p^2 = 1 - p^1$. A higher value for the mass point or regime θ_j implies a larger marginal propensity to consume, and hence a larger work effort. Both mass points θ_j and the associated probabilities are estimated by maximum likelihood techniques. The probability that individual *i* makes choice *k* consists of two parts, each associated with one value of the heterogeneity factor:

$$p^1\ (exp\ (\mathbf{x'}_{ik}\beta(\theta_1))/\Sigma_j\ exp\ (\mathbf{x'}_{ij}\beta(\theta_1)) + p^2\ (exp\ (\mathbf{x'}_{ik}\beta(\theta_2))/\Sigma_j exp\ (\mathbf{x'}_{ij}\beta(\theta_2)),$$

where $\mathbf{x'}_{ik}\ \beta(\theta_a)$ is shorthand notation for the vector preference factors θ_a appearing in the marginal propensity to consume $\beta_a(\mathbf{d}_j)$, $a = 1, 2$. The likelihood function to be maximized equals:

$$log\ LD = \Sigma_i\Sigma_j\Sigma_a\, p^a\ (exp\ (\mathbf{x'}_{ik}\beta(\theta_a))/\Sigma_j\ exp\ (\mathbf{x'}_{ij}\beta(\theta_a)), \quad (4)$$

and results in an estimated coefficients vector *(θ_1, θ_2, β'_{c1}, β_{l0}, β'_{l1})*, the mass points and the probabilities p^1 and $p^2 = 1 - p^1$. In order to ensure that that the probabilities do lie between 0 and 1, p^1 and p^2 are replaced by the expressions *exp (m)/(1 + exp (m))* and *1 - exp (m)/(1 + exp (m)),* respectively, where the scalar *m* is estimated.

Maximum likelihood estimation results based on (4) for two mass points for single males and females are reported in Table 4. The last row in each panel shows the log likelihood value obtained with the multinomial logit model without allowing for unobserved heterogeneity. The improvement when allowing for unobserved heterogeneity is large in both cases. However, moving from two to three mass points does not improve the log likelihood at all. On the other hand, in the computation of the optimal predicted labour supply of each single in the sample, for each individual we choose the regime or mass point which gives the best prediction. The estimated probabilities (which result from the estimation procedure) and the frequencies (which correspond to the regime which gives the best labour supply prediction) for both regimes are as follows:

	MALES		FEMALES	
	Est. Prob.	**Freq.**	**Est. Prob.**	**Freq.**
Regime 1	0.28	0.25	0.64	0.67
Regime 2	0.72	0.75	0.36	0.33

Although regime 1 appears to be chosen slightly too often, the regime frequencies obtained are very close to the estimated probabilities.

Table 4 around here

The interpretation of the coefficients in Table 4 is not easy. However, the normalized marginal propensities to consume and to demand leisure are shown in Table 5. They are practically identical for males and females. Using these propensities, price and wage elasticities at observed hours are computed by linearising the budget constraint at those points. The results are given in Table 6. The mean price elasticity is almost – 1 for both males and females. The mean wage elasticity is slightly larger for females for whom it reaches the value 0.11. Mean income elasticities are very similar for males and females. It is large for consumption and, in absolute value, even larger for labour. In all four cases, the range of variation of the estimated elasticities in the sample is large.

Table 5 and 6 around here

Finally, Table 7 presents the cross tabulation of predicted hours worked (columns) against observed worked hours. The observed marginal distributions of hours worked are fairly accurately reproduced, except for all persons working 50 hours who are predicted to work the usual 40 hours per week. Non-participants are very well predicted indeed. In all, 63 and 69 % of all male and female cases, respectively, are well predicted by the model.

V. 2. The Construction of the Collective World

Table 8 contains descriptive statistics for singles about age, education, number of children, region of residence, and labour participation. Figure 2 describes in more detail the distribution of observed labour supplies for females and males, respectively.

Table 8 and Figure 2 around here

V. 2. 1. Missing Wages

As can be seen in Table 8, 15 and 68 % of married males and females, respectively, do not participate in the labour market. In order to impute wages to non-participants, wage equations are estimated separately for male and female participants. However, in the couples' context a difficulty must be confronted: to deal with the selectivity issue, a participation model based on the collective framework would have to be built. Fortunately, there is a more straightforward alternative, namely, to apply Lewbel's (2000) estimation method that does not require the specification of the selection mechanism. Thus, this method (in its simplest form) is used here for wives, whose participation rate is very low. For men, whose selectivity problem is much less severe, the OLS predictions are more accurate than those based on the Lewbel estimator. Regression results and wage predictions are presented in Table 9.(16)

Table 9 around here

For males, the greater the age or the educational level, and to live in Madrid has a significant positive effect on wages. For females, the age variable has a positive but decreasing effect on wages; to have a College degree and to live in Madrid has a positive effect, and to have children has a negative effect on wages. The latter effect might be due to the depreciation of female's human capital in periods out of the labour market caused by child-care. As expected, predicted wages have again a lower variance than actual wages. Actual, but not predicted wages are slightly higher for males. Both male and female non-participants are predicted to have a lower wage than participants.

V. 2. 2. Preference Parameters

As indicated in Section IV, it is assumed that a person, once married, retains the preferences for consumption and leisure he/she had when single, but with an interaction term in log leisures added. That is, the spouses preferences, $i = m, f$, are given by

$$u^i = \beta_c^i(\mathbf{d}) \ln(c^i - c^i(\mathbf{d})) + \beta_l^i(\mathbf{d}) \ln(l^i - l^i(\mathbf{d})) + \delta(\mathbf{d}) \ln(l^i - l^i(\mathbf{d})) \ln(l^j - l^j(\mathbf{d})),$$

where the parameters $\beta_c^i(\mathbf{d})$ and $\beta_l^i(\mathbf{d})$ have been estimated in the first stage of the identification process (see Section V. 1. 2).

