Master PSE « Public Policies and Development »

Microsimulation and Evaluation of Public Policies

Amedeo Spadaro; spadaro@pse.ens.fr

Anne-Sophie Robillard; Robilliard@dial.prd.fr

Testbooks

1. Bourguignon F., M. Bussolo and L.A. Pereira da Silva, “The Impact of Macroeconomics Policies on Poverty and Income Distribution. Macro-Micro Evaluation Techniques and Tools”, Palgrave Macmillan and World Bank, (2008).

2. Bourguignon F., and L.A. Pereira da Silva, “The Impact of Economics Policies on Poverty and Income Distribution. Evaluation Techniques and Tools”, Oxford University Press and World Bank, (2003).

3. Spadaro A., “Microsimulation as a Tool for the Evaluation of Public Policies: Methods and Applications", FBBVA, Madrid, (2007).

Papers

a long list on the web

Evaluation of public policies : a general introduction

Introduction 1: the demand for for evaluation

- The rising demand for 'accountability' of policy-makers
  - Democracy: are governments holding on commitments ?
  - Benchmarking brought about by globalization
  - Efficacy of public spending: cost/benefit analysis

Demand …

- Policy (quantitative) evaluation as the main instrument of 'accountability'
  - The quantitative bias of modern societies
  - Economic rationality and marketization of societies
  - Voters' fatigue about doctrinal or political discourses:

    "what actually works and what does not work"
  - Need to know about distributional impact of policies

Demand…

- Changes in the practice of evaluation
  - Evaluation is evolving from :
    - Intuitive ex-ante justification of policies (through structural analysis or possibly through doctrinal arguments)
  - To:
    - Causal ex-post structural analysis
    - Randomized experimentation as in "hard" sciences
  - But numerous intermediate stages
- One way or another, evaluation now is at the heart of the reflection on policies

Introduction 2: the various methodological dimensions of policy evaluation

- Policy reform = Change in rules governing public supply of goods and services, including regulations of all sorts
- "Evaluation" = impact of policy reforms on various dimensions of social welfare:
  - Aggregate (GDP per capita)
  - Distributional (income level)
  - Social (characteristics other than income)
  - Environmental
  - …
- Objective: use evaluation to check adequation to initial goals and improve the policies by modifying its design or its parameters

Methodological dimensions …

- Logical equivalence between 'evaluation' of policies and 'incidence' analysis
  - Tax or public spending 'incidence' = how the various agents in the economy are affected?
- Accounting vs. behavioral evaluation
- Partial vs. General equilibrium, micro vs. macro
- Ex-ante vs. ex-post
- Average vs. Marginal effects of policy reforms (the additional € taxed or spent)
- Qualitative vs. Quantitative
- The various dimensions of distribution: vertical, horizontal (including geography)

Ex Ante Evaluation of Policy Reforms Using Microsimulation Models

Outline:

- Introduction to microsimulation
  - Construction
  - components (data, algorithm)
  - validation and calibration
  - Theoretical background of arithmetical evaluation exercises
- Introducing Behaviours (Labour Supply)
- Integrating the Macro aspects in microsimulation: CGE models
- Experiences of application of ex ante evaluation: policy and research questions :
  - *Effects on labour supply of the implementation of an in-work benefit for Spanish mothers*
  - *Redistribution and Polarization Impact of the European Redistribution Architecture: an Analysis Using Microsimulation Techniques*

1) Introduction to microsimulation

•What is the effect of income tax upon different types of families?
•What does it cost to raise the age pension by 2 Euros a week and what proportion of the aged would benefit?
•What will the structure of Israeli society look like in 20 years time?

These are the sort of questions that microsimulation models (and a little bit of imagination..) are designed to answer !

Definitions:

➢**Microsimulation models** (MSMs) allow simulating the effects of a policy on a sample of economic agents (individual, households, firms) at the *individual* level.

➢**Policy evaluation** is based on representations of the economic environment of individual agents, their budget constraints and possibly their behaviour.

➢**A policy simulation** then consists of evaluating the consequences of a change in the economic environment induced by a policy reform on a vector of indicators of the activity or welfare for each individual agent in a sample of observations.

The idea of applying micro simulation techniques to socio-economic modelling was pioneered by Guy Orcutt in the United States in the late 50's and early 60's (Orcutt, 1957; Orcutt et al., 1961). However, until relatively recently, the enormous cost of the computing resources required by such models and the lack of appropriate microdata had made their development and use for policy formation of questionable value. Only with the development of increasingly powerful computer hardware and the greater availability of individual unit record data has microsimulation modelling become a cost-effective and accessible option.

The usefulness of microsimulation techniques in the analysis of public policies has two aspects.

- First is the possibility of fully taking into account the heterogeneity of economic agents observed in micro-datasets.

- Second is the possibility of accurately evaluating the aggregate financial cost/benefit of a reform.

The comparison is thus made ex ante rather than ex post.

MicroSimula
Unité de Microsimulation et Analyses des Politiques Publiques
Microsimulation And Public Policy Analysis Unit

The desirable characteristics of a microsimulation model:

1) It must be an instrument able to characterise the **starting situation** (estimation stage) and to **simulate reforms** (simulation stage).

2) The tool must be **easy enough to be used for anyone**; even if computing languages are not a skill owned by the user. This does not mean that necessary information for knowing how everything works is not given. The interested researcher could know all the necessary steps followed to elaborate the final product

3) Indicators for **measuring the most relevant effects** of tax parameters must be incorporated (revenue magnitudes, equity and efficiency, poverty, etc., analysis).

4) The **input data** must incorporate as faithfully as possible the **real world**.

Structure of a microsimulation model:

- Dataset
- Economic Model [Rationality]
- Environment
- Redistribution system,
- Market characteristics,

A taxonomy of microsimulation models:

- arithmetical vs behavioural models
- static vs dynamic models
- partial vs general equilibrium models

Dataset:

➢representativity,
➢underreporting,
➢updating,
➢net to gross.

Algorithms:

➢flexibility vs rigidity;
➢policy vs research,

Validation: what is? How you do it.

Calibration: what is? How you do it.

Definition: **Arithmetical models** show the 'first-round' or 'morning after' effects of policy changes, before individuals have had time to adjust their behaviour to the changes

Theoretical justification of arithmetical microsimulation (1)

Define $V_i(p, y_i)$ as the indirect utility function of that household (indexed *i)*:

$$V_i(p, y_i) = U\left[x^M(p, y_i)\right] \text{ with } x^M(p, y_i) = Arg\,max\left\{U_i(x_i) \text{ s.t. } px_i \leq y_i\right\} \quad (1)$$

where y_i is household *i*'s income, p the price vector that it faces, $U_i(x)$ its direct utility function and $x^M(p, y_i)$ its vector of Marshallian demand functions.

