Positive and normative analysis of tax policy : does the representation of the household decision process matter ? Evidence for France¤

Olivier Bargain[y], François Laisney[z], Nicolas Moreau[x]

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Abstract

The burgeoning literature on collective models has recently focused on attempts to estimate such models of household behaviour. However, no simple econometric technique is available when accounting for participation decisions and tax-bene…t system leading to non-linear and possibly non-convex budget sets. This delays the use of collective models for policy recommendation purposes. Relying on cruder calibration techniques to …ll the gap is thus necessary. The paper …rst suggests a piecemeal approach to simulate labour supply using a collective model with taxation. The second contribution is to compare the predictions in term of policy analysis between the unitary and the collective models. The exercise consists in assessing a current French tax reform using a unitary model estimated on data generated by the collective one. The size of errors from the unitary model, both on positive and normative conclusions, suggests that more e¤ort should be devoted to the estimation and operationalization of collective models with taxation.

Key Words : collective model, intrahousehold allocation, household labour supply, tax reform.

JEL Classi…cation : C71, D11, D12, J22.

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[y]DELTA (joint research unit ENS - CNRS - EHESS), Paris

[z]BETA-THEME, Université Louis Pasteur, Strasbourg, and ZEW, Mannheim.

[x]GREQAM (joint research unit Aix-Marseille II - CNRS - EHESS), Marseille

1 Introduction

Economists often base household tax policy recommendations on positive and normative analysis rooted on the use of the traditional "unitary" representation of the household. In this framework, household behaviour is generally assumed to result from the maximization (under household budget constraint) of a single utility function, which implies equivalently dictatorship or pure consensus within the household.

Collective models introduced by Chiappori (1988, 1992) are a substantial improvement in the modelling of individuals living in couples. First, this appealing representation of household behaviour respect the logic of individualism as it openly accounts for the presence of several decision makers who may have di¤erent preferences, relying solely on the assumption of Pareto-e¢ciency. Second, it allows intrahousehold distribution analysis and individual welfare analysis. Interestingly enough, some studies have shown that the restrictions coming from the collective model are seldom rejected by the data on couples, whereas associated with the unitary model often are.[1]

The literature has recently focused on the econometric estimation of labour supply behaviour implied by collective models. However, no simple econometric technique is available yet, especially when accounting for the distinction between participation and hours of work and for a tax-bene…t system leading to non-linear and possibly non-convex budget sets (see Blundell and al., 2001). This delays the use of collective models for purpose of policy analysis. Relying on cruder calibration techniques to …ll the gap is thus necessary.

The …rst objective of the present paper is to suggest a way to simulate labour supply using a collective model with taxation. We calibrate the latter through heterogeneous unobserved preferences and intra-household bargaining rules. Calibration is carried out on French data from 1995 wave of the European Community Household Panel (ECHP95), using observed work hours of spouses. The rest of the empirical identi…cation relies on the assumption that some aspects of individual preferences - but not all - remain the same after marriage. The simulated collective setting reveals richer behavioural implications than the unitary setting, which may have serious consequence on positive and normative policy analysis.

Our second objective is then to compare unitary and collective representations by assessing the concrete implications of choosing one rather than the other for policy recommendation. The exact question we address here is: how large is the size of distortions when using the unitary model instead of the collective one to assess tax policy change? To do so, we simulate labour supplies by means of the 'deterministic' collective model at use, as if households behaved according to the collective rationality. A unitary model is then estimated on such 'collective data'.[2] Apart from possible misspeci…cation of the unitary

[1] See Browning and Chiappori (1998) and Chiappori, Fortin and Lacroix (2001).

[2] Previous work of Beninger and Laisney (2001) addressed the issue of comparing collective and unitary representations but made use of purely synthetic 'collective data' (most of the parameters of the collective model were just randomly drawn).The present paper attempts

model, discrepancies between the predictions from both representations can be due to the wrong assumption that (collective) households behave as if they were single decision makers. If the gap turns out to be large, both models cannot be used indiscriminately when formulating policy recommendations. All this naturally justi…es putting more e¤ort into the identi…cation and estimation of collective models with taxation.

The outline of the paper is as follows. Section 2 presents the piecemeal approach used to simulate collective rationality. In section 3, we present a positive and normative analysis of a topical reform based on collective behaviour. Section 4 deals with the estimation of a unitary model on the simulated 'collective data' and presents the analysis based on the unitary approach. Predictions from both representations are …nally discussed.[3]

2 Simulation of a collective model of labour supply

We need to derive an empirical way to identify a collective model.[4] In the literature on collective models, identi…cation of structural components has been achieved usually thanks to the decentralization of the model, which is possible only when preferences are egoistic or 'caring' à la Becker and when the budget set is convex.[5] However, in the case of several European countries including France, the budget set is often non-convex. Consequently, we cannot use the pure estimation strategy and must rely on calibration. This way, we introduce heterogeneity between households with regards to one preference parameter (common between husband and wife) and to the intra-household bargaining rule.

to check the robustness of their results when the baseline situation is generated realistically using a calibration on real data. Note that the current approach could be related to a model choice procedure in the spirit of Cox (1962); we could inversely wonder what a collective model predicts when estimated on 'unitary data' (generated by a unitary model). The asymmetry in the procedure is fully justi…ed by the fact that estimation of a collective model is a di¢cult task.

[3] Appendices contain information about the data, the sample selection and the estimation of preferences on single individuals. Complementary appendices are available on request, containing the estimation of wages for non-working women, a description of the French tax system, an illustration of its non-convexity for low-wage couples, a detailed description of the tax reform at stake and an illustration of empirical utility sets and their possible non-convexity.

[4] The construction of an empirical model of household labour supply has been tackled by Kooreman and Kapteyn (1990) in the case of bargaining models. They use desired working hours as additional information to better identify individual from collective preferences. See also Björn et Vuong (1984, 1985) for empirical models of labour supply based on noncooperative equilibria.

[5] This requirement coincides with the application of the Second Theorem of Welfare Economics. In a convex setting, Blundell and al. (2001) and Donni (2002) have extended the theoretical identi…cation of collective models to account for participation decisions in the case of linear and non-linear taxation, respectively.

2.1 Collective setting with taxation

2.1.1 Collective rationality

The …rst de…nition of collective rationality in Chiappori (1992) corresponds to the program:[6]

$$\underset{c_f;c_m;l_f;l_m}{Max} \quad U_f(c_f;l_f;l_m) \tag{1}$$

$$\text{s.t.} \quad U_m(c_m;l_m;l_f) = \overline{U}_m(\mu) \tag{2}$$

$$\text{s.t.} \quad c = c_f + c_m = g(w_f h_f; w_m h_m; y_0; z) \tag{3}$$

where c_i represents private individual consumption and $l_i = T - h_i$ the demand for non-market time for gender $i = f;m$, with total time endowment $T = 7 \pounds 24 = 168$ hours a week. Total consumption (equivalent to total disposable income in such a static framework) depends not only on individual earnings but also on nonlabour income y_0, on household socio-demographic characteristics z (that can in‡uence the computation of the taxes paid or the bene…ts received) and on the tax-bene…t system $g()$. The required utility $\overline{U}_m(\mu)$ for the husband captures the outcome of intrahousehold negotiation and depends on the set μ of all distribution factors.[7] Therefore, it is named husband's negotiated utility in the sequel. It must be kept in mind that this level of utility also depends on the (net) productivity of the household.

2.1.2 Speci…cation of individual preferences

We assume that preferences of single individuals are of the LES type, written for gender $i = f;m$:

$$U_i(c_i;l_i) = \alpha_i^c \ln(c_i - \underline{c}_i) + \alpha_i^l \ln(l_i - \underline{l}_i) \tag{4}$$

and that preferences for individuals in couples are the same except that a speci…c interaction term in spouses' leisures is added, so that for each spouse $i = f;m$:

$$U_i(c_i;l_f;l_m) = \beta_i^c \ln(c_i - \underline{c}_i) + \beta_i^l \ln(l_i - \underline{l}_i) + \delta \ln(l_f - \underline{l}_f) \ln(l_m - \underline{l}_m): \tag{5}$$

Pure leisure corresponds to $l_i - \underline{l}_i$, where the minimum level of non-market time includes time spent for physiological regeneneration and standardised aspects of household production, which vary with sex and with the demographic composition of the household. The cross-leisure e¤ect takes up potential complementarity or substituability in spouses' leisure and other likely types of interaction between them. Introducing this term, we relax the strong assumption of separability of individual preferences in the pairs $(c_f;l_f)$ and $(c_m;l_m)$ made usually

[6] It has been proved that both constraints are binding and we assume so in what follows.