For couples, it is assumed that the set of discrete choices for hours worked per week is somewhat wider than for singles:

Discretization of Weekly Working Hours
Female and Male Choices:

Observed	Assumed
0 – 9	0
10 - 19	10
20 – 29	20
30 – 39	30
40 - 49	40
50 - 59	50
60 and more	60

In the second stage of the identification process, the parameters $c^i(\mathbf{d}))$, $l^i(\mathbf{d}))$, $\delta(\mathbf{d})$, $i = m,f$, and individual f's power index must be identified. The minimum subsistence parameters are fixed taking into account the impact of children on both time use and consumption. The final choices are the following.

The minimum amount of time for sleeping and domestic tasks for males is fixed at $l^m(\mathbf{d})$ = 82 hours per week, plus 4 hours if there is any child between 0 and 3 years of age, and 2 hours if there is any child between 4 and 15 years of age. For females, $l^f(\mathbf{d})$ = 88 hours per week, plus 9 hours if there is any child between 0 and 3 years of age, and 7 hours if there is any child between 4 and 15 years of age. Since in Spain there is no a Time Use Survey available, these figures have been borrowed from the Italian survey.

The minimum consumption is assumed to be the same for males and females, $c^m(\mathbf{d}) = c^f(\mathbf{d}) = medi - c_0$, where *medi* is the minimum equivalent disposable income over the sample under the 1994 tax system and the discretization of weekly working hours already described, and c_0 is a parameter which is taken to be 2. Equivalent disposable income, *edi*, is the result of applying an equivalence scale to household disposable income, *di*. Following Buhmann *et al.* (1988) and Coulter *et al.* (1992a, b), for each household *j* of size m equivalised disposable income is defined by

$$edi_j(\lambda) = di_j/(m_j)^{\lambda},\ \lambda \in [0,1].$$

When $\lambda = 0$, equivalised income coincides with original household income, while if $\lambda = 1$, it becomes *per capita* household income. Taking a single adult as the reference type, the expression $(m_j)^{\lambda}$ can be interpreted as the number of equivalent adults in a household of size m_j. Thus, the greater the equivalence elasticity λ, the smaller the economies of scale in consumption or, in other words, the larger the number of equivalent adults. In this paper, λ is taken to be equal to 0.5 (for the use of this value in international comparisons of income inequality, see Atkinson *et al.*, 1995).

As explained in Section IV, the identification of the parameters $\delta(\boldsymbol{d})$, $i = m,f$, and individual f's power index is accomplished in two rounds. In round 1, the parameters δ_j^m and δ_j^f for each couple $j = 1,\ldots, J$ are made equal, so that $\delta_j^m = \delta_j^f = \delta_j$. For each couple, the value of δ_j is allowed to vary in a grid $\Delta = \{-6, -5.5,\ldots, 5.5, 6\}$. For each δ_j in Δ, the solution to the efficiency problem (4) determines a set of efficient allocations $A(k, \delta_j)$ along $k = 1,\ldots, 50$ points in the efficient possibility frontier. For each δ_j, the efficient allocation that minimizes the difference between predicted and actual weekly leisure hours is selected. An outcome of this procedure is f's power index $\mu = \mu(\delta_j)$. Finally, the δ_j in Δ that minimizes the difference between predicted and actual weekly leisure hours is selected. For each couple, denote this calibrated value by δ_j^*. The corresponding power index is denoted by $\mu^* = \mu(\delta_j^*)$. The cross tabulation of the parameters $\boldsymbol{\delta^*}$ and $\boldsymbol{\mu^*}$ and female participation in the labour market are described in Table 10.

Table 10 around here

More than 50 % of all females have a power index below 0.5, and on average μ^* equals 0.42. Less than 10 % of the population has a negative leisure interaction term, and on average δ^* is equal to 0.65. The situation is very different in couples where the female participates. In this case, not surprisingly, on average δ^* is close to zero (0.05). If the leisures of the spouses weakly enter into their utility functions, then females (and possibly males too) would tend to actively participate in the labour market. Perhaps more surprisingly, in this case the bargaining power shifts in favor of males. The opposite is the case when women do not participate, a majority situation in Spain and other Southern European countries: the average δ^* is close to 1 (0.93), the spouses enjoy each others' leisures, and μ^* becomes 0.45.

The cross tabulation of predicted hours worked (columns) against observed hours worked (rows) are presented in Table 11. The calibration of the parameters μ^* and δ^* is very successful: the labour supplies of 943 males and 936 females in 975 couples, or 96.7 and 96.0 %, respectively, are correctly predicted by the model.

Table 11 around here

Round 2 begins by regressing a logistic transformation the power index μ_j^* on a vector $\boldsymbol{d}$ of demographic characteristics and a vector **z** of explanatory variables interpreted as distribution factors. These variables capture the way in which the tax benefit system influences the relative earning power of the spouses. If these turn out to contribute significantly to the prediction of the power index, they will allow us to describe changes in the power index induced by tax reforms. Three distribution factors are included: (i) the difference between the male minus the female age, denoted by *dage*; (ii) the logarithm of the difference between the female's and the male's non-labour incomes, denoted by lndif, and (iii) the ratio of the female's to the male's marginal contribution to the household's earnings when switching from non-participation in the labour market to working 40 hours per week, denoted by *mgcontr*. More specifically, this variable is defined as follows. Let $p_f^{\ k}$ and $p_m^{\ k}$ denote the observed sample frequencies of (discretised) weekly labour supplies h^k of wives and husbands, respectively. Denote $R_{mk}^{\ fk'}$ the household disposable income when the husband works h^k hours and the wife works $h^{k'}$ hours. Variable $yf40$ is defined as:

:
$$yf40 = \; = \Sigma_k p_m^{\ k} \; (R_{mk}^{\ f40} - R_{mk}^{\ f0})$$

that measures the expected increase in the household disposable income it the wife switches form 0 to 40 hours, the expectation being taken over the male hours distribution. Defining $ym40$ similarly, we consider the ratio $mgcontr = yf40/ym40$. Table 12 gives summary statistics for these variables, and shows that there is important variation across households there.