The welfare effect of a public policy affecting marginally household *i*'s income at constant prices p is given by $\Delta V_i = V^i_y \Delta y_i$, where V^i_y is its marginal utility of income.

Inverting this expression, one may express any change in the welfare of individual *i* in an "equivalent" variation of income, Δy_i^* :

$$\Delta y_i^* = \Delta V_i / V_y^i \quad (2)$$

In other words, there is complete equivalence between the change in the welfare income metric, Δy_i^* , and the change in welfare once a value has been selected for the marginal utility of income V_y^i . But the latter is essentially unobserved and has therefore to be chosen arbitrarily on a purely normative basis.

Theoretical justification of arithmetical microsimulation (2)

Consider now a policy change that affects the price vector *p*. Differentiating the indirect utility function yields: $\Delta V_i = \sum_j V_{ij} \Delta p_j$ (3)

where V_{ij} is the derivative of the indirect utility function with respect to the price p_j.
From the envelope theorem, or Sheppard's lemma or Roy theorem, it is known that:

$$V_j = -V_y^i . x_j^M (p, y_i) \qquad (4)$$

Replacing in (3) and using the welfare income metric definition (2), the change in the price vector Δp causes a change in the welfare of individual *i* equivalent to a change in income given by:

$$\Delta y_i^* = -\sum_j x_j^i \Delta p_j \qquad (5)$$

where x_j^i is the actual consumption of good *j* by household *i*.

The preceding equation fully justifies the arithmetical microsimulation approach.
It implies that the change in the welfare income metric due to a change in price is simply equal to the change in the cost of the consumption basket due to the price change Δp .

Theoretical justification of arithmetical microsimulation (3)

This result generalizes easily to the case where the "consumption" vector *x* also includes labour supply or possibly the production of certain goods by the household itself.

In this more general case, call y_i^0 the income of household *i* that is truly exogenous—that is, income not coming from labour or from the sale of goods. The preceding argument implies that:

$$\Delta y_i^* = -\sum_j x_j^i \Delta p_j + \Delta y_i^0 \qquad (6)$$

where x_j^i is now to be interpreted as the "net" demand of good (or labour service) *j* by the household.

Then, imagine a change in the tax-benefit system that affects the price the household receives for the goods and services it sells on the market, its exogenous income y_i^0 and possibly the price of the goods that it consumes.

The preceding expression shows that the change in the welfare of agent *i* may be obtained by applying the new price system generated by the reform of the tax-benefit system to the agent's initial bundle of consumption, production and labour supply.

Theoretical justification of arithmetical microsimulation (4)

This is exactly the assumption behind the arithmetical microsimulation approach.

Since the preceding argument applies only at the margin, it can be shown moreover that the same reasoning applies when the price system is non-linear, as with tax-benefit systems in most developed countries—through instruments like progressive income taxes or means-tested benefits.

According to the foregoing argument, it is erroneous to present arithmetical *MSMs* as being based on the assumption that agents' behaviour is totally rigid.

Arithmetical *MSMs* not adequate when:

a) evaluating changes in tax revenues or benefit payments due to a reform when strong behavioural responses are expected

b) redistribution or tax-incidence analysis focuses on other criteria than individual welfare. (e.g poverty studies)

Other sources of inaccuracy of arithmetical MsM:

a) the assumption that tax changes are completely passed on to consumers' prices or net wages.

b) Tax evasion and non take-up of the benefits.

AMEDEO SPADARO

Representing (labour supply) choices subject to complex opportunity sets

- The “marginalist” approach

- The “random utility” approach

The “Marginalist” Approach

Review of the basic labour supply model

$$\max \psi(h, x)$$
$$s.t.$$
$$x \leq y + wh$$

where *h* = units of time spent on market work.

Note that here h is a “bad”, rather than a good.

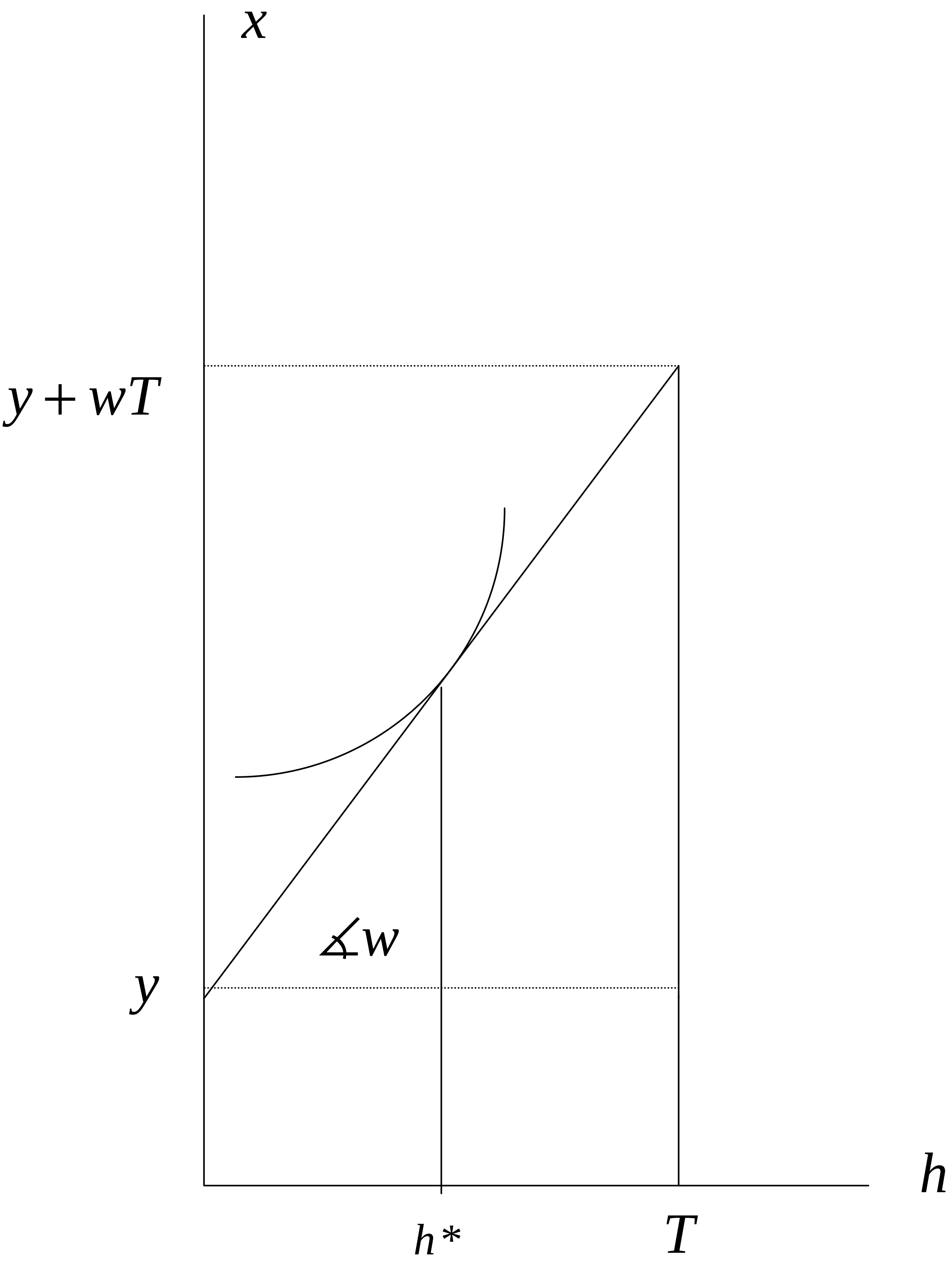
The solution will be a function of w and y:

$$h^* = h(w, y)$$

The above function is obtained from the FOCs and – at least at an interior solution – it is characterised by the equality between w and the marginal rate of substitution:

$$-\frac{\frac{\partial \psi}{\partial h}}{\frac{\partial \psi}{\partial x}} = w$$

Hence the qualification “marginalist” we attach to the procedure.



x
y + wT
∠w
y
h
h*
T

Empirical specification and estimation

Let us specify

$h_i = h(w_i, y_i; \theta) + \eta_i$ = observed labour supply of individual i

where $h()$ is a function of known variables and parameters θ to be estimated and η_i is random variable (summarising the effect of unknown variables)

It can be interpreted as obtained from the FOCs associated to the problem

$$\max \psi(h_i, x_i; \theta, \eta_i)$$
$$s.t.$$
$$x_i \leq y_i + w_i h_i$$

The optimal labour supply is determined by equating the <u>*marginal*</u> *rate of substitution* between *h* and *x* to *w*.

We will denote this procedure as the <u>*marginalist*</u> *approach*.

Let $f(\eta)$ be the assumed density of η_i
Maximum likelihood estimates of θ:
$$\theta^{ML} = \arg\max_\theta \sum_i \ln f\left(h_i - h(w_i, y_i; \theta)\right)$$

It must be noted that in the above formulation the optimal labour supply $h(w_i, y_i; \theta) + \eta_i$ is equal to the observed one h_i.

In other words, there are no “measurement” or “optimisation” errors. The random component measures the effect of variables that are known to agent i-th but not to the economist.

More generally one could allow for a random component ε_i reflecting variables that are unknown or unexpected also by the agent (measurement or optimisation error), for example one could specify:

$$h_i = h(w_i, y_i; \theta) + \eta_i + \varepsilon_i$$

For the sake of simplicity, in what follows we will maintain the assumption the observed and optimal choices coincide.

Example: the linear labour supply function

By maximising the utility function

$$\psi_i(h_i, x_i) = \left(\frac{h_i}{\beta} - \frac{\alpha}{\beta^2} \right) \exp\left\{ - \left(1 + \frac{\beta x_i - \alpha/\beta + \gamma + \eta_i}{\alpha/\beta - h_i} \right) \right\}$$

subject to the budget constraint

$$x_i = w_i h_i + y_i$$

the linear labour supply function is obtained:

$$h_i = \gamma + \alpha w_i + \beta y_i + \eta_i$$

Given a distribution for the stochastic component η_i one can proceeds as above to form the likelihood function and estimate α, β and γ.

Non-negativity constraints

In analysing labour choices it is usually important to take non-negativity constraints and corner solutions (i.e. $h^* = 0$).

$$\max \psi(h, x)$$
$$s.t.$$
$$x \le y + wh$$
$$h \ge 0$$

Trick:

Define $h(w, y)$ as the solution (the optimal labour supply) to

$$\max \psi(h, x)$$
$$s.t.$$
$$x = y + wh$$

Then you can verify that the optimal labour supply is:

$$h^* = \begin{cases} 0 \text{ if } h(w, y) \le 0 \text{ (corner solution)} \\ h(w, y) \text{ if } 0 < h(w, y) \end{cases}$$

Estimation and policy simulation with non-negativity constraints

$$h_i = \begin{cases} h(w_i, y_i; \theta) + \eta_i \ \text{ if } h(w_i, y_i; \theta) + \eta_i > 0 \\ 0 \text{ if } h(w_i, y_i; \theta) + \eta_i \leq 0 \end{cases}$$

= observed labour supply of individual i

Maximum likelihood estimates of θ: (Tobit Model)

$$\theta^{ML} = \arg\max_{\theta} \sum_{h_i > 0} \ln f\left(h_i - h(w_i, y_i; \theta)\right) + \sum_{h_i = 0} \ln F\left(-h(w_i, y_i; \theta)\right)$$

where $F(.)$ is the cumulative distribution function of η

As long as the policy leads to a different - but still linear – budget constraint, the estimated labour supply function $h(w_i, y_i; \theta)$ is what is needed.

Suppose the policy implies for individual i-th a new budget set defined by $(w_i^{'}, y_i^{'})$. Then the new (expected) labour supply will be given by $h(w_i^{'}, y_i^{'}; \theta)$.

Non-linear budget constraint.

The labour supply function $h(w, y)$ is defined with reference to a linear budget constraint: the budget constraint determined by the wage rate w and the exogenous income y.

What if the budget constraint is not linear?

The answer provided by the marginalist approach consists in treating the non-linear constraint as the intersection of many linear constraints. The idea is particularly appealing when the budget set is convex.