[7] Distribution factors includes relative earning power of spouses as well as all socio-economic factors that may in‡uence the conditions in which intra-household negotiation takes place. For a complete discussion, see Bourguignon and al. (1995). See also McElroy (1990) for the close notion of "extra-environmental parameters".

in the empirical studies on collective models.[8] A full model with domestic production would require much more information than what is typically available in household surveys and poses a host of theoretical problems.[9]

A realistic approach requires the impact of the demographic structure of the household to be modelled in several ways (see Browning, 1992). Here, children have no decision power in the household and are internalized in the preferences of the parents: they are considered as a source of additional private consumption (for child needs) and private non-market time demand (time dedicated to childcare) for each spouse, as suggested by Deaton and Mullbauer (1980). Therefore, the minimum consumption and 'leisure' requirements $\underline{c}_i$ and $\underline{l}_i$ of each spouse depend on the number and age of the children in the household, according to (implicit) equivalence scales for $\underline{c}_i$ and to published information on time allocation for $\underline{l}_i$.[10] Again, allowing for expenditures on children and time for childcare to be decision variables is an improvement that we keep for further research.[11]

2.1.3 Identification of structural parameters

Six parameters need to be identified, namely the coefficients $\mu^c_f; \mu^l_f; \mu^c_m; \mu^l_m$ and π plus the husband's negociated utility $\overline{U}_m$. First, we normalize the wife's and the husband's utilities by including an adding-up constraint:

$$\mu^c_i + \mu^l_i + \pi = 1 \qquad i = f; m: \tag{6}$$

[8] Browning and Chiappori (1998) is an exception, but their paper is not primarily concerned with labour supply. In our setting, there is no externality with respect to consumption so that the preferences are little bit less general than the altrusitic specification.

[9] Theoretical support for domestic production can be found in Chiappori (1997) and Apps and Rees (1997). Theoretical distinction between individual and shared leisure in a collective framework is suggested by Fong and Zhang (2001). In both types of paper, the possibility to identify a collective model is explored.

[10] The individual minimum consumption $\underline{c}_i(z)$ is set equal to $\underline{c}(z)=2$ ¡ 1. The household minimum consumption $\underline{c}(z)$ is computed as the lowest disposable income for all possible combinations of male and female labor supplies within each demographic groups. Consequently, this level depends on the number of children via the implicit equivalence scale of the tax-benefit system in the lower part of the income distribution. In couples without children, the individual minimum leisure $\underline{l}_i$ is set arbitrarily to 92 (resp. 95) hours a week for men (resp. women). For households with children, we need to account for some minimum time requirement for household production associated with childcare: this minimum level is computed according to the French Time Allocation Survey 1998 (INSEE). Additional weekly time is set according to the age of the youngest child. Respectively for the wife and the husband: 14 and 7 hours if at least one child up to age 5, 6 and 3 hours if at least one child between 6 and 11, 5 and 2 hours if at least one child older than 11.

[11] Chiuri (1999) provides the first attempt to test a collective model with domestic production of childcare.

Second, the crucial identifying assumption that individuals in couples keep the same relative preferences toward consumption and leisure implies that:[12]

$$\frac{\bar{\gamma}^c_i}{\bar{\gamma}^l_i} = \frac{\circ^c_i}{\circ^l_i} = \beta_i \qquad i = f;m \qquad (7)$$

and $\circ$ coefficients can be estimated on two samples of single men and women separately. At this stage, we know that $\bar{\gamma}^c_i = \frac{1}{1+1/\beta_i}$ and $\bar{\gamma}^l_i = \frac{1}{1+\beta_i}$: Third, heterogeneity across households is captured through the coefficient $\pm$ and the structural term $\overline{U}_m$. For each household in the sample of couples, these two degrees of freedom are calibrated on the observed private demands for non-market time of both spouses.

The two major steps, that is to say the estimation of $\circ$ coefficients on singles and the calibration of $\pm$ and $\overline{U}_m$ on couples, are detailed in what follows. Let us note that individual utility functions for spouses are strictly concave in own consumption and own leisure as soon as they are increasing in these arguments, i.e. under the restrictions $\bar{\gamma}^c_i > 0$ and $\bar{\gamma}^l_i + \pm \ln(l_j - \underline{l}_j)$ for $i;j = f;m$. Using (6) and (7), these restrictions become $\pm \in [\pm_{min};\pm_{max}]$ with:

$$\pm_{min} = -\frac{1}{(1+\beta_i)\ln(l_j - \underline{l}_j) - 1} \qquad \text{for } i;j = f;m$$

$$\pm_{max} = 1$$

2.2 Estimation of relative preferences toward own leisure and consumption on single individuals

We opt for a discrete choice model where the set of possible work hours reflects the actual distribution of hours for France. Non-participating single individuals are withdrawn as they represent only a very small percentage of the selected samples for both single women and men. Therefore, the set of discrete choices $j = 1;:::5$ corresponds to labour supplies $h_j = 0;20;30;40;50$ hours per week for single women and $h_j = 20;40;45;50;60$ hours per week for single men. Individual i choosing labour supply j reaches the utility level:

$$U(c_{ij};l_j) = \circ^c \ln(c_{ij} - \underline{c}_i) + \circ^l \ln(l_j - \underline{l}_i) \qquad (8)$$

We assume that the utility derived for each choice j and each subsequent consumption is a random function, distributed with mean $U(c_{ij};l_j)$ as specified above and according to a random term ε_{ij}. Furthermore, let us assume that this utility level is independent of utility level at other options, conditional on observables. This results in the possibility to estimate the $\circ$ parameters using McFadden's conditional logit model. To add some observed heterogeneity, we let the $\circ$ coefficients vary linearly with individual characteristics like age and

[12] By doing so, we follow the suggestion made by McElroy (1990) concerning the use of data on singles to partly recover information about the preferences of individuals in couples. The same assumption was used by Barmby and Smith (2001) in a simpler setting with two-earner households and linearised budget restrictions.

education. We also account for unobserved heterogeneity by introducing mass points in the parameters which allow each individual to choose between di¤erent regimes of preference.[13] Results of the estimation are given in the Appendices. Finally, we use the resulting estimates on singles to compute individual relative preferences ® toward consumption and leisure for all husbands and wives of the sample of couples.

2.3 Calibration of cross-leisure preference and husband's negociated utility

As recalled in Varian (1992):

> "If we …x a required nonnegative utility level for consumer 2, we can locate a point on the frontier of the utility possibility set by maximising consumer 1's utility subject to the required utility constraint for consumer 2. By varying 2's required utility level, we trace out the set of Pareto optimal points".

We follow exactly this simple approach to generate the Pareto frontier for each household. The calibration consists in picking the allocation on the frontier which provides the best …t of observed labour supplies h_f^{obs} and h_h^{obs}.

2.3.1 Generation of the Pareto-frontiers

For a given $\pm$, we generate the Pareto frontier of each household by varying $\overline{U}_m$ in its range $[U_m^{min}(\pm); U_m^{max}(\pm)]$ over 20 steps.[14] We also vary $\pm$ in the bracket $[\pm_{min}; \pm_{max}]$ over 20 steps so that we obtain 400 di¤erent pairs $(\overline{U}_m; \pm)$. First, the binding constraint (2) gives, for each combination of labour supplies $(h_f; h_m)$, the corresponding consumption level for the husband:

$$c_m(h_f; h_m) = \underline{c}_m + \exp\{[\overline{U}_m - \gamma_m \ln(T - h_m - \underline{l}_m) - \pm \ln(T - h_f - \underline{l}_f)] / (1 - \gamma_m)\}. \quad (9)$$

Second, the budget constraint (3) gives, for each combination of labour supplies $(h_f; h_m)$, the corresponding consumption level for the household. This is realistically computed by means of (i) the actual wages for workers and predicted wages for non-working women and (ii) a simpli…ed version of the French tax-bene…t system (symbolized by the function g) programmed on SAS. Hence the objective function:

$$U_f(g(w_f h_f; w_m h_m; y_0; \varsigma) - c_m(h_f; h_m); T - h_f; T - h_m) \quad (10)$$

[13] This mixed logit approach is in the line of Hoynes (1996) and is described more largely in the section dedicated to the estimation of the unitary model.

[14] Bounds $U_m^{min}(\pm)$ and $U_m^{max}(\pm)$ are the husband's utilities corresponding respectively to her and his dictatorial position on the Pareto frontier. First, $U_m^{max}(\pm)$ is the highest utility reached by the husband for all possible combinations of labour supplies when he receives the best share of negotiable consumption. Then, $U_f^{max}(\pm)$ is de…ned symmetrically for the wife and $U_m^{min}(\pm)$ is the corresponding utility for the husband.