Table 12 around here

The results of the regression are reported in Table 13. The demographic variables are not significant. As far as the distribution factors are concerned, the age and the non-labour incomes differences are not significant, but the higher the female's marginal contribution to household earnings, the higher is her power index. This provides an interesting new avenue, absent in the unitary model, for policy analysis and, in particular, tax reforms: as long as tax reforms differentially affect the spouses' marginal contribution to household earnings, the female's power index, and hence both spouses behaviour will be affected.

Table 13 around here

In the next step, using the estimated power index μ_j, for individual f in each couple j, a pair of interaction leisure terms (δ^m_j, δ^f_j) is selected in the set $\Delta^m \times \Delta^f$, where $\Delta^m = \Delta^f = \Delta = \{-3, -2.5, \ldots, 2.5, 3\}$. First, for each δ^f_j in Δ^m, a utility reservation value $u_p{}^f(\delta^f_j)$ which best reflects f's estimated bargaining power μ_j is selected. Then, the solution to the efficiency problem (5) determines a set of household allocations $A(\delta^m_j, \delta^f_j)$. For each couple, the efficient allocation in $A(\delta^m_j, \delta^f_j)$ that minimizes the difference between predicted and actual working hours is selected. Denote by $(\delta^m_j{}^*, \delta^f_j{}^*)$ the values thus calibrated of the leisure interaction terms. The distributions $\boldsymbol{\delta}^{m*}$ and $\boldsymbol{\delta}^{f*}$ are described in Table 14.

Table 14 around here

On average, over the whole sample δ^{f*} is considerably higher than δ^{m*}: *ceteris paribus*, females enjoy more their spouses leisure. The values of this parameter change quite dramatically as a function of females' labour participation. When females participate, δ^{m*} becomes negative and the distance between a positive $\delta^f{}^*$ and $\delta^m{}^*$ increases considerably. Otherwise, δ^{f*} and δ^{m*} are both positive and close to each other.

The cross tabulation of predicted hours worked (columns) against observed worked hours (rows) are presented in Table 15. Again, the calibration exercise is very successful: the behaviour of 873 males and 911 females out of 975, or 89.5 and 93.4 %, respectively, is well predicted by the model.

Table 15 around here

Unfortunately, the demographic variables explain very little of the variation in the leisure interaction terms (see the regression results in Table 16). Consequently, the predictions of hours worked when the estimated leisure terms are considered are very bad (see Table 17). The behaviour of only 183 males and 539 females, or 18.8 and 55.3 % of the total, respectively, is correctly predicted. According to the model, males tend to work much more and females less than what the data show.

Table 16 and 17 around here

For this reason, the collective world used for the estimation of the unitary model in the next section, is taken to be the one resulting from the estimation of the female power index and the calibration of the male and female leisure interaction terms (see Table 15 for hours worked in this case).

VI. THE UNITARY MODEL FOR COUPLES

In order to quantify the distortions from using a unitary model when the collective approach is appropriate, an empirical specification of the former is needed. The option is to extend the couples′ Stone-Geary utility function by means of a leisure interaction term. Moreover, each couple has a finite set of labour supply choices. Thus, the utility derived by household j at the h-th labour supply choice is given by:

$$u_{jh} = \beta_c(\boldsymbol{d}_j)ln(c_{jh} - c(\boldsymbol{d}_j)) + \beta_l{}^m(\boldsymbol{d}_j)ln(l^m{}_{jh} - l(\boldsymbol{d}_j)) + \beta_l{}^f(\boldsymbol{d}_j)ln(l^f{}_{jh} - l(\boldsymbol{d}_j)) + \delta(\boldsymbol{d}_j)ln(l^m{}_{jh} - l(\boldsymbol{d}_j))\ ln(l^f{}_{jh} - l(\boldsymbol{d}_j)) + \varepsilon_{jh},$$

where the disturbance is assumed to be drawn from a type ***I*** extreme value distribution. Preference heterogeneity across households is dealt with via the preference factors $\beta_k(\boldsymbol{d}_j)$. Like in the singles model, it is assumed that there is only unobserved preference heterogeneity with regard to the marginal propensity to consume $\beta_c(\boldsymbol{d}_j)$. Thus, preference parameters are assumed to be of the following form:

$$\beta_c(\boldsymbol{d}_j) = \theta_j + \beta'_{c1}\boldsymbol{d}_j,$$

$$\beta_l{}^m(\boldsymbol{d}_j) = \beta^m{}_{l0} + \beta^{m\prime}{}_{l1}\boldsymbol{d}_j\ ,$$

$$\beta_l{}^f(\boldsymbol{d}_j) = \beta^f{}_{l0} + \beta^{f\prime}{}_{l1}\boldsymbol{d}_j,$$

where it is assumed that θ_j can only take two values, θ_1 and θ_2, with probabilities p^1 and $p^2 = 1 - p^1$. This empirical model can be estimated by means of maximum likelihood techniques. The results are in Table 18. Among the explanatory variables we include information concerning the regimes "chosen" in the calibration of the collective model. This can be seen as a sort of "observed unobservable heterogeneity", and the corresponding variables turn out to be highly significant (variables $reg1_f$ and $reg2_m$). Children have a negative, although non-significant impact on the cross leisure interaction term.

Table 18 around here

These parameter estimates give rise to a considerable number of bad behaved direct utility functions. There are 429 households that have negative marginal utilities of consumption or of leisure. Therefore, one problem with these unitary estimates is that they lack any economic meaning for many households. It turns out that violations of the restriction of positive marginal utilities heavily depend on the parameter associated with the leisure interaction term.

Of course, rejections of unitary behavioural restrictions could be expected beforehand. As has been shown earlier, the wife's bargaining power index significantly depends on wage variables and non-labour incomes. This feature makes the collective model distinct from the unitary model. It implies that observed (multi-person) household behaviour cannot be considered as resulting from the maximization of unique rational preferences, subject to a budget constraint. Note further that the simulated data come from a perfectly deterministic collective model. Nowhere in the model there is unobserved preference heterogeneity. By means of observed wages, non-labour incomes and other household characteristics, the labour supply of the household members can be exactly predicted, along the lines of the collective model. Putting collectively generated data in the straitjacket of the unitary model may indeed result in a strong rejection of the unitary theoretical implications.