Non linear convex budget constraints

The example of a two-bracket progressive taxation

In this example, as long as your income does not exceed a certain amount X you don't pay taxes. For every EURO of income above *X,* the marginal tax rate is τ. The resulting budget set is convex, with a "kink" at *x* = X. This is the simplest case of a class of budget constraints referred to as *convex piecewise-linear budget constraints.* Define (assuming $X > y$):

$$w_\tau = w(1-\tau)$$
$$H = (X - y)/w$$
$$y_\tau = X - w_\tau H = y + (w - w_\tau)H$$

y_τ is the so-called "virtual income" (of the second bracket).

The budget constraint can be written as follows:

$$x = \begin{cases} y + wh & \text{if } h \le H \\ y + wH + w_\tau(h-H) & \text{if } h > H \end{cases}$$

Alternatively, note that the budget set is defined by the following two inequality constraints, which make clear that the budget set results from the intersection of two linear constraints:

$$x \le y + wh$$
$$x \le y_\tau + w_\tau h$$

It can be verified that

$$h^* = \begin{cases} 0 \text{ if } h(w\ , y\ ) \le 0 \\ h(w\ , y) \text{ if } 0 < h(w\ , y) \le H \\ H \quad \text{if } h(w\ , y\ ) > H \quad \text{and } h(w_\tau, y_\tau) \le H \\ h(w_\tau, y_\tau) \text{ if } H\ < h(w_\tau, y_\tau) \le T \\ T \text{ if } h(w_\tau, y_\tau) > T \end{cases}$$

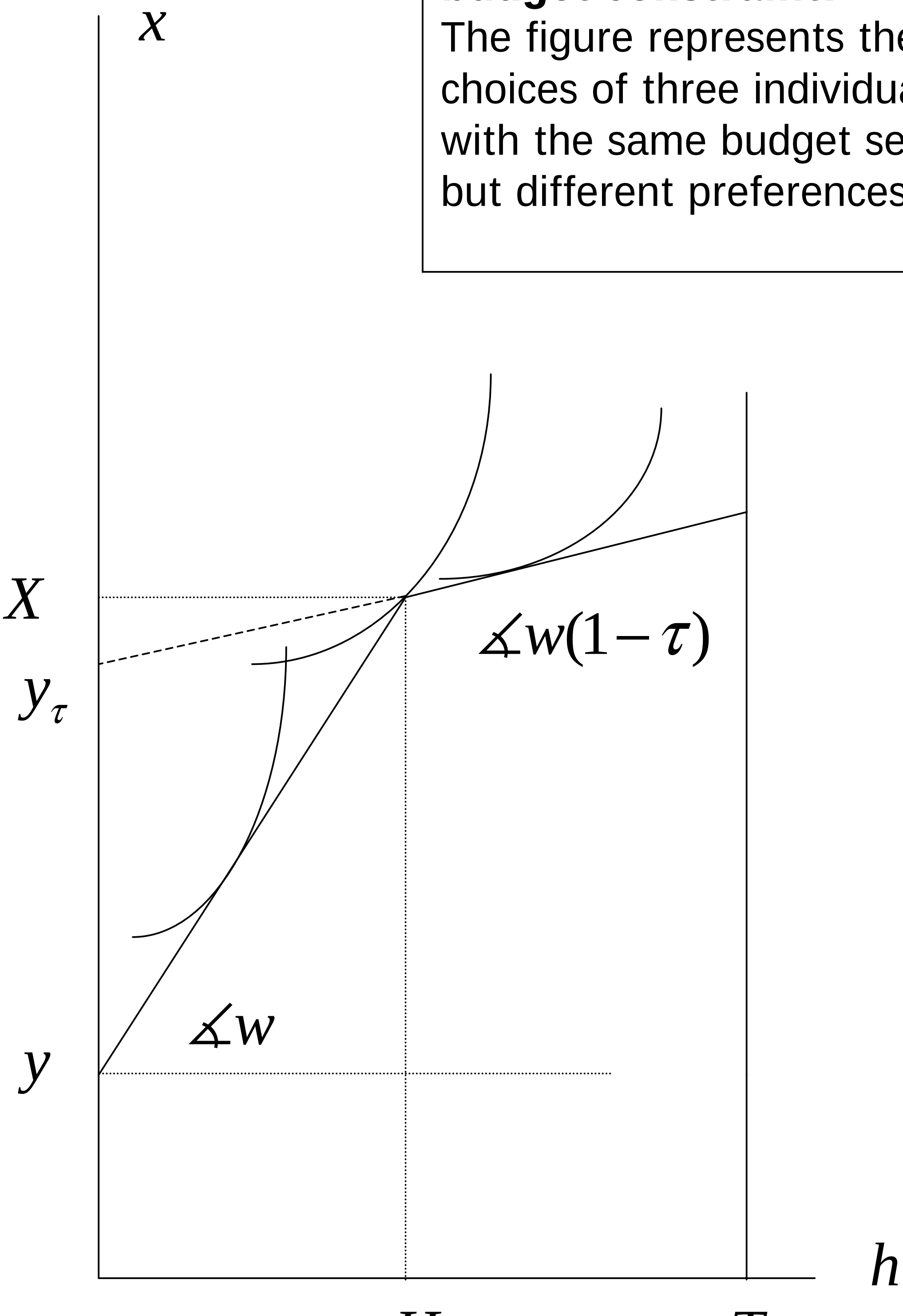
where $h(w, y)$ is the optimal labour supply for the problem

$$\max \psi(h, x)$$
$$s.t.$$
$$x = y + wh$$

and $h(w_\tau, y_\tau)$ is the optimal labour supply for the problem

$$\max \psi(h, x)$$
$$s.t.$$
$$x = y_\tau + w_\tau h$$

Piecewise-linear convex budget constraint:
The figure represents the choices of three individuals with the same budget set but different preferences



Estimation and policy simulation with piecewise-linear convex budget constraints

$$h_i = \begin{cases} 0 \text{ if } h(w_i, y_i;\theta) + \eta_i \le 0 \\ h(w_i, y_i;\theta) + \eta_i \text{ if } 0 < h(w_i, y_i;\theta_i) + \eta_i \le H_i \\ H \quad \text{if } h(w_i, y_i;\theta) + \eta_i > H_i \text{ and } h(w_{i\tau}, y_{i\tau};\theta) + \eta_i \le H_i \\ h(w_{i\tau}, y_{i\tau};\theta) + \eta_i \text{ if } H_i < h(w_{i\tau}, y_{i\tau};\theta) + \eta_i \le T \\ T \text{ if } h(w_{i\tau}, y_{i\tau};\theta) + \eta_i > T \end{cases}$$

The ML estimates are obtained as

$$\theta^{ML} = \arg\max_\theta \Big[\sum_{h_i=0} \ln F(-h(w_i, y_i;\theta))$$

$$+ \sum_{0<h_i\le H} \ln f(-h(w_i, y_i;\theta)) +$$

$$\sum_{h_i=H} \ln\big(F(H - h(w_i, y_i;\theta)) - F(H - h(w_{i\tau}, y_{i\tau};\theta))\big) +$$

$$\sum_{H<h_i\le T} \ln f\big(-h(w_{i\tau}, y_{i\tau};\theta)\big) + \sum_{h_i=T} \ln\big(1 - F(T - h(w_i, y_i;\theta))\big) \Big]$$

As long as the policy induces a budget constraint that preserves piecewise-linearity and convexity, the basic labour supply function $h(w, y;\theta)$ is still sufficient to simulate the policy.