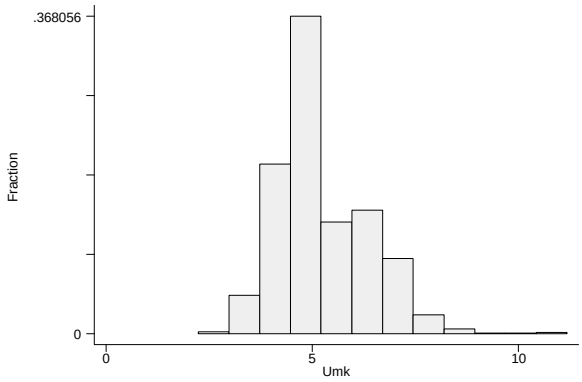

Figure 1: distribution of the husband's negotiated utility

Therefore, a unique optimal allocation $(h_f; h_m)$ corresponds to each combination $(\overline{U}_m; \pm)$.

2.3.2 Calibration on labour supplies

The calibrated pair $(\overline{U}_m^{\star}; \pm^{\star})$ for each household must then satisfy:

$$\left(\overline{U}_m^{\star}; \pm^{\star}\right) \in \arg\min_{\overline{U}_m; \pm} \left[h_f^{obs} - h_f\left(\overline{U}_m; \pm\right)^2 + h_m^{obs} - h_m\left(\overline{U}_m; \pm\right)^2 \right] : \quad (11)$$

In case of multiple solutions, we keep the one for which the husband's share of negotiable consumption $p = \frac{c_m - \underline{c}_m}{c - \underline{c}}$ (where $\underline{c} = \underline{c}_f + \underline{c}_m$) is at closest to the share that maximizes $U_f + U_m$. General results from the calibration are presented in Table 1. The distribution of the calibrated $\overline{U}_m$ is presented in Figure 1 and the distribution of the calibrated $\pm$ in Figure 2 (the stars are omitted to simplify notations).

The cross-leisure e¤ect $\pm$ is positive on average and increases with the number of children, accounting for possible complementarity between spouses' leisure activities. Though, 51% of the households have a negative cross-leisure e¤ect: the fact that leisures are substitutes in direct utility for so many households is surprising and may result from the way we import parameters estimated for singles into the preferences of individuals in couples. It may also come from the fact that not all domestic production is accounted for in required levels of non-market time $\underline{l}$. Further research is needed there. Average weekly hours of work for households with a negative $\pm$ are 37.2 for women and 42.5 for men whereas these …gures are respectively 11.4 and 39.5 for households with a positive $\pm$.

Considering the steps of calibration are quite small, there should not be much di¤erence between calibrated and observed hours. This is indeed the case for 98.5% of the husbands and 99.6% of the wives.[15] This is faithfull to our

[15] The limited number of discrete choices for hours implies that the calibration criteria can

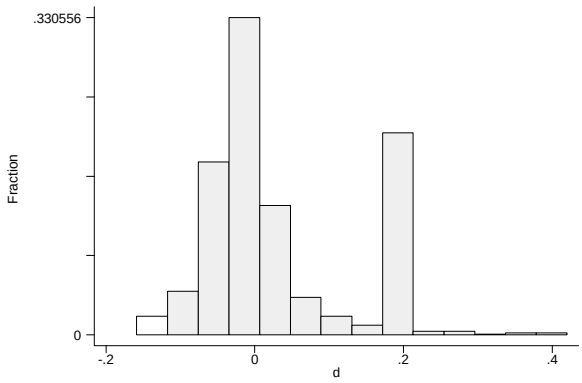

Figure 2: distribution of the cross-leisure coe¢cient

Table 1: results from calibration

	$\overline{U}_m$	±	p
Mean	5.22	0.03	0.54
Median	4.9	-0.01	0.58
Mode(s)	4.6	0.18	0.67
Std Dev.	1.10	0.095	0.18
Max.	11.2	0.42	0.97
Min.	2.6	-0.15	0.13
Mean households with 0 child	5.64	0.038	0.52
Mean households with 1 child	4.97	0.011	0.53
Mean households with 2 children	5.12	0.026	0.55
Mean households with 3 children	5.54	0.066	0.59

initial intention to engineer plausible 'collective data'. This set of calibrated working hours is called 'collective baseline simulation' (or pre-reform situation) hereafter.

2.4 Estimation of a power index

Some signi…cant determinants of the intrahousehold distribution process can be revealed by the calibrated level of the husband's negotiated utility and the corresponding wife's utility, provided we control for the (net) productivity of the household.

2.4.1 Productivity e¤ect and distribution e¤ect

The level reached by the negotiated utility $\overline{U}_m$ depends indeed on the net productivity of the household (its ability to transform labour into consumption for a given tax-bene…t system, i.e. net wages) as well as on the outcome of the intrahousehold negotiation. We shall refer to these two aspects as productivity e¤ect and distribution e¤ect. We account for the former by using some proxies of the position of the Pareto frontier in the empirical utility set. For this purpose, we make use of the coordinates of the bounds of the frontier on husband's utility scale (denoted U_m^{max} and U_m^{min} and previously de…ned). The negotiated utility $\overline{U}_m(\mu)$ also depends on all the distribution factors μ that can possibly in‡uence the conditions in which the bargaining process takes place in the household.[16] We simply use the relevant factors available in the data. They are gathered in a vector X and include a proxy for the husband's relative earning power. We …nally suggest the following speci…cation:

$$\overline{U}_m = \acute{}U_m^{min} + !(X)(U_m^{max} \text{ ¡ } U_m^{min}) + u \qquad (12)$$

with the term ! varying linearly in distribution factors X. This term is household-speci…c and accounts speci…cally for the the distribution e¤ect. The residual u capture all unobserved and unexplained heterogeneity among households.

2.4.2 Distribution factors

Distribution factors X are assumed exogenous regarding household decisions: the number and age of children (the exogeneity of fertility decisions is assumed), the di¤erence in ages between the spouses, the di¤erence in proxy for education level (the exogeneity of human capital accumulation is assumed), the di¤erence in unemployment rates. It seems also desirable to include parameters related to the relative (net) earning power of the spouses. However, net wages depend on e¤ective marginal tax rates, endogeneous to labour supply decisions. Still,

take the same minimum value for several solutions, hence multiple solutions leading to a matching lower than 100%.

[16] As mentioned by Browning and Lechene (2001), however, the collective model does not give any guidance as to what variables should appear in the set of distribution factors. Our goal is not exhaustivity anyway, as justi…ed below.

Table 2: estimation of the husband's negotiated utility

Coef. name	Variable	coef.	Robust s.e.	t-value
$\hat{}$	U_m^{min}	1.012	.004	235.98
$°_1$	RPC £ $(U_m^{max} ¡ U_m^{min})$	.670	.046	14.36
$°_2$	d_urate £ $(U_m^{max} ¡ U_m^{min})$	-.022	.002	-10.48
$°_3$	nkid £ $(U_m^{max} ¡ U_m^{min})$	.174	.010	17.61
$°_4$	kid1215 £ $(U_m^{max} ¡ U_m^{min})$	-.043	.019	-2.34
$°_5$	d_age £ $(U_m^{max} ¡ U_m^{min})$	.006	.003	2.29
$°_6$	d_etud £ $(U_m^{max} ¡ U_m^{min})$	-.033	.003	-10.74
Adj. R-squared		0.99		

Notes: RPC : his relative earning power as explained in the text; d_urate: relevant male minus female unemployment rates (depend on education level); nkid: number of children; kid1215: number of children aged between 12 and 15; d_age: his age minus her age; d_etud: his minus her level of education (each level measured by a variable in the range 0-18).

we can include some measure of the way the tax system modi…es the potential contribution of the husband to disposable income:

$$PC_m = \sum_{i=1}^{X} Pr(h_f = h_{fi}) \sum_{j=2}^{X} [c(h_{fi}; h_{mj}) ¡ c(h_{fi}; h_{m1})] \qquad (13)$$

This is a discrete integration of the budget constraint from choice 1 ($h_m = 40$) over choices $j = 2;:::4$ corresponding to $h_m = 45; 50; 60$, conditionally on the labour supply h_f of the woman. This is extended to a bivariate budget constraint using likely female work hours in the sample so not to make it endogenous to the decision of the wife. A similar computation is carried out for the woman, yielding PC_f: Eventually, we obtain the 'Relative Potential Contribution' of the husband to household disposable income, noted RPC and de…ned as $RPC = PC_m=PC_f$. As this regressor depends on the tax-bene…t system, it plays a central role in our analysis with a collective model. Indeed, a reform will alter not only the household budget constraint (and consequently the productivity e¤ect), but also the bargaining process via RPC (distribution e¤ect).