As regards the predictions with the unitary model, Table 19 shows that the unitary model does not perform well in predicting labour supplies. Predictions are correct only for 35% of the wives and for 55% of the husbands. The table gives the labour supply predictions in using the regime chosen for each couple. Some large discrepancies occur. For instance, more than 50% of non-working women and 90% of non-working men are predicted to work. Moreover, over 3% of the wives are predicted not to work, although they actually work 40 hours. Again, this points to the misspecification of the model, at least concerning the particular unitary model estimated here, but possibly of the unitary model at large.

Table 19 around here

It can be argued that the above results clearly show that applying the unitary model when it is inappropriate may have large consequences on policy evaluations. Together with the many rejections of the unitary model in the literature, and the failure to reject collective restrictions, this result seems to give strong support to the thesis that it is time to shift the burden of the proof to the unitary model.

VII. THE ANALYSIS OF A TAX REFORM

VI. 1. The 1999 Tax Reform

In 1996, after 14 years of socialist-dominated governments in Spain, a center-right coalition government formed around the Popular Party. In 1999, the government launched an important reform of the personal income tax. The main novelty is the introduction of a minimum family allowance depending on the tax unit's demographic composition. This allowance is directly deductible from gross taxable income, before applying the tariff to determine gross taxable liability. In addition, a new tariff with only six tax brackets for both singles and couples is introduced. The tariff applies now from the first euro of taxable income, but tax rates are considerably reduced with respect to previous years. As before the reform, couples are allowed to fill in either two separate income tax returns or a joint one. Deductions from labour income are computed according to a new formula (see below). Finally, for the purpose of this paper all tax credits are now eliminated.(17)

As explained in Section II, the 1994 household sample of singles and couples between 25 and 55 years of age, with or without children less than 16 years of age, constitutes a convenient sample for the purposes of this paper where the self-employed, the unemployed and the retired are excluded. The impact of the 1999 tax reform is assessed on the 1994 sample.

Naturally, both tax systems are expressed in current monetary units. To make possible their comparison in common monetary units, two options were available. First, 1994 household incomes can be expressed in 1999 monetary units. Lacking detailed information on how different income sources evolved for the sample households, a simple solution to the problem is to inflate all 1994 incomes according to the 15.15

official inflation rate based on the Consumer Price Index.[18] That all income sources grow at the same rate as prices of consumption goods and services is a strong assumption. Therefore, the option followed in this paper is to take the monetary figures that define the 1999 tax system, and express them at 1994 values using the official inflation rate.

The 1999 stylized tax system can be briefly described as follows:

A Simplified Taxation Scheme for Singles	
Gross labour income	$GW = wL + O$
Gross taxable income	$GT = GW + K$
Taxable labour income	$W = wL(1 - ss) + O - D$
Taxable income	$I = W + K - M$
Gross = Net tax liability	$T_n = T(I)$
Non-wage income	$y = O + K + P$
Gross income, net of social security contributions	$g = wL(1 - ss) + y$
Disposable income	$x = g - T_n$

As in 1994, gross labour income, GW, is the sum of wage earnings, wL (wage rate w times hours worked L), plus certain taxable public transfers, O. Gross taxable income, GT, is the sum of GW plus capital income and property income, K. For singles there are two deductions from gross labour income. First, the deduction of the employee's contribution to social security from wage earnings. This deduction's average rate, denoted by ss, is taken again from row 6 of Table 1. The magnitude $wL(1 - ss) + O$, is called net labour income. Second, for both singles and couples there is a deduction, denoted by D, and computed equally for both types of tax units as follows:

- Suppose net labour income is less than or equal to 7,046 euro. If capital and property income, K, is less than or equal to 5,219.3 euro, then D = 2,609.6 euro. If K is greater than 5,219.3 euro, then D = 1,957.2 euro.
- Suppose net labour income is between 7,046 and 10,438.5 euro. If K is less than or equal to 5,219.3 euro, then D = 2,609.6 euro – 0.1923 (net labour income – 7,046). If K is greater than 5,219.3 euro, then D = 1,957.2 euro.
- If net labour income is more than 7,046 euro, then D = 1,957.2 euro.

Thus, conditional on property and capital income, the deduction D is meant to favor households with low wage earnings. Taxable labour income, W, is equal to net labour income less D. Taxable income, I, is the sum of taxable labour income, W, plus K, less the minimum family allowance, M. This allowance is computed as follows:

- For a single without children, M = 2,870.6 euro.
- For a single with children, M = 4,697.35 euro + 1,104.3 euro for the first and the second child + 1,565.78 euro for the remaining children.
- For a couple without children, M = 5,741.2 euro.
- For a couple with children, M = 5,741.2 euro + 1,104.3 euro for the first and the second child + 1,565.78 euro for the remaining children.

All taxpayers face the same graduated tariff, which gives the gross tax liability $T_g = T(I)$ for any taxable income X. Since all tax credits considered in the 1994 simplified tax system have been eliminated, the net tax liability coincides with the gross one. The tariff is as follows:

1999 Graduated Tariff for All Tax Units, $T_n = T(I)$, Where I is Measured in Euro per Year:

Taxable Income, I	**Gross = Net Tax Liability, T_n**
$I <$ 3,130	0.18 I
$I <$ 10,956	563+ (I - 3,130) 0.24
$I <$ 21,390	2,442 +(I – 10,956) 0.283
$I <$ 34,433	5,394 + (I - 21,390) 0.372
$I <$ 57,389	10,246 + (I - 34,433) 0.45
$I >$ 57,389	20,576 + (I - 57,389) 0.48

V*I*. 2. The Consequences of the 1999 Tax Reform. The Static Case

Recall that the available sample consists of 109 single males, 135 single females, and 975 couples. Thus, there are 1,219 households. Under the 1994 tax system, 352 couples, or 36.12 % of the total, choose to fill in separate returns. Therefore, the total number of returns is equal to 1,572. As can be seen in the left-hand side of Table 20, 269 tax returns, or 17.1 % of the total involve zero tax liability.