Non convex opportunity sets

The marginalist approach can also accommodate non-convex opportunity sets, although with some complications.

To illustrate the idea, we consider here the example of the **Negative Income Tax**.

The budget constraint that defines the NIT rule can be written as follows:

$$x = \begin{cases} G \text{ if } y + wh \le G \\ \\ G + (1-\tau)(y + wh - G) \text{ if } y + wh \le G \end{cases} .$$

where G is a minimum guaranteed income level.

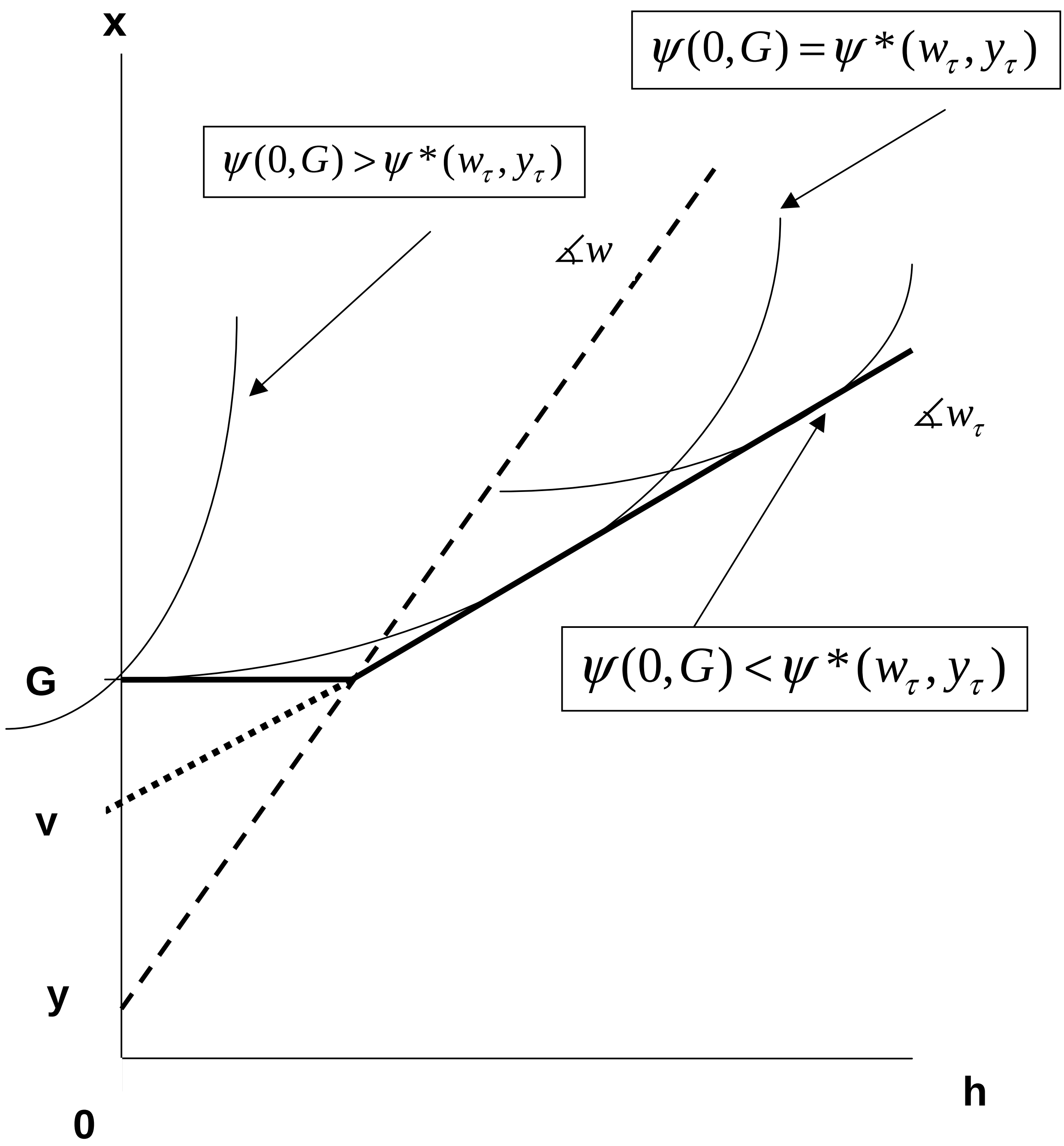
The optimal labour supply can then be defined as follows:

$$h^* = \begin{cases} 0 \;\text{ if }\; \psi(0, y) > \psi^*(w_\tau, y_\tau) \\ \\ h(w_\tau, y_\tau) \text{ if } \psi(0, y) \le \psi^*(w_\tau, y_\tau) \text{ and } h(w_\tau, y_\tau) \le T \\ \\ T \text{ if } \psi(0, y) < \psi^*(w_\tau, y_\tau) \text{ and } h(w_\tau, y_\tau) > T \end{cases}$$

where $w_\tau \equiv (1-\tau)w$, $y_\tau \equiv y + \tau(G - y)$ and $\psi^*(w_\tau, y_\tau)$ is the indirect utility function evaluated at (w_τ, y_τ).

Non-convex budget set. The NIT case

The three indifference curves belong to three different individuals (with different preferences and the same wage w rate and exogenous income y).



Estimation and policy simulation with non-convex budget constraints

As the NIT example makes clear, simulation (as well as estimation) under non-convex budget constraints involves the utility function itself.

A standard labour supply function $h(w, y; \theta)$ is not sufficient anymore

You need an explicit representation of the preferences (direct or indirect utility function or expenditure function)

The empirical specification and the estimation are more complicated and very much model-dependent. For more details you should consult Moffit (1986) and Hausman (1980).