2.4.3 Estimation of the husband's negotiated utility

Results of the estimation of the husband's negotiated utility are presented in Table 2. The regression is simply conducted by OLS method. The equation is dominated by the di¤erence of cardinalisation between households. Though, the other regressors are signi…cant and may explain some distribution we want to account for.

The husband's relative earning power (RPC) and the environmental parameter 'di¤erence in unemployment rates' come up as signi…cant determinants of the husband's bargaining position, with the expected signs: a higher relative

Table 3: comparison between calibrated and estimated results

	$\overline{U}_m$	$\overline{U}_m^{\hat{\theta}}$	$\hat{\theta}$
Mean	5.22	5.16	0.603
Median	4.9	4.7	0.60
Mode	4.6	4.5	0.6
Std Dev.	1.10	1.27	0.241
Max.	11.2	11.0	1.4
Min.	2.6	2.9	0

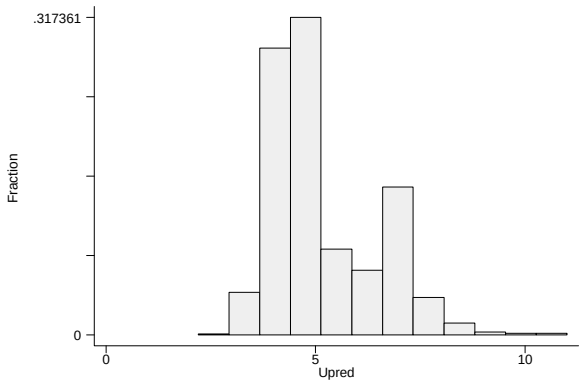

Figure 3: distribution of the predicted negotiated utility of the husband

earning power or a lower rate of unemployment for the husband both act in favour of his bargaining position. Other factors are not strict environmental parameters (they also have an impact on preferences, somehow) so that we have no a priori opinion on their signs and they probably involve identi…cation issues.

2.4.4 Prediction of the various components

Calibrated and estimated $\overline{U}_m$ are compared in Table 3 and through Figure 3 and 1. We check a posteriori that $\overline{U}_m^{\hat{\theta}}$ is in the bracket $[U_m^{min}; U_m^{max}]$: this is not the case for only 10% of the households and due to the fact that $\hat{\theta}$ is larger than 1 for half of them.

Distribution of $\hat{\theta}$ is illustrated by Figure 4. The facts that $\hat{\theta}$ stands in [0,1] in 95% of the households and that the coe¢cient $\hat{\alpha}$ is very close to 1 convey to the idea that our speci…cation could be:

$$! = \frac{\overline{U}_m \ i \ U_m^{min}}{U_m^{max} \ i \ U_m^{min}} \tag{14}$$

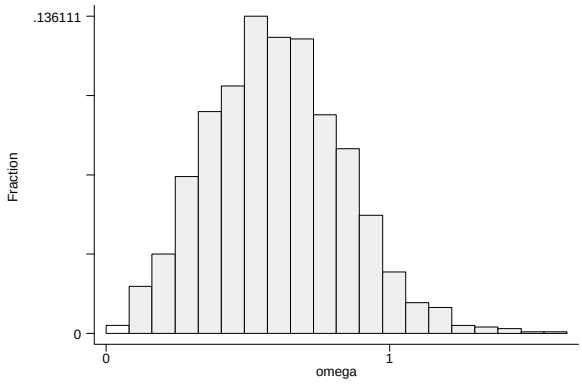

Figure 4: distribution of estimated !

with ! as husband's bargaining power index.[17] Such interpretation requires much caution, though, and our interest is not to predict the balance of power (one could claim for instance that many relevant distribution factors should be added in the regression) but rather to simulate the likely change in the distribution due to a variation of one of the factors (the relative earning power) after a reform. Hence, the collective baseline situation retained correspond to calibrated values, but with retention of residuals from the estimation of the husband's negotiated utility level, in order to trace changes to that magnitude as a consequence of the reform.[18]

3 Simulation of tax policy using the collective setting

This section and the next deal with the main objective of the study, namely the conduct of positive and normative analysis through the prism of unitary and collective models. In the present section, we assess the various e¤ects of the reform on the husband's negotiated utility. We analyse the labour supply response corresponding to each e¤ect and perfom positive and normative analysis of the reform.

[17] An alternative approach could have been to calibrate such a normalized index (so that the reference to the utility scale disappears) and regress the resulting value on the distribution factors alone. We think that this a priori normalization is less rigorous than the path followed above as it makes this index a function of net wages in an indistinguishable way. Indeed, net wages are determinants of both the distribution e¤ect (through $\overline{U}_m$) and productivity e¤ect (through $\overline{U}_m$; U_m^{max} and U_m^{min}).

[18] Only 60% of the $\overline{U}_m$ are correctly predicted by the estimation and using $\overline{U}_m^{\hat{\omega}}$, only a third of the households' labour supplies would be correctly predicted. We prefer to use calibrated labour supplies as we assume collective behaviour close to reality for the purpose of our exercise.

Table 4: e¤ects of the tax reform (all households)

	$¢\overline{U}_m$	$¢U_m^{min}$	$¢(U_m^{max} ¡ U_m^{min})$	¢RPLC	¢!
mean	-0.02%	+0.2%	0	-2.5%	-1.2%
max.	+2.9%	+6.5%	+24.6%	+2.5%	+21.0%
90%	+0.3%	+0.6%	+0.5%	+0.9%	+0.3%
50%	0	0	0	-0.2%	-0.1%
10%	-0.4%	0	-0.3%	-6.9%	-3.7%
min.	-2.9%	-7.6%	-33.1%	-12.3%	-15.3%

Notes: ¢ terms account for changes in percentage after the reform.

The reform consists of a new tax credit for low-wage households, implemented in France in 2001 ("Prime pour l'emploi"). It has been designed in the spirit of the anglo-saxon workfare reforms, namely the Earned Income Tax Credit in the US and the Working Family Tax Credit in the UK. We simulate the rules for 2003, year when the measure reaches its full regime. An important aspect for the study is that there can only be gainers with such reform.

3.1 Breakdown of the impact of a policy change

A tax policy reform has three impacts on the collective setting: (i) a change in the budget constraint; (ii) a subsequent change in the net productivity of the household captured by $¢U_m^{min}$ and $¢(U_m^{max} ¡ U_m^{min})$ (net productivity e¤ect);[19] (iii) a change ¢! via a variation of the relative earning power of the husband ¢RPC (distribution e¤ect): The full behavioural response to the reform is assessed for each household by using the program (1) with a new budget constraint (our tax-bene…t programme simulates the implementation of the tax credit) and a new husband's negotiated utility $\overline{U}_m^{new}$ accounting for both e¤ects:

$$\overline{U}_m^{new} = \acute{e}U_m^{min\,new} + !^{new}(U_m^{max\,new} ¡ U_m^{min\,new}) + \text{e} \quad (15)$$

$$\text{with } !^{new} = \text{°}_1 RPLC^{new} + \text{°}_2 dunemp + \text{°}_3 nkid + \text{°}_4 kid1215 + \text{°}_5 dage + \text{°}_6 detud.$$

A breakdown of these two e¤ects is described in Table 4. The husband's utility scale $(U_m^{max} ¡ U_m^{min})$ is rather constant: the di¤erence is null for 56% of the households and less than 1% change (§) in 94% of the cases.[20] His (potential) minimum utility U_m^{min} has increased for half of the households and on average; it has decreased for only 1% of the households. Consequently, it appears clearly that for half of the households, the Pareto frontier moves toward North-East in the utility set in response to the reform. These net productivity e¤ect is overall Pareto-improving.

[19] New dictatorial utilities are computed following the same methodology as earlier and using the new budget constraint.

[20] The scale is distorted by more than 5% in magnitude (§) for only 33 households out of 1440 in our sample.

However, all the husbands do not bene…t from a welfare improvement with the tax credit. Indeed, the …nal e¤ect on their negotiated utility is negative on average. This is due to an average change in the balance of power in favour of the wives: women are more likely to be concerned by the reform as it is targeted to second-earners. More than 30% of the husbands are found signi…cantly worse-o¤ after the reform. For 97% of these, their relative earning power decresases su¢ciently (RPC decreases by 6% on average, compared to 2.5% over all the sample of couples) so that the subsequent distribution e¤ect o¤sets the welfare improvement provided by the net productivity e¤ect of the reform. This corresponds to a shift at the expense of the husband along the new Pareto frontier. RPC decreases signi…cantly for half of the households and remains unchanged for a quarter, so that on average, husbands are worse-o¤ after the reform.[21]

3.2 Positive analysis with a collective representation

3.2.1 Simulation of collective labour supply response

Labour supply responses to the tax credit reform are computed as the di¤erence between the collective baseline situation and the post-tax reform situation predicted by the collective model. Pre- and post reform situations are presented in Table 5 for women and in Table 7 for men in couples. Corresponding labour supply responses are presented in Table 6 for women and in Table 8 for men in couples. Overall, 78 households adjust their labour supply: 69 wives (4.8% of the sample) and 12 husbands (0.9% of the sample). Three of these husbands adjust their labour supply together with their wives (2 couples display a decrease in the wife's hours (-10) and an increase in husband's hours (+5) and one couple displays a joint decrease in hours: -10 for the wife, -5 for the husband). Among the 78 households who react, 7 are not receivers of the tax credit. Indeed, adjustment may be only due to a change of the bargaining environment after the reform (through a change in the relative earning power).