Table 20 around here

In the static approach to tax reform, the labour supply is held constant. Therefore, attention is focused on the changes induced by the two tax liability vectors on a fixed distribution of pre-tax gross incomes, or gross incomes net of social security contributions. The first effect of the reform is on the couples' decision to fill in separate or joint returns, as well as on the number of returns for which the net tax liability is zero. As can be seen in the right-hand panel of Table 20, under the 1999 tax system the proportion of couples choosing separate, individual tax returns reaches 92.9 % of the total. Therefore the total number of tax returns become 2,125. Further, relatively to 1994, the number of tax returns with zero tax liabilities increases from 17.1 % to 24.9 %.

In what follows, the unit of analysis will be the household. The first three columns of Table 21 refer to the classification of households by deciles of the unchanged gross income distribution net of social security contributions, resulting from the predicted labour supplies in the collective world under the 1994 tax system (that is, the labour supplies in the last row of Table 15 for both males and females).(19) Columns 3 and 4 in that Table give the average net tax liabilities according to the 1994 and 1999 tax system, respectively, expressed in common 1994 monetary units. Finally, columns 6 and 7 present the mean effective tax rates by decile.(20)

Table 21 around here

The average household with 17,629 euro of mean gross income bears a tax liability of 2,967 and 2,371 in the 1994 and 1999 tax systems, respectively. Consequently, the average household's disposable income increases from 14,662 to 15,258, a 4.06 % increase. On the other hand, column 6 shows that the mean increase in disposable income by decile is an increasing function of gross income (varying from 0 euro for the first decile, to 2,074 euro for the tenth decile, or 2,551 euro for the richest 5 % of the sample).

From a different angle, the 1999 reform reduces the sample's mean effective tax rate in 2.73 percentage points, or a decrease of 24.5 % relative to 1994. The difference between mean effective tax rates in the two scenarios is positive for every decile (see column 9 in Table 21). However, this difference is below the average for the deciles 1, 2, and 6, and above the average for the remaining deciles. The difference in average tax rates for the sample's richest 10 % is slightly greater than 4 percentage points.

The above facts appear to indicate the redistributive effect of the 1999 tax system is of a smaller order of magnitude than the one achieved by the 1994 tax system. As will be seen below, this is indeed the case. But then, how can the reform be evaluated in social welfare terms? For any income distribution $\boldsymbol{x}$, this paper uses the following social evaluation function studied in Herrero and Villar (1989):

$$S(\boldsymbol{x}) = \Sigma_h \alpha^h x^h = m(\boldsymbol{x})(1 - I(\boldsymbol{x}))$$

where:

$$\alpha^h = (1 - \ln (x^h/\mu(\boldsymbol{x})))/H;$$

$m(\boldsymbol{x})$ = mean of income distribution $\boldsymbol{x}$;

$$I(\boldsymbol{x}) = (1/H)\ \Sigma_h \{x^h/m(\boldsymbol{x})\}\log\{x^h/m(\boldsymbol{x})\}.$$

The function S is a weighted sum of individual incomes, where the household whose income coincides with the mean of the population receives a weight equal to 1/H, and households with income above or below the mean receive weights increasingly smaller or greater, respectively, than 1/H. Moreover, it can be expressed as mean income, m(**x**), times an adjustment factor, (1 – I(**x**)), which varies inversely with the degree of income inequality according to a well behaved member of the general entropy family of inequality indices.(21) Finally, although this property will not be used in the sequel, this function possesses a convenient additive decomposability property.(22)

Let $\boldsymbol{g}$ be the before tax gross income distribution (net of social security contributions), and let $\boldsymbol{x}$ and $\boldsymbol{r}$ be the after-tax disposable income distributions corresponding to the 1994 and 1999 tax systems, respectively. Using the inequality index I already introduced, the redistributive effect of the two tax systems, *RE-1994* and *RE-1999*, can be computed as the percentage change in income inequality induced by the corresponding vector of net tax liabilities, that is:

$$RE\text{-}1994 = 100\,(I(\mathbf{g}) - I(\mathbf{x}))/I(\mathbf{g}) = 100\,(0.3146 - 0.2584)/0.3146 = 17.8$$
$$RE\text{-}1999 = 100\,(I(\mathbf{g}) - I(\mathbf{r}))/I(\mathbf{g}) = 100\,(0.3146 - 0.2658)/0.3146 = 15.5$$

As conjectured, the 1999 tax system has a smaller redistributive effect than the 1994 tax system. However, as has been already observed, the tax reform leads to an increase in mean disposable income. Using the social evaluation function *S*, the social welfare consequences of the increase in disposable income and the increase in income inequality induced by the tax reform can assessed with the help of the following expression:

$$\begin{aligned} S(\mathbf{r}) - S(\mathbf{x}) &= m(\mathbf{r})(1 - I(\mathbf{r})) - m(\mathbf{x})(1 - I(\mathbf{x})) \\ &= (m(\mathbf{r}) - m(\mathbf{x}))(1 - I(\mathbf{r})) + (I(\mathbf{x}) - I(\mathbf{r}))m(\mathbf{x}). \end{aligned} \tag{6}$$

The first term in equation (6) is the change in mean disposable income, which has been shown to be positive, weighted by the 1999 adjustment factor $(1 - I(\mathbf{r}))$. The second term is the change in disposable income inequality, weighted by the 1994 mean income $m(\mathbf{x})$. It turns out that

$$100\,(S(\mathbf{r}) - S(\mathbf{x}))/S(\mathbf{x}) = 100\,(11{,}207 - 10{,}879)/10{,}879 = 3.01.$$

That is, as long as the evaluation is limited to a comparison of the two disposable income distributions, the 1999 tax reform induces a 3.01 % increase in social welfare.