Basic references for the *marginalist* approach

The Journal of Human Resources, Special Issue on Taxation and Labor Supply in Industrial Countries, 25, 3, 1990

Hausman J., The Effect of Wages, Taxes and Fixed Costs on Women's Labor Force Participation, *Journal of Public Economics*, 14, 1980

Hausman J., The Econometrics of Non-Linear Budget Sets, *Econometrica*, 53, 1985

Heckman J., Effects of Child-Care Programs on Women's Work Effort, *Journal of Political Economy*, 82, 2, Part II,1974

Moffit R., The Econometrics of Piecewise-Linear Budget Constraints, *Journal of Business & Economic Statistics*, 4, 3, 1986

Weaknesses of the *marginalist* approach

1. Typically the predictions of the model have a very bad fit

2. It becomes analytically messy and computationally very requiring as soon as you try to:

- Represent policies significantly more complex than the NIT example

- Model simultaneous decisions (e.g. household decisions)

- Account for discontinuities (e.g. discrete opportunity sets)

- Account for quantity constraints

The “Random Utility” approach

Think of the opportunity set of individual i as a set of “points” $(h_{1i}, x_{1i}), (h_{2i}, x_{2i}), ..., (h_{Mi}, x_{Mi})$. The discrete set might correspond to a truly discrete opportunity set or it might be an approximation of a continuous opportunity set.

x_{ij} denotes the income available if point j is chosen. It is determined by some known rule (a simple budget constraint or maybe a **very complex tax-transfer rule**).

Note that we can always write

$$h_i^* = h_{iz} \text{ if } \psi_i(h_{iz}, x_{iz}) = \max\{\psi_i(h_{i1}, x_{i1}), ..., \psi_i(h_{iM}, x_{iM})\}$$

Now let us choose the following random specification for the utility function

$$\psi_i(h_{ij}, x_{ij}) = V(h_{ij}, x_{ij}; \theta) + \varepsilon_{ij}$$

denote the utility level attained by individual i when choosing point j, where ε_{ij} is random component.

Assume that ε_{ij} is i.i.d. distributed according to (Type I Extreme Value)

$$\Pr(\varepsilon \le k) = \exp(-\exp(-k))$$

Then it turns out that the probability that individual i chooses point z is (Multinomial Logit):

$$\Pr(h_i^* = h_{iz}) = \frac{\exp(V(h_{iz}, x_{iz}; \theta))}{\sum_{j=1}^{M} \exp(V(h_{ij}, x_{ij}; \theta))}$$

- The expression above is *not affected in any way by the complexity of the rule generating* x. It is sufficient that we are able to compute x_{ij} for any point j.

- The expression is not affected by the number of arguments entering the utility function. For example h might be the vector of hours supplied by household's members. All we need is being able to specify the values of the arguments entering V at each point j.

- The expression is not affected by the complexity of the function $V()$. We can choose very general and flexible specifications without complicating the problem in any significant way.

The parameters θ can be estimated by Maximum Likelihood as

$$\theta^{ML} = \arg\max_{\theta} \sum_{i=1}^{H} \ln \left[\frac{\exp(V(h_i^*, x_i^*; \theta))}{\sum_{j=1}^{M} \exp(V(h_{ij}, x_{ij}; \theta))} \right]$$

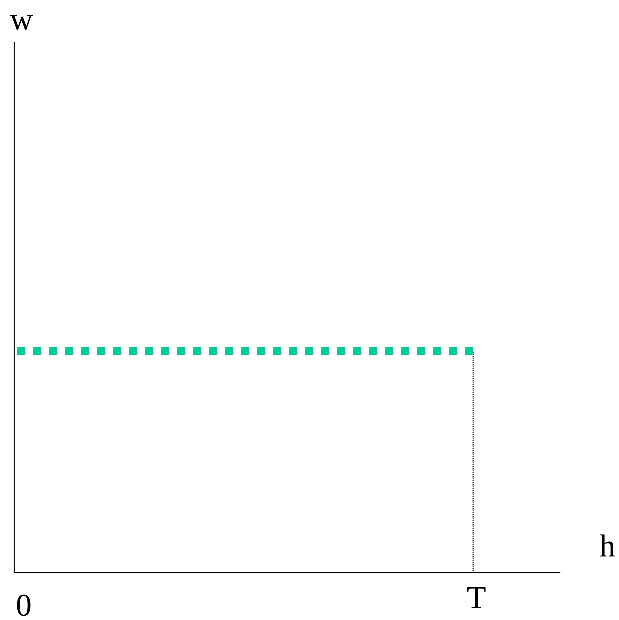
where h_i^* is the choice made by individual i and *H* is the sample size.

Among the advantages of this approach: the above log-likelihood function is usually well behaved (easy to locate the global maximum).

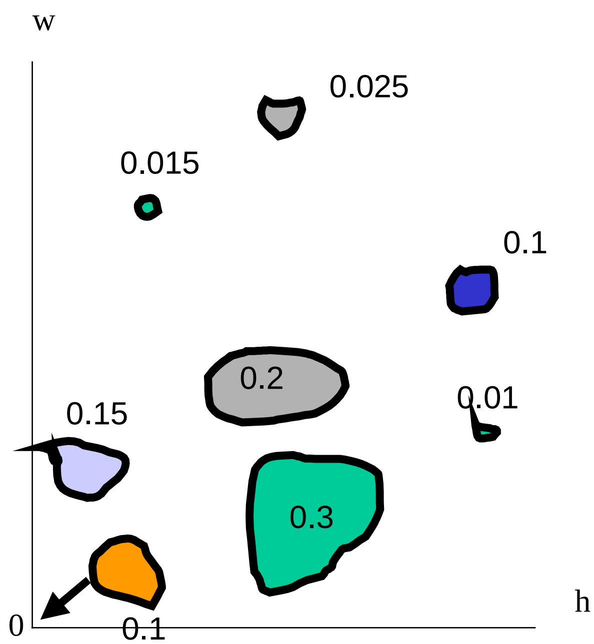
The density (opportunity density) $p(h,w)$ is the "channel" through which one can allow into the model hypotheses upon quantity constraints, unemployment and in general differential opportunities among households.