The major changes concern a shift from half-time job to non-participation and the reverse way. These moves into or out of the labour market occur only for women and are balanced (4 wives each way). The 4 households whose wives leave the labour market encounter a substantial decrease of their total disposable income. For these couples, the trade-o¤ between between consumption and female leisure, namely between the joint hours (20,40) and (0,40), has turned to the advantage of the latter after the reform. This may be due to the additional amount of tax credit received through the salary work of the husbands in these couples. Some explanation is also found in the discontinuities caused by means-

[21] For households where RPC decreases (50%), the husband's average hourly wage is 53 and the wife's is 34 : the household is more likely to receive the tax credit through the wife. For households where RPC increases (25%), the husband's average hourly wage is 52 and the average wife's hourly wage is 61 : the household is more likely to receive the tax credit through the husband. For households where RPC remains constant, the husband's average hourly wage is 113 and the wife's is 71 : the spouses' wages are too high for the household to receive any tax credit.

Table 5: comparison between pre- and post-reform situation in the collective setting (women)

prenpost-reform	0	20	30	40	50	Total
0	26.9	0.3				27.2
20	0.3	11.4				11.7
30		1.0	10.6			11.6
40			2.9	41.3	0.4	44.4
50					5.1	5.1
Total	27.2	12.7	13.4	41.3	5.5	1440

Note: entries in the table give frequencies (in%), except the last cell which gives the number of observations.

Table 6: collective labour supply response (women)

$¢h_f$ (weekly hours)	-20¤	-10	+10	+20¤
freq. (%)	0.3	3.9	0.4	0.3

*: The shift from 20 (resp. 0) to 0 (resp. 20) correspond to a shift from half-time job (resp. non-participation) to non-participation (resp. half-time job).

Table 7: comparison between pre- and post-reform situation in the collective setting (men)

prenpost-reform	40	45	50	60	Total
40	74.4	0.4			74.8
45	0.1	10.6	0.3		11.0
50		0.1	9.7	0.1	9.9
60				4.4	4.4
Total	74.5	10.9	10.0	4.5	1440

Note: entries in the table give frequencies (in%), except the last cell which gives the number of observations.

Table 8: collective labour supply response (men)

$¢h_m$ (weekly hours)	-5	+5	+10
freq. (%)	0.2	0.7	0.1

Table 9: breakdown of the recipients of the tax-credit

Amount of tax credit received (euro/year)	mean NR	mean R	min.	max.
all households	454	456	2	1,322
households without children	536	533	48	1,322
households with 1 child	453	458	19	1,252
households with 2 children	460	462	2	1,305
households with 3 children	383	383	16.9	1,273

Note: NR denotes the situation with no response and R the situation with a full behavioural response to the reform; min. and max. do not change.

testing at both household and individual level. By lack of space, we do not investigate the precise features of the reform that may explain the results on incentives. This is the subject of Bargain and Terraz (2002).

According to collective behaviour, the 'workfare' reform appears to be of little incentive e¢ciency for wives in (one or two-earner) couples; indeed, the net participation e¤ect of the reform is neutral. On the other hand, for the 4 wives who decided to start working part-time, the …nancial incentive is quite strong as the yearly amount of tax credit received by their household shifts on average from 165 euro to 703 euro by doing so. Overall, wives' average weekly hours decrease from 26.1 (collective baseline) to 25.8. Husbands' hours slightly increase from 42.4 to 42.5.

3.2.2 Tax analysis

If households are assumed not to adjust their labour supply after the reform, the cost of the tax credit is 336.5 Meuro and 741 households (out of 1440) are actually recipients of a tax credit.[22] When accounting for labour supply responses, the cost of the reform becomes 338.3 Meuro and 742 households (out of 1440) are now recipients of the tax credit. Further information is given in Table 9.

3.3 Normative analysis with a collective representation

Our representation of the collective model is more general than the one that consists of a household welfare function (the latter has been abandonned as the utility set may be non-convex) and prevents interhousehold welfare comparison. Though, it gives an insight for intrahousehold normative analysis and gender analysis (the latter is not performed here) as individual utility is assessed.

[22] We do not intend to compute aggregated …gures using sample weights: they would not be meaningful as the simulation of the whole tax-bene…t system is a simpli…ed version. On-going research consists in using microsimulation models which will allow further studies to draw a more realistic picture of the reform.

Table 10: change in wives' welfare after the reform (collective setting)

	post-reform at (NR)	post-reform at (R)
couples where $\Delta h_f = +20$	1.0052	1.0033
couples where $\Delta h_f = -20$	1.0047	1.0069
couples where $\Delta h_f = 0$	1.0015	1.0032
All couples	1.0017	1.0038

Note: for each line, the pre-reform situation is normalized to 1; the post-reform situations are expressed relatively to this benchmark; NR denotes the situation with no response and R the situation with a full behavioural response to the reform (productivity + distribution effects).

3.3.1 Impact on individual welfare when no response in the collective setting

Average weekly disposable income (consumption level) for households in the sample slightly increases from 637 euro before reform to 641 euro after tax reform if there is no behavioural response. No response means unchanged intra-household distribution so that both individual consumptions rise in the same proportion as aggregated consumption (+0.6%). It also means no labour supply adjustment. In that case, the reform is then Pareto-improving, as illustrated by the comparison of second columns in Tables 10 and 11 (the pre-reform situation is normalized to 1).

3.3.2 Impact on individual welfare when full response

We now consider optimal adjustment to the reform by (collective) households facing the new budget constraint. Average weekly disposable income slighlty decreases from 641 euro (post-reform situation with no response) to 640 euro after full response. We perform individual welfare analysis on average and, for comparison purpose, on the 8 couples where women move into and out of the labour market (§20).

Overall, the reforme is not Pareto-improving as illustrated by the comparison of the third columns in Tables 10 and 11: as mentioned earlier, the wives gain welfare at the expense of the husbands' (on average) as they gain earning power thanks to the reform. The distribution effect is 'Pareto-deterioring' on average and offsets the welfare improvement due to the net productivity effect.

4 Unitary analysis of the tax policy change

We now turn to the analysis of the same tax reform using a standard unitary model of household labour supply. First, the model is estimated on the 'collective data' previously generated. Second, pre- and post-reform situations can be predicted and compared to assess the household behavioural reactions and to

Table 11: change in husbands' welfare after the reform (collective setting)

	post-reform (NR)	post-reform (R)
couples where $\Delta h_f = +20$	1.0244	0.9962
couples where $\Delta h_f = -20$	1.0048	1.0057
couples where $\Delta h_f = 0$	1.0021	1.0000
All couples	1.0021	0.9998

Note: for each line, the pre-reform situation is normalized to 1; the post-reform situations are expressed relatively to this benchmark; NR denotes the situation with no response and R the situation with a full behavioural response to the reform (productivity + distribution effects)

draw positive and normative conclusions to the reform.

4.1 Estimation of the unitary model

We use a discrete choice model of household labour supply in the spirit of Van Soest (1995). As noted earlier for the estimation of singles, discretized models allow to account easily for participation issue plus nonlinearity and nonconvexity of the budget sets.