It should be pointed out that the increase in household disposable incomes amounts to a decrease of equal size in 1999 tax revenues, which would lead to a reduction in publicly provided goods and services relative to the 1994 situation. The possible social welfare cost of such a reduction can be assessed in terms of equation (6). On one hand, the reduction in public expenditures can be assumed to be equivalent to a certain loss of household incomes, although possibly by an inferior amount than the loss in tax revenues. Denote the average loss by $a(m(\mathbf{r}) - m(\mathbf{x}))$, where $a \in (0, 1)$. The closer a is to 1, the smaller will be the positive contribution to the social welfare change by the first term in equation (6). On the other hand, the way the loss in public expenditures is distributed among households has some bearing on the question. Denote this effect by $bI(\mathbf{r})$. If the reduction in public expenditures is distributed in proportion to disposable incomes in the 1999 distribution $\mathbf{r}$, then the parameter b will be equal to 1. However, if this reduction is borne in equal absolute amounts by all households, or in greater absolute amounts by the poor, then $b > 1$. Conversely, if the reduction is beard in greater amounts by the rich, then $b < 1$. Thus, the larger is b, the greater will be the negative contribution to the change in social welfare by the second term in equation (6).

This subsection has assumed that households view passively the 1999 tax reform. However, faced with new tax incentives, households will typically respond with behavioural changes which will affect labour supplies, gross incomes and, hence, disposable incomes. In the next subsection these effects will be examined according to the collective model.

VI. 3. The Consequences of the 1999 Tax Reform According to the Collective Model

In the collective model the 1999 tax reform induces two types of behavioural changes. First, the new tax system provides new incentives through changes in the budget constraint of every household. Second, as far as couples is concerned, changes in the marginal contribution of males and females to the household earnings has an effect on the estimated female's power index; in turn, this effect gives rise to a second round of changes in labour supplies. The detailed changes in labour supplies, operating only through the budget constraint, are reported in Table 22.

Table 22 around here

Only 5 out 109 single males and 15 out of 135 single females are seen to increase their labour supply. In addition, one single female chooses to reduce her labour supply. As far as couples are concerned, 219 males and 253 females are seen to increase their labour supply, while 133 males and 41 females decrease their labour supply. Thus, 352 married males and 294 married females, or 36.1 and 30.2 %, respectively, experience some change.

The changes in the estimated female's power index induced by the 1999 tax reform are presented in Figure 3. It can be seen that for all the couples, the women turn out to be favoured from that point of view by the reform we consider. On average, the female's power index increases from 0.41 to 0.57. The consequences for labour supplies are in Table 23.

Figure 3 and Table 23 around here

The changes are very important. Essentially, males tend to exert a much larger work effort, while the opposite is the case for females. In particular, 531 males but only 69 females increase their labour supplies relative to the 1994 situation. At the same time, only 73 males but 211 females reduce their labour supplies. Consequently, 604 married males and 288 married females, or 61.9 and 29.5 % of the total, respectively, change their behaviour relative to 1994.

By way of a summary, the first three columns of Table 24 record the mean hours worked under the 1994 tax system and the two situations under the 1999 tax system, namely, before and after the change in the female's power index. On average, male and female singles, as well as married males and females, increase their hours worked in response to changes in the tax system operating through the budget constraint (see columns 1 and 2 in Table 24). Such increases are moderate, ranging from approximately 2 % for single and married males to 6.3 and 18.4 % for single and married females. On the other hand, changes induced in couples by the increase in female's power index are dramatic (see column 3 in Table 24). The combined effect of the two channels relative to the initial 1994 situation, lead to an average increase of 13.1 % in hours worked by married males, and a 21.9 % *decrease* by married females.

Table 24 around here

Naturally, these behavioural changes have an impact on mean before tax income (gross income net of social security contributions) and mean after tax income (disposable income), which are presented in columns 4 to 9 in Table 25. Before tax incomes for the whole sample increase by 4.8 % as a consequence of changes in the budget constraint. For couples, whose mean increase in before-tax incomes is 5.3 %, the second channel adds a 0.8 % increase (see columns 4 to 6 in Table 25). Relative to 1994, after tax incomes for the whole sample increase on average by 9.6 % after the changes in the budget constraint. However, disposable incomes remain essentially the same when the consequences of the change in female's power index are taken into account (see columns 7 to 9 in Table 25).

Tables 25 and 26 present the changes in net tax liabilities and average tax rates induced by the 1999 tax reform through the two channels. Households are classified by deciles of the before tax income distribution in 1994, once the effect of the tax reform has been allowed for. Together with the increase in before tax incomes already analyzed, the main impact of changes in females' power indices, relative to a situation in which labour supplies vary only in reaction to changes in the budget constraint, is twofold: an increase in mean tax liabilities of 196 euro, or 8.1 %, and an increase in the average tax rate of only 0.55 percentage points.

Table 25 and 26 around here

More importantly, what are the consequences of the tax reform on tax revenues, average tax rates, the redistributive effect of the tax system, and social welfare? The average tax rate for the sample after the reform is 8.85, compared to 11.13 under the 1994 tax system. Thus, the average tax rate in 1999 is 2.28 percentage points, or 20.5 % lower than in 1994. This leads to a loss in tax revenues in 1999 equal to 361 euro, or 12.2 % below the magnitude reached in 1994.

On the other hand, the changes in behaviour already analyzed lead, not only to an increase in the mean, but to a considerable reduction in before tax income inequality that becomes 12.9 % lower than in 1994. Furthermore, in spite of the reduction in average tax rates, the redistributive effect of the 1999 tax system is now larger than before:

$$RE\text{-}1999 = 100\ (I(\mathbf{g'}) - I(\mathbf{r'}))/I(\mathbf{g'}) = 100\ (0.2740 - 0.2202)/0.2740 = 19.6,$$

where $\mathbf{g'}$ and $\mathbf{r'}$ are, respectively, the before tax and after tax income distributions under the 1999 tax system, allowing for all changes in behaviour. As a matter of fact, the after tax income inequality is 14.8 % lower than before the reform. Consequently, the increase in mean disposable income and the reduction in disposable income inequality induced by the 1999 tax system lead to a considerable increase in social welfare:

$$100\ (S(\mathbf{r'}) - S(\mathbf{x}))/S(\mathbf{x}) = 100\ (12{,}487 – 10{,}879)/10{,}879 = 14.8.$$

Of course, as pointed out in the static exercise in the previous subsection, this increase in social welfare does not take into account the social welfare consequences of the reduction in public expenditures due, in the present dynamic case, to the 12.2 % loss in average tax revenues.