The following pictures illustrate the differences in hypothetical opportunity sets generated by the standard RUM and by the extended RUM

Opportunity set in the standard RUM of Labour Supply. Fixed wage rate, Fixed discrete values of hours to choose among



Hypothetical opportunity set in an extended RUM of labour supply (the numbers represent the density of jobs in each spot)



```
/* programa para calcular el modelo de McFadden con costes fijos */

/* borramos todos los datos y programas que pueda tener en memoria el
stata*/

clear
program drop _all

/* damos nombre al programa y determinamos la version del stata sobre la
que se hace el programa */

program define mysoest
version 6

/* definimos las variables temporales */

args todo b lnf
tempvar byy bhmhm byhm by bhm fc pi ut D ut0 ut30 ut40 ut50

/* Indicamos el número y orden de las ecuaciones y definimos los "thetas"
*/

mleval `byy'   = `b', eq(1)
mleval `bhmhm' = `b', eq(2)
mleval `byhm'  = `b', eq(3)
mleval `by'    = `b', eq(4)
mleval `bhm'   = `b', eq(5)
mleval `fc'    = `b', eq(6)

/* Definimos la función de utilidad usando los thetas anteriores */

quietly gen double `ut0'   =  `byy'*y1^2        + `bhmhm'*hm1^2 +
`byhm'*y1*hm1        + `by'*y1        + `bhm'*hm1
quietly gen double `ut30'  =  `byy'*(y2-`fc')^2 + `bhmhm'*hm2^2 +
`byhm'*(y2-`fc')*hm2 + `by'*(y2-`fc') + `bhm'*hm2
quietly gen double `ut40'  =  `byy'*(y3-`fc')^2 + `bhmhm'*hm3^2 +
`byhm'*(y3-`fc')*hm3 + `by'*(y3-`fc') + `bhm'*hm3
quietly gen double `ut50'  =  `byy'*(y4-`fc')^2 + `bhmhm'*hm4^2 +
`byhm'*(y4-`fc')*hm4 + `by'*(y4-`fc') + `bhm'*hm4


/* Calculamos la probabilidad */

quietly gen double `D'= exp(`ut0') + exp(`ut30') + exp(`ut40') +
exp(`ut50')
quietly gen double `pi' = (hrm==0)*exp(`ut0')/`D'+
(hrm==30)*exp(`ut30')/`D'+ (hrm==40)*exp(`ut40')/`D'+
(hrm==50)*exp(`ut50')/`D'

/* Calculamos la funcion de verosimilitud */

/*mlsum `lnf' = ln(abs(`pi'+0.0001))*/
mlsum `lnf' = ln(`pi')
end


/* para ejecutarlo */
```

```
use "C:\Documents and Settings\Xisco\Mis documentos\pc-uib\tesis\paper3\estimaciones\singlesnew.dta", clear
drop if wrate > 10000 | agetrab1<20
sort idm hm

/* genero la variable numero de adultos */
gen adults =  npersechp -  child

/* genero la variable choice (variable dependiente) */

rename  hrm hobsm

gen hrm = 0 if hobsm < 5
replace hrm = 30 if hobsm >= 5 & hobsm < 35
replace hrm = 40 if hobsm >= 35 & hobsm < 45
replace hrm = 50 if hobsm >= 45

gen choice = (hrm == hm)


/* genero las variables explicativas */


/* renombro y reescalo las variables para conseguir una notación más corta e intuitiva */

gen y = netincomefam/(30000*166.386)
replace hm = (24*7 - hm)/150

replace sexm = 0 if sexm == 2
label variable sexm "1 si hombre"

gen edadm = (agetrab1 - 38)/10
gen edad2m = edadm^2
gen edad3m = edadm^3/10

/* genero dummies para hijo y educación y las interacciones*/

gen dchild0 = (child==0)
gen dchild1 = (child==1)
gen dchild2 = (child==2)
gen dchild3 = (child==3)
gen dchild23 = dchild2+dchild3

gen edu1m = (edum == 1)
gen edu2m = (edum == 2)
gen edu3m = (edum == 3)

gen edume = 15 if edum==1
replace edume = 12 if edum==2
replace edume = 8 if edum==3
replace edume = edume/10

gen edadedu = edadm*edume
gen edadchild = edadm*child

/*umg singles
gen umgy =29.06148*hm+0.5065325*edadm-25.54584
```

```
count if umgy<0 & choice==1
*/
/*umg hombres
keep if sexm==1
gen umgy =-1.1401*2*y+35.433*hm+.5655284*edadm-34.029
count if umgy<0 & choice==1
*/
/*umg mujeres
keep if sexm==0
gen umgy =29.06148*hm+0.5065325*edadm-25.54584
count if umgy<0 & choice==1
*/

/* reshape */

gen ones = 1
by idm: gen j = sum(ones)
drop  netincomefam
drop  grossincomefam ssfam irpffam tme taxes1999 baseliquidable
reshape wide  y hm choice, i(idm) j(j)

/* Defino las ecuaciones del modelo y maximizamos */

ml model d0 mysoest (y2:) (hm2:) (yhm:)  (y: edadm edume child ) /*
*/ (hm: edadm edu1m edu2m ) (fc: )
set more off
ml check
/*ml init /y2=-.44 /hm2=-20  /yhm=27 /y=-28 /hm=32*/
ml search
ml maximize, difficult /*gtol(1e-4) ltol(1e-5)*/
```

References for the extensions of the basic random utility approach

Aaberge R., J. Dagsvik and S. Strøm, (1995), “Labor Supply Responses and Welfare Effects of Tax Reforms”, Scandinavian Journal of Economics, 4,.

Aaberge R., U. Colombino and S. Strøm, (2000), "Labour supply responses and welfare effects from replacing current tax rules by a flat tax: empirical evidence from Italy, Norway and Sweden, Journal of Population Economics, 13, 4, 595-621.

Dagsvik J. (1994), “Discrete and Continuous Choice, Max-stable Processes and Independence From Irrelevant Attributes”, Econometrica, 4.

Labeaga J.M., Oliver X. and A. Spadaro (2008) “Discrete Choice Models of Labour Supply, Behavioural Microsimulation and the Spanish Tax Reforms”. *Journal of Economic Inequality*, 6 (3): 247-263. (2008)

Pavot J. and A. Spadaro (2009) “Labour Supply in France, New Evidence”. Mimeo, Paris School of Economics.

Van Soest A. (1995), “Structural Models of Family Labour Supply. A Discrete Choice Approach”, *Journal of Human Resources*, 30, 63-88.

EFFECTS ON LABOUR SUPPLY OF THE IMPLEMENTATION OF AN IN-WORK BENEFIT FOR SPANISH MOTHERS

Xisco Oliver
University of the Balearic Islands

Amedeo Spadaro
Paris School of Economics and University of the Balearic Islands

SOME TRENDS…

… trend toward **active welfare state**

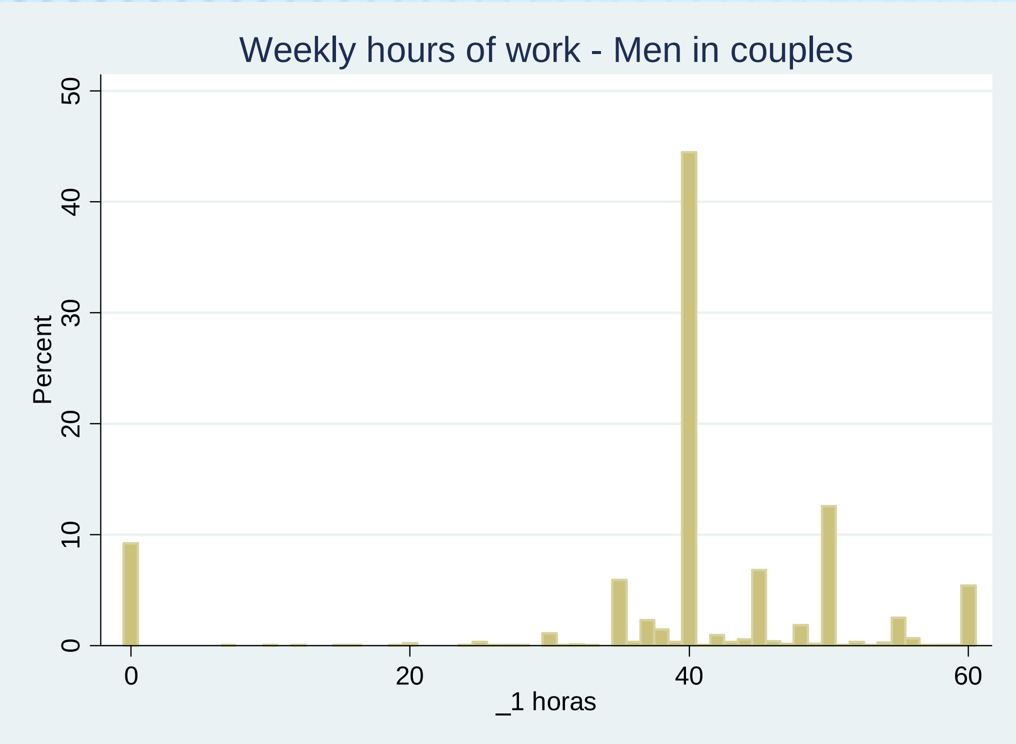
- Several **European countries** have implemented some sort of an **in-work benefits or tax credits:**
  - In **UK:** Working family tax credit (WFTC, 2000)
  - In **Belgium** (Crédit d'impôt sur les bas revenus de l'activité professionnelle, in 2001)
  - In **France:** Prime pour l'emploi or, more recently, the Revenu de Solidarité Active (RSA) replaced the RMI. RSA tries to avoid some of the labour disincentives of the previous system
  - In **Sweden** (as previously commented)
  - Etc.
- In **Spain** 2003 they introduced a very modest tax credit for working mothers

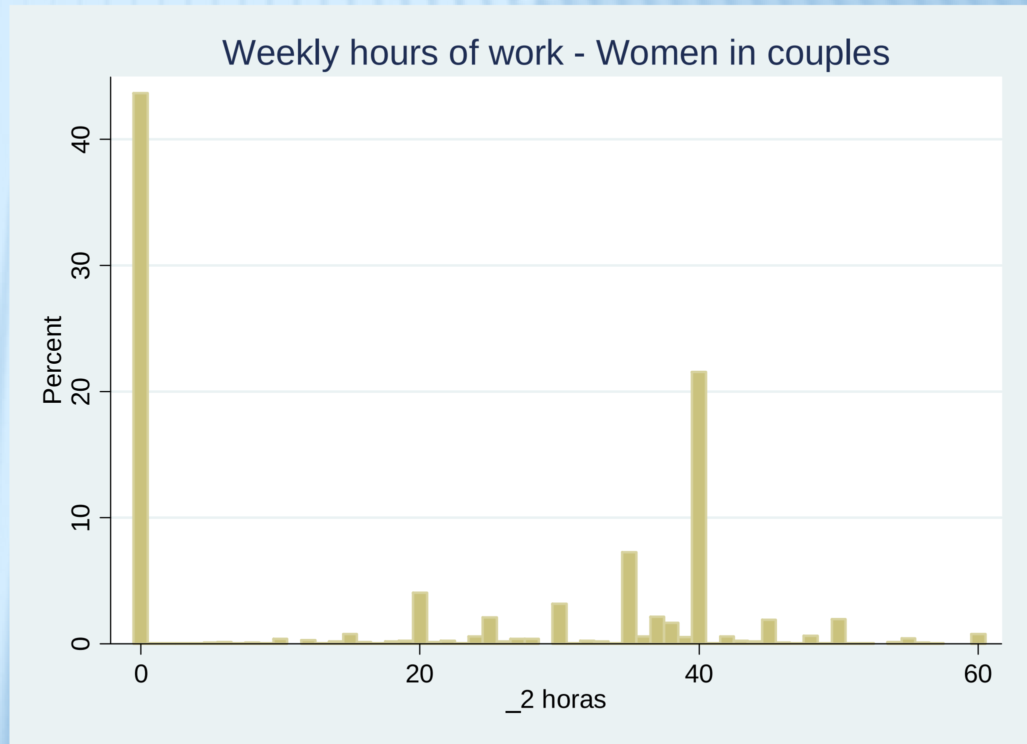
WHY IS INTERESTING AN IN-WORK BENEFIT IN SPAIN?

- In-work benefits could be especially relevant in Spain where…
  - High rate of female non-participation
    - 1995: almost 60% of the women living in couples (between 25-65 years old) are not working
    - 2006: 43%
    - It has decreased but still far from other EU countries
  - Part-time jobs are scarce in Spain (as a consequence of demand restrictions in the labour market)
  - Less generous social benefits than in other UE countries
- Consequently, it is hard to reconcile family burden and professional careers, especially in the case of mothers with young children

HOURS OF WORK