4.1.1 Specification of the unitary model

For the specification of such unitary model, we adopt the analogue to the individual utility fonctions used in the collective setting, that is:

$$W(c; l_f; l_m) = \alpha_c \ln(c - \underline{c}) + \alpha_f \ln(l_f - \underline{l}_f) + \alpha_m \ln(l_m - \underline{l}_m) + \gamma \ln(l_f - \underline{l}_f)(l_m - \underline{l}_m):$$

It is easy to prove that a sufficient condition for W to be increasing in its arguments is:

$$\gamma > \max\{-\frac{\alpha_f}{\ln(l_m - \underline{l}_m)}; -\frac{\alpha_m}{\ln(l_f - \underline{l}_f)}\} \text{ and } \alpha_c > 0$$

and that the concavity condition is:

$$[\alpha_f + \gamma \ln(l_m - \underline{l}_m)][\alpha_m + \gamma \ln(l_f - \underline{l}_f)] > \gamma^2$$

This model is estimated on the collective baseline situation ("collective data") so that it seems natural to use the same discretisation as previously for weekly work hours, that is $h_f = 0; 20; 30; 40; 50$ for the wife and $h_m = 40; 45; 50; 60$ for the husband. This gives a total of 20 possible combinations $(h_f; h_m)$ noted $j = 1; ::: 20$. The budget constraint of the household remains the same as for the collective model. The household minimum requirement in consumption $\underline{c}$ is set to the values calibrated for the collective model. So is the individual requirement in leisure $\underline{l}_i$ for spouse $i = f; m$:

4.1.2 Estimation using conditional logit with mass points

The coe¢cients vary linearly with household's observed characteristics and with unobserved heterogeneity.[23] Following the methodology described by Hoynes (1996), we use mass points (discrete heterogeneity) rather than continuous random errors used in Random Parameter Logit models à la Van Soest (1995) or McFadden and Train (2000). Indeed, this approach has proved more e¢cient, both in terms of likelihood and predictive power. Conditionally on observables, households are drawn from a mixture of R regimes, regime r corresponding to a given mass point μ^r on the coe¢cients for consumption and for the interaction in leisures. Thus there are R di¤erent pairs $(\mu_c^r; \mu_\pm^r)_{r=1;:::R}$ that determine household preferences, each observed with a probability $¼_r = Pr(\mu_c = \mu_c^r; \mu_\pm = \mu_\pm^r)$, with $\sum_r ¼_r = 1$. Both the mass points and their associated probabilities are estimated as parameters in the model. The unconditional choice probability (or contribution to likelihood) for a household choosing alternative j is written:

$$EP_j = \sum_{r=1}^{R} ¼_r \frac{\exp W(c_j; l_{fj}; l_{mj})}{\sum_{s=1}^{20} \exp W(c_s; l_{fs}; l_{ms})}: \qquad (16)$$

4.1.3 Estimation results

Results of the estimation of the unitary model are presented in Table 12.[24] All parameters are statistically di¤erent from zero at conventional levels, except Paris region for the interaction term ±. We assume that the regime chosen by each household is the one which gives the best hours prediction (as long as it leads to regular preference, i.e. non-negative coe¢cients). As illustrated in Table 13, regime 2 is prevailing. All households except 7 (out of 1440) exhibit regular preferences. We withdraw the latter from the analysis in the sequel.

4.1.4 Unitary baseline situation

The predictions resulting from the unitary model are quite poor, both for wives and for husbands. First, this points to the misspeci…cation of the particular unitary model at use, even if we avoid that male and female leisure be net (income compensated) substitutes. Second, recall that we use a static model and that demand-side constraints are not accounted for. Predictions obtained for wives and husbands are presented in Tables 14 and 15.

Only 44 % of the wives' hours are correctly predicted. More than 7 % of the wives are predicted to work (mostly part-time) although they are non-participants. On the contrary, around 11 % of the wives are predicted not

[23] The introduction of heterogeneity is even more important here than for singles. Indeed, in the case of couples, it seems really necessary to avoid the IIA assumption, since two combinations of spouses' labour supplies are not likely to be independant (e.g. the choices (40,20) and (40,40)).

[24] Two regimes (R = 2) are enough given the heavy dominance of one of them. Predictions are not improved in the case of three regimes. We tested several other speci…cations as the one with mass points on $®_c; ®_f; ®_m$ and ±: As few households have regular preferences in these alternative contexts, none of these speci…cations was retained.

Table 12: estimation of the unitary model of household behaviour

variable	coef.	std. err.	z-value
$®_f$:			
Age of wife	0.58	0.31	1.87
Education of wife	-0.84	0.12	-6.85
Number of children	1.25	0.38	3.28
$®_m$:			
Age of husband	4.92	0.36	13.54
Education of husband	-2.97	0.20	-14.58
Number of children	1.29	0.42	3.05
$®_c$:			
Number of children	-2.58	0.26	-9.97
Paris region	2.04	0.74	2.75
± :			
Number of children	-0.59	0.12	-5.04
Paris region	-0.13	0.08	-1.64
Heterogeneity on consumption:			
μ_{c1}	3.42	0.65	5.25
μ_{c2}	8.12	0.61	13.39
Heterogeneity on interaction term:			
$\mu_{±1}$	3.15	0.51	6.19
$\mu_{±2}$	0.89	0.11	8.19
	-1.86	0.09	-20.54
Heterogeneity probablility:			
$¼_1$	0.13	0.01	13
Log-likelihood		-3531.2	

Note : Education is an indicator for college or university degree. Age is actual age divided by 40. Paris region equals 1 if the couple lives in Paris region, 0 otherwise. The asymptotic standard error for the heterogeneity parameter was computed with the Delta method.

Table 13: estimated probabilities and frequencies of the regimes - unitary couples

Regime r	est. prob. $¼_r$	frequency
1	:13	:10
2	:87	:90

Table 14: collective (rows) versus unitary (columns) labour supply of wives

collective n unitary	0	20	30	40	50	Total
0	20:5	4:4	2:2	0:6	0	27:6
20	4:9	2:1	3:7	0:6	0:1	11:3
30	1:7	2:2	3:8	3:1	0:8	11:5
40	3:9	5:2	14:5	16:4	4:5	44:6
50	0:6	0:5	0:7	1:3	1:3	5:0
Total	31:7	14:4	24:8	22:5	6:6	1433

Note: entries in the table give frequencies (in%), except the last cell which gives the number of observations.

Table 15: collective (rows) versus unitary (columns) labour supply of husbands

collective n unitary	40	45	50	60	Total
40	73:4	0	0	0	73:4
45	10:7	0:6	0:1	0	11:4
50	9:6	0:6	0:2	0	10:4
60	4:5	0:3	0	0	4:8
Total	98:3	1:4	0:3	0	1433

Note: entries in the table give frequencies (in %), except the last cell which gives the number of observations.

Table 16: Comparison between pre- and post reform situation in the unitary setting (women)

prenpost-reform	0	20	30	40	50	Total
0	28.3	0.4				28.7
20	0.2	24.0				24.2
30		1.7	24.4			26.2
40			0.8	14.7		15.5
50				0.4	5.1	5.5
Total	28.5	26.1	25.2	15.1	5.1	1440

Note: entries in the table give frequencies (in%), except the last cell which gives the number of observations.

to work when they actually do. The distribution of labour supply is indeed smoothed as only 36 % of the full-time working wives are predicted to do so. Labour supply is underpredicted on average as 36% (resp. only 20%) of the wives are predicted to work less (resp. more) than they actually do. For husbands, the satisfying rate of correct predictions (74.2 %) comes from the fact that most of the husbands are predicted to work 40 hours, which is the actual main choice. However, the unitary model misses most of all the other cases (hours over 40) so that male labour supply is largely underpredicted. Concerning the joint distribution of husband and wife labour supplies, only 33% of the di¤erent allocations are well predicted. Nevertheless, these predicted labour supplies are used in what follows as 'unitary baseline'.

4.2 Positive analysis with a unitary representation

In the unitary setting, the weight of each spouse does not depend on wages or extra-environmental parameters. Consequently, the outcome of intra-household distribution cannot easily be identi…ed, i.e. disentangled from individual preferences. A tax reform alters only the household budget constraint.

4.2.1 Simulation of unitary labour supply response

Labour supply responses to the tax credit reform are computed as the di¤erence between the unitary baseline situation and the post-tax reform situation predicted by the unitary model. Only 50 households present a labour supply response when 78 of them do so according to collective behaviour. The main di¤erence stands in the fact that, according to the unitary setting, there happen to be no change for men in couples. For women in couples, pre- and post reform situations are presented in Table 16 and labour supply responses in Table 17.

Overall, women react less compared to collective behaviour: 50 (3.5%) of them respond to the reform and only 6 of them (0.4%) increase their labour supply. With the reform, wives' average weekly hours shift from 21.6 (unitary

Table 17: unitary labour supply response (women)

Δh_f (weekly hours)	-20*	-10	+10	+20*
freq. (%)	0.2	2.9	0.0	0.4

*: The shift from 20 (resp. 0) to 0 (resp. 20) correspond to a shift from half-time job (resp. non-participation) to non-participation (resp. half-time job).

Table 18: breakdown of the recipients of the tax-credit

Amount of tax credit received (FF/year)	mean	std.dev.	min.	max.
all households	465	465	2	1,322
households without children	628	621	44	1,322
households with 1 child	513	518	2	1,259
households with 2 children	457	456	3	1,302
households with 3 children	292	289	17	1,032

Note: NR denotes the situation with no response and R the situation with a full behavioural response to the reform; min. and max. do not change.

baseline) to 21.4 whereas husbands' do not change. The net participation effect of the reform, though, is positive.