Naturally, the fact that mean disposable income increases as a consequence of the tax reform does not mean that all households gain with the change. The first three columns of Table 28 present the evidence on gainers and losers in disposable income after the reform. Households are classified by quintiles of the 1994 after tax, or disposable income distribution. Large gains by households with small 1994 disposable incomes lead to large relative gains. Thus, individual relative gains in each quintile are calculated as the ratio between individual household gains and mean disposable income in that quintile; the average of such relative gains is reported in column 3 of Table 27.

Table 27 around here

It is observed that 959 households, or 78.6 of the total, have a mean gain of 2,189 euro in disposable income, while 224 households, or 18.4 % of the total, experiment an average loss of 2,025 euro. The remaining 3 % households is indifferent because they pay no taxes under both tax systems. Such mean gains and losses represent 14.9 and 13.8 % of mean disposable income in 1994. The poorest quintile enjoys relative large gains and suffers relatively small losses. From the second to the fifth quintile, gains and losses in absolute value increase in proportion to household income.

The availability of a collective model permits to go beyond gains and losses in household disposable income and toward gains and losses in utility for individual males and females. In this respect, it has been already observed that, on average, the tax reform induces an increase of hours worked by both single males and females (see columns 1 and 2 in Table 23). Less leisure implies a utility decrease, but larger disposable income for consumption (see columns 7 and 9 in Table 23) works in the opposite direction. Within couples, the situation of males and females is very different. After the reform, males work on average considerably harder but enjoy a 37.6 % increase in consumption, while females reduce their average labour supply but experience a 22.4 % decrease in consumption.

The final question is: how do these changes in leisure and consumption affect the utility of the 1,084 males and 1,110 females in the sample? It turns out that all females in the sample experience a utility gain as a consequence of the reform. Columns 4 and 5 in Table 27 classify males in each quintile of the 1994 household disposable income as gainers, indifferent or losers in utility space. Only 9.8 % of all males in the sample enjoy a utility increase. It should be noticed that 102 out of the 105 gainers are single males. That is to say, practically all married men lose utility as a consequence of the reform. In any case, 55.2 % of the gainers, including the 3 married males, belong to households classified in the poorest 20 % according to 1994 household disposable income. The conclusion is clear: the increase in females' power indices induced by the reform is translated in utility gains for them and utility losses for practically all their spouses.

VIII. CONCLUSIONS

This paper has made two contributions. In the first place, it has presented a collective model of household labour supply behaviour, allowing for labour participation, the presence of children, and non-linear taxation. In the second place, the model has been used to simulate an important tax reform in Spain using data from the first three waves of the ECHP. However, many caveats must be stressed in this concluding section.

As pointed out in the Introduction, at present we do not known how to identify and estimate a collective model with the above characteristics. Consequently, only a certain application of the collective approach has been presented under the baseline 1994 tax system. Marginal propensities for consumption and leisure have been estimated for single males and females. Using these estimates for married individuals, a leisure interaction term and an index of female's bargaining power have been calibrated so as to replicate observed labour supplies in couples as well as possible. The female's power index has been estimated as a function of demographic variables and a set of distribution factors. This has led to the calibration of a leisure interaction term for each member of each couple. The data set thus obtained, which replicates very well the observed behaviour in 1994, has been used to estimate a unitary model of similar characteristics as the collective one.

The first conclusion of the paper is that when a unitary model is estimated on data obtained from a deterministic collective model, the results lack economic meaning. To us, this is an indication that unitary models do not provide a convincing basis for policy evaluations. Instead, more resources should be put to identify and estimate collective models under complex situations like the one considered in this paper.

The results of the singles model and the simplified approach to collective decision making, provide some hints on essential aspects which have not received sufficient attention in the paper. When single, males and females appear to behave very similarly as far as labour supply is concerned. However, when married, these individuals change drastically their behaviour. In particular, as it is well known from many previous studies, married females in Southern European countries tend not to participate in the labour market and, generally, to exert much less market work effort than their husbands. In the simplified approach presented in this paper, differences in labour supply behaviour are simply captured through the calibration of a leisure interaction term and a female's power index. It is true that, in the spirit of the collective approach, this index is partly explained by distribution factors, including a key variable capturing the differential contribution by males and females to household earnings. This is encouraging and very useful for the purpose at hand, namely, the evaluation of a tax reform with potential important effects on such marginal contributions.

However, high female labour participation in couples is associated in this paper with a negative leisure interaction term for males and a low female power index. Similarly, low female labour participation is associated with a high leisure interaction term for female and a high female power index. It remains to be seen if this inverse relationship between females' labour participation and females' bargaining power is maintained once household production and time use within the household are appropriately taken care of in an explicit collective model of the spouses' labour participation.

The second part of the paper evaluates the tax reform that took place in Spain in 1999. This exercise has important limitations. (i) Given the nature of the data, only a stylized modeling of the tax system has been possible, excluding the key role of tax deductions and allowances granted for pension funds, health expenditures, investments in housing acquisition, life insurance and charity contributions. (ii) Rather than evaluating the 1999 tax reform on data for that year, it has been necessary to convert the 1999 tax parameters into 1994 monetary units. (iii) The samples of singles and couples have been selected with a focus on wage earners (or potential earners) which form easily identifiable tax units, namely, households with adults between 25 and 55 years old with or without children below 16 years of age. This sample represents only a very small part of the total population. (iv) The available income data refer to income net of both social security contributions and income tax withdrawals. Therefore, gross earnings had to be estimated in the paper.

Notwithstanding the above limitations, the results obtained are very interesting indeed. First, in the static case which is taken as a benchmark, the 1999 tax reform leads to a decrease in tax revenues and average tax rates, as well as to a smaller redistributive effect than the 1994 tax system. Taking only into account the impact on the mean and the inequality of disposable income, social welfare in 1999 increases by approximately 3 %. Second, it has been confirmed that labour supply considerations are an essential part of tax reform evaluation. When only the effect of the 1999 tax reform through reactions to changes in the budget constraint are considered, both single and married individuals of both genders tend to exert a larger work effort. Third, couples behaviour changes dramatically as a consequence of the increase in the female's power index induced by the tax reform: while males exert a considerably larger market work effort, females do the opposite.[(23)] Fourth, in the case where labour supplies are allowed to vary, the before tax income distribution under the 1999 tax system presents a larger mean and a smaller inequality than the corresponding distribution under the 1994 tax system. Further, the decrease in tax revenues and average tax rates is now smaller than in the static case, the redistributive effect is larger than in 1994, and there is a 14.8 % increase in social welfare. Fifth, single males and females are shown to experience a utility increase as a consequence of the tax reform. More importantly, corresponding to the increase in females' power index, all females in the sample of couples experience a utility gain, while essentially all men are seen to experiment a utility loss.

These results should suffice to justify the interest of evaluating tax and other reforms by means of a collective model of household labour supply.

NOTES

(1) This study is part of a research project using a common methodology in seven European countries: Belgium, Denmark, France, Germany, Italy, Spain and the United Kingdom.

(2) For a summary of this approach, see Bourguignon and Chiappori (1992), and for a more recent survey, see Vermeulen (2000).

(3) The only attempt to model the (female) participation decision, but with linear taxation and convex budget sets, is Blundell *et al.* (1998). See also Donni (2000) for a model with nonlinear budget constraints resulting in convex budget sets. For the issue of female labour participation in the context of cross-section data on commodity expenditures, see Zamora (2000).

(4) As explained in Section VII, rather than estimating the growth of the 1994 gross incomes until 1999 for the tax units in the sample, the standard deductions and the tax brackets of the 1999 reform are expressed at 1994 prices using the official 15.15 % inflation rate between the two periods according to the Consumer Price Index.

(5) See, for instance, Castañer *et al.* (2000).

(6) People interviewed during the last quarter of 1996 cannot be considered because there is no information on incomes earned that year but reported in the unavailable 1997 wave.

(7) The 244 singles and the 975 couples represent 15.6 and 11.7 %, respectively, of all households interviewed during two consecutive years in the three available waves of the ECHP. Naturally, for the reasons mentioned in the text, it is impossible to know the percentage that this sample represents relative to the total number of tax units which are legally required to fill in a tax return in the year of reference 1994.

(8) In addition, as will be seen below, the ECHP provides information about property income, which is part of taxable income but is not subject to withdrawals, as well as certain non-taxable public transfers including students' scholarships and some minor housing subsidies.

(9) We should thank Juan Castañer and José Luis Varela, from the *Instituto de Estudios Fiscales*, for giving us access to the program for the conversion of net into gross incomes, as well as for helping us in its application to our data set. For details on the simplifying assumptions made in the construction of the program, see the document *La conversión neto a bruto*, *Instituto de Estudios Fiscales*, August 2001.

(10) In the absence of information on necessary expenditures, in this paper *K* is taken to be the gross capital income resulting from the application of the IEF program to the raw data from the ECHP (see Section II for details), plus the property income appearing in the ECHP.

(11) In the absence of information on child care expenses, in this paper this tax credit is taken to be 150 euro for all tax units with children in the appropriate age bracket.

(12) As pointed out in the Introduction, this approach has already proved to be useful in a unitary setting (see the references quoted there).

(13) This procedure was jointly elaborated by M. Beblo, D. Beninger, F. Laisney, and F. Vermeulen.

(14) Notice that, in so far as the utility levels $u_k^f(\delta)$ can be appropriately redefined, □ constitutes an ordinal power index.

(15) These labour supply choices were chosen on the basis of the observed labour supplies in the data set (see Table 2 and Figures 1 and 2). Notice that observed hours reflect the number of weekly hours typically worked in many sectors. However, this paper does not take into account restrictions imposed from the demand side of the labour market.

(16) A drawback is that standard errors for the Lewbel estimates, as well as measures of the goodness of fit, are hard to obtain and are not available at this point.

(17) For a more detailed description of the 1999 tax system, see Castañer *et al.* (1999).

(18) This is the option followed in Castañer *et al.* (2000), which uses a large sample of 1994 tax returns collected by the Spanish IEF (*Instituto de Estudios Fiscales*).

(19) Alternatively, the analysis could be made in terms of equivalent disposable incomes, once differences in household size and composition are taken into account. As a first approximation, in this paper only the impact on unadjusted disposable incomes will be evaluated.

(20) Let g^h and T_n^h be the gross income and net tax liability of household h. The mean tax rate is defined by $t^h = T_n^h/g^h$. For any decile, or for the population as a whole, the mean tax rate computed in this paper is the unweighted average of the individual tax rates in the group in question. Alternatively, the expression $(\Sigma_h T_n^h/\Sigma_h g^h)$, which is often used in the literature as an estimate of the average tax rate of a group, is the weighted mean of the individual tax rates, with weights proportional to individuals' gross income. From a normative point of view, it seems preferable to avoid this weighting scheme. This should be specially the case when, because of the graduated tariff with increasing marginal tax rates, average effective tax rates are also expected to raise with gross income.

(21) Among the continuous, S-convex, scale independent inequality indices which are invariant to population replications, the members of this family are the only ones which are additively decomposable for any partition of the population (see, i.a. Shorrocks, 1980, 1984).

(22) In particular, for any partition of the population, the function S can be decomposed into two terms: (i) the weighted average of the social welfare in each subgroup, with weights equal to the subgroups' demographic importance, less (ii) a term equal to the between-group income inequality times the distribution mean. For applications in the income distribution literature, see Garner *et al.* (1999), Ruiz-Castillo (1998), Ruiz-Castillo and Sastre (2001).

(23) It should be pointed out that the amount of observed changes may depend on the fact that a partially calibrated data set has been used. Perhaps, in a new version of the paper a fully estimated data set may give rise to fewer changes.

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