4.2.2 Tax analysis

If households are assumed not to adjust their labour supply, the cost of the tax credit is 344 Meuro and 740 households (out of 1440) are recipients. When accounting for labour supply responses, the cost of the reform becomes 348 Meuro and 748 households (out of 1440) are now recipients of a tax credit. Further information is given in Table 18.

4.3 Normative analysis with a unitary representation

4.3.1 Impact on household welfare when no reponse in a unitary setting

If there is no adjustement to the reform, average weekly disposable income for households in the sample slightly increases from 592 euro to 597 euro after tax reform and both individual consumptions rise by the same percentage (+0.8% on average). The welfare impact is visible only at the household level: this is illustrated by the shift from the second to the third column in Table 19. The reform is overall welfare-improving.

Table 19: change in household welfare with the reform (unitary setting)

	pre-reform	post-reform (NR)	post-reform (R)
couples where $\Delta h_f = +20$ after reform	30.36	30.37	30.40
couples where $\Delta h_f = -10$ after reform	33.75	33.89	33.91
couples where $\Delta h_f = -20$ after reform	19.07	19.12	19.18
couples where $\Delta h_f = 0$ after reform	29.33	29.36	29.36
All couples	29.443	29.476	29.477

Note: contrary to the collective analysis, we do not normalize to 1 the pre-reform situations; indeed, welfare comparison between adjusting and non adjusting households (lines 2 to 5) may contain some valuable information; in the collective setting, the cardinalisation of female utility is too arbitrary to allow meaningful comparisons of that kind or between wife and husband and we focus only on variations.

4.3.2 Impact on household welfare when full reponse

We now consider optimal adjustment to the reform by (unitary) households facing the new budget constraint. The average weekly disposable income for households in the sample slightly decreases from 597 euro (post-reform with no behavioural reaction) to 596 euro after unitary labour supply responses. This is essentially due to the overall disincentive e¤ect of the reform.

Despite the subsequent decrease in disposable income, labour supply responses are clearly welfare-improving (as expected) as shown by the shift from the third to the fourth column in Table 19. Welfare gain for households whose wives reenter labour market is provided by the tax credit received through the half-time job they take. This is the real incentive part of the reform, concerning unfortunately very few households.

4.4 Final comparison between unitary and collective analysis

4.4.1 Positive analysis

The reform seems to have little incentive impact for couples where (at least) the husband works. Especially, several wives withdraw from the labour market. The fact that second earners decide to leave labour force is quite common in simulations of this kind. Using a traditional econometric approach, Blundell and al. (2000) …nd similar results for the replacement of the Family Credit by the WFTC in the UK : such reform suggests that on one hand, 'workless households' (non-working single parents and couples with no earner) are slightly encouraged to work, but, on the other hand, some working mothers in two-earner households may be induced to leave work because WFTC has increased their husband's income.

Table 20: impact of the reform on average hours (unitary model)

	Pre-reform	Post-reform
h_f	21.6	21.4
h_m	40	40

Table 21: impact of the reform on average hours (collective model)

	Pre-reform	Post-reform
h_f	26.1	25.8
h_m	42.4	42.5

As far as the French reform is concerned, conclusions about singles should be drawn to give an overall picture of the reform. The guess is that tax credit would appear more incentive for single individuals. Our main concern for the present study rather was one and two-earner couples. Both unitary and collective models agree on the conclusion about potential disincentive e¤ects of the reform for some wives. In addition, the collective model tells us that the reform seems in favour of the wife bargaining position and that an overall increase occurs in male hours. Tables 20 and 21 put in a nutshell the e¤ect of the reform on average male and female hours in both settings.

4.4.2 Normative analysis

For each decile as well as for the whole sample, Table 22 compares the change in unitary household welfare (¢U), that can be only positive or null, with the changes in individual welfares from the collective setting, that can be positive, null or negative.

Clearly, con‡icting situations take place and cannot be accounted for by the traditional unitary model at use. That is, for 19% of the couples, the reform seems neutral (unitary model) whereas in reality, the husband's welfare increases and the wife's decreases (collective model); for 32% of the couples, the reform improves total welfare (unitary model) whereas this time, the wife wins at the expense of the husband (collective model). Only 23% of the couples are predicted to be better-o¤ after the reform when both spouses actually are (the reform is Pareto-improving according to the collective model).

5 Conclusion

We have designed the exercise so that tax analysis with both unitary and collective models are performed on the same ground, namely a 'collective world'. Indeed, our analysis has assumed that households behave 'collectively' so that post-tax reform predictions from the collective model can be considered as 'true' responses whereas the predictions from the unitary model are what the traditional literature can tell about household behaviour. One rationale for such

Table 22: summary of welfare changes after a tax reform with both models

Decile	¢U (%)	Total	U_m+ U_f+	U_m+ $U_f=$	$U_m=$ U_f+	$U_m=$ $U_f=$	U_m- U_f+	U_m+ U_f-	U_m- $U_f=$	$U_m=$ U_f-	U_m- U_f-
1	U+	98.6	74.3				24.3				
	U=	1.4						1.4			
2	U+	97.9	47.2				50.7				
	U=	2.1						2.1			
3	U+	93.1	33.3		1.4		58.4				
	U=	6.9				0.7		5.6		0.7	
4	U+	86.8	27.8		0.7		58.3				
	U=	13.2				1.4		11.8			
5	U+	66.6	19.4		0.7		46.5				
	U=	33.3				2.1		31.2			
6	U+	47.9	13.2		0.7		38.2				
	U=	52.1		0.7		13.9		33.3			
7	U+	27.1	8.3				18.7				
	U=	72.9		1.4		28.5		42.4	0.7		
8	U+	18.1	2.8		0.7		14.6				
	U=	81.9		0.7		38.9		41.7	0.7		
9	U+	91.7	1.4				6.9				
	U=	8.3		2.1		69.4		19.4		0.7	
10	U+	2.8	2.1				0.7				
	U=	97.2		1.4		92.4		2.8		0.7	
Total	U+	55.1	23.0		0.4		31.7				
	U=	44.9		0.6		24.7		19.2	0.1	0.3	

Note: non-con‡icting results are in bold.

interpretation can be that collective behaviour implies an (non-speci…ed) intra-household bargaining process that is more likely to take place in reality than pure consensus. If we believe that a collective model gives a better picture of actual household behaviours (at least for the sake of the exercise), then there may be some distortion in using the unitary model for policy analysis as suggested by the results of this study.

Indeed, positive conclusions with both models are con‡icting, mostly to the extent that the unitary model does not predict any response from men in couples after the reform. Normative conclusions are also quite di¤erent. The main di¤erence comes from the fact that for more than half of the couples, a unitary setting cannot account for the con‡icting situations taking place. Especially, in collective households, women seem to gain to expense of husbands on average.

The present methodology manages to handle non-convex budget sets, to account for both work hours and participation decisions of both spouses and to allow non-separable preferences. This goes one step beyond what is usually done in the empirical literature on collective model. Further results are needed. First, the minimum required consumption goes some way in the direction of subsuming public goods (like housing) but at the cost of neglecting decisions made within the household concerning the level of public consumption and its adjustment to new bargaining environment. Maybe even more crucial when it comes to labour supply decisions in a couple, domestic production need to be introduced, notably production of childcare. A research avenue could then consists in exploiting extra information from time use surveys in complement to the data and the methodology presently used, in order to introduce modelling of childcare (and possibly other type of household production). Finally, a major direction is the investigation of a one-shot econometric estimation of collective models with non-participation and taxation. The present study has opened up the way to work in such realistic setting. Ultimately, this would consists of the simultaneous estimation of the single individuals' preferences, of the preferences of individuals in couples and of the determinants of the spouses' bargaining position.

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6 Appendices

6.1 Data and sample selection

The data used come from the second wave (1995) of the European Community Household Panel (ECHP). We select three samples out of the data set (single men, single women, married couples) and restrict each of the samples according to the following selection criteria. First, adult members must be in the age bracket 25 - 55. Second, they must be engaged in salary jobs if they work

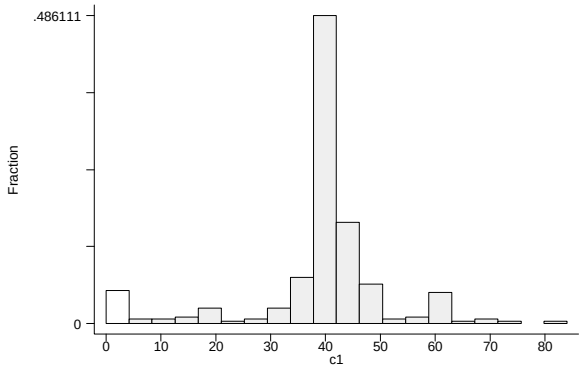

Figure 5: distribution of contract work hours for single men

(self-employed, farmers and students are excluded);[25] they must be 'voluntarily' unemployed if they do not (registered unemployed are excluded).[26] Third, extreme households are withdrawn, especially the ones receiving important level of non-labour income (capital income, pensions, etc.). Moreover, single individuals must not have children in the household; couples must have no more than 3 children and no other adults than the basic couple. Children's earnings are considered as exogenous since only a very small number of households report such incomes, for very small amounts. Wage rates are not provided directly and must be computed.[27] At this stage of the selction process, …gures 5 and 6 present the distribution of work hours for single men and women respectively and …gures 7 and 8 for husbands and wives respectively. The distribution of hours for single men and for husbands conveys to the exclusion of inactive men from our samples (and non-participation is excluded from the set of possible options for single men and husbands in discrete models of labour supply at use here). In our selection, all men participate, 24% of the wives do not 16% of single women do not. Descriptive statistics for couples are provided in Table 23.

6.2 Estimation of individual preferences on singles

Parameters $°^c$ and $°^l$ are estimated separately and must eventually verify the usual restrictions $1 > °^c > 0$, $1 > °^l > 0$ and $°^c + °^l = 1$, which is done

[25] Self-employed and farmers are subject to income tax rules that may be very di¤erent from the ones applied to earnings and that require information which is not available. Their labour supply behaviour may also be rather di¤erent and would require a di¤erent modelling strategy altogether.

[26] One reason is the measurement di¢culties connected with unemployment bene…ts. Another is that unemployment is considered as exogenous to the process at stake in the study.

[27] Individuals are asked to report the yearly wage income YW, the number of months worked during the year NM and the number of hours normally worked per week HW so that hourly wage rate can be computed as $YW/(NM \times HW \times 4.33)$.

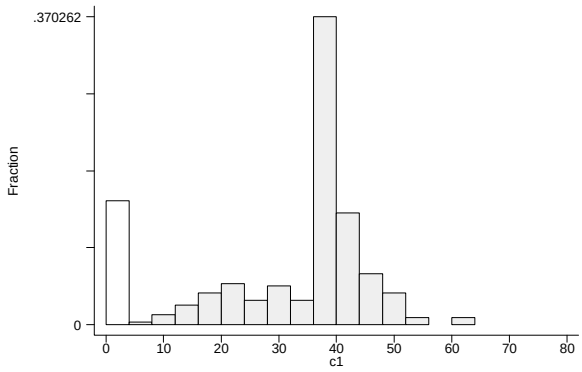

Figure 6: distribution of contract work hours for single women

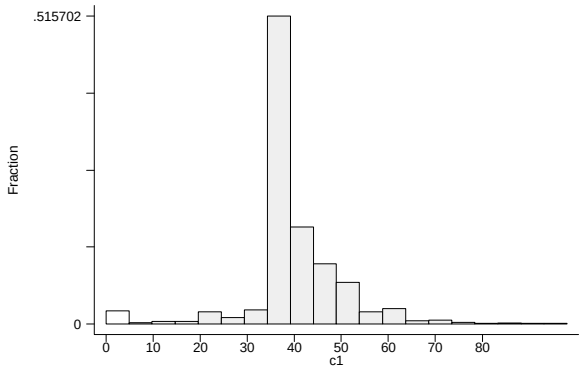

Figure 7: distribution of contract work hours for men in couple

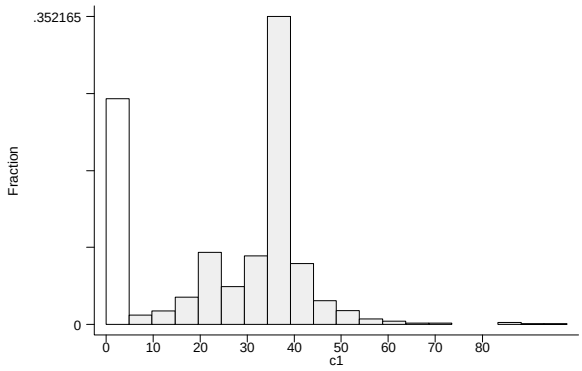

Figure 8: distribution of contract work hours for women in couple

Table 23: descriptive statistics for selected couples

	obs.*	Mean	Std. dev.	Min.	Max.
Weekly work hours husband#	1,440	41.2	7.9	8	84
Weekly work hours wife#	1,096	33.8	9.7	2	70
Hourly gross wage rate husband (in euro)	1,440	10.3	6	3.1	91.4
Hourly gross wage rate wife (in euro)	1,096	8.4	4.3	3.1	37
Age husband	1,440	40.3	7.6	25	54
Age wife	1,440	38.4	7.6	25	55
Dummy for Paris region	1,440	.17	.38	0	1
Dummy for children	1,440	.84	.37	0	1
Number of children	1,440	1.53	0.94	0	3
Dummy for education husband	1,440	.36	.48	0	1
Dummy for education wife	1,440	.36	.48	0	1

Note: dummy for Paris region: 1=Paris region; dummy for education: 1=high school or university degree.

*: number of observations; for hours worked and wages, this is the number of participating individuals, followed by the corresponding statistics.

#: with the discretisation used in the study, we have for the husbands: mean = 42:6, min = 40, max = 60, and for the wives: mean = 34:3, min = 0, max = 50.

by imposing a posteriori normalization (the utility is rescaled by their sum). Estimations have been performed (separately for single men and women) on restricted subsamples without children. This is mainly justi…ed by the fact that single individuals alone with children may have unobserved characteristics that change the resulting estimates substantially. Still, the single individuals we consider may well have some children leaving outside of the household.

Maximum likelihood estimation results are reported in Table 24. All parameters are statistically di¤erent from zero at conventional levels except Paris region (consumption term) for men. In the sequel we assume that the regime chosen by each single is the one wich gives the best hours prediction, once full-…lled the concavity restrictions. Looking at the Table 25, it appears that regime 2 prevails. It seems to be chosen too often but many single men and many single women actually do not exhibit regular preferences under regime 1.

On the whole, 64:2% of actual discretized labour supply is well predicted for single women. It amounts to 66:4% for single men. These …gures hide important discrepancies. For single women, respectively 75% and 94% of non-working and full-time working situations are correctly predicted. On the contrary, part-time jobs are very badly predicted. Only 11% of them are properly predicted. About single men, 90 % of them are predicted to work 40 hours a week, where as 67 % actually do so. Apart from this category, none of the other actual discretized hours are rightly predicted, but 28:6% of part-time hours. Parameters ° are presented in Table 26 once normalized.

Table 24: Mixed logit estimates for single individuals (two mass points)

variable	coef. single men	coef. single women
Marginal propensity for leisure α^l:		
Age	-8.81 (2.03)	5.05 (1.20)
Education	-40.89 (7.51)	-2.27 (.59)
Paris region	-3.03 (1.04)	-3.27 (.77)
Marginal propensity for consumption α^c:		
Age	-2.75 (1.09)	9.03 (3.16)
Education	-27.27 (5.53)	-0.56 (.29)
Paris region	0.37 (.71)	-1.19 (.39)
Age£education	Á	-4.17 (1.58)
Heterogeneity on leisure:		
μ_{l1}	8.72 (2.16)	-3.23 (1.33)
μ_{l2}	58.99 (7.61)	46.87 (10.98)
Heterogeneity on consumption:		
μ_{c1}	2.55 (1.13)	-4.05 (1.48)
μ_{c2}	37.23 (5.67)	53.88 (12.84)
Heterogeneity probablility:		
$¼_1$	0.18 (.06)	0.57 (.03)
Log-likelihood	-256.54	-397.86

Note : Education is an indicator for college or university degree. Age is actual age divided by 40. Paris region equals 1 if the couple lives in Paris region, 0 otherwise. Standard errors are given in brackets. The asymptotic standard error for the heterogeneity parameter was computed with the Delta method.

Table 25: estimated probabilities and frequencies of the regimes

	Single men		Single women	
Regime r	est. prob. $¼_r$	frequency	est. prob. $¼_r$	frequency
1	:18	:06	0:57	0:25
2	:82	:94	0:43	0:75

Table 26: normalized marginal propensities

Variable	Coe¢cient	Std. dev.	Min.	10%	Median	90%	Max.
α^l_f	.52	.15	.35	.37	.47	.80	.92
α^c_f	.48	.15	.08	.20	.53	.62	.65
α^l_m	.61	.03	.52	.57	.62	.63	.87
α^c_m	.39	.03	.13	.37	.38	.43	.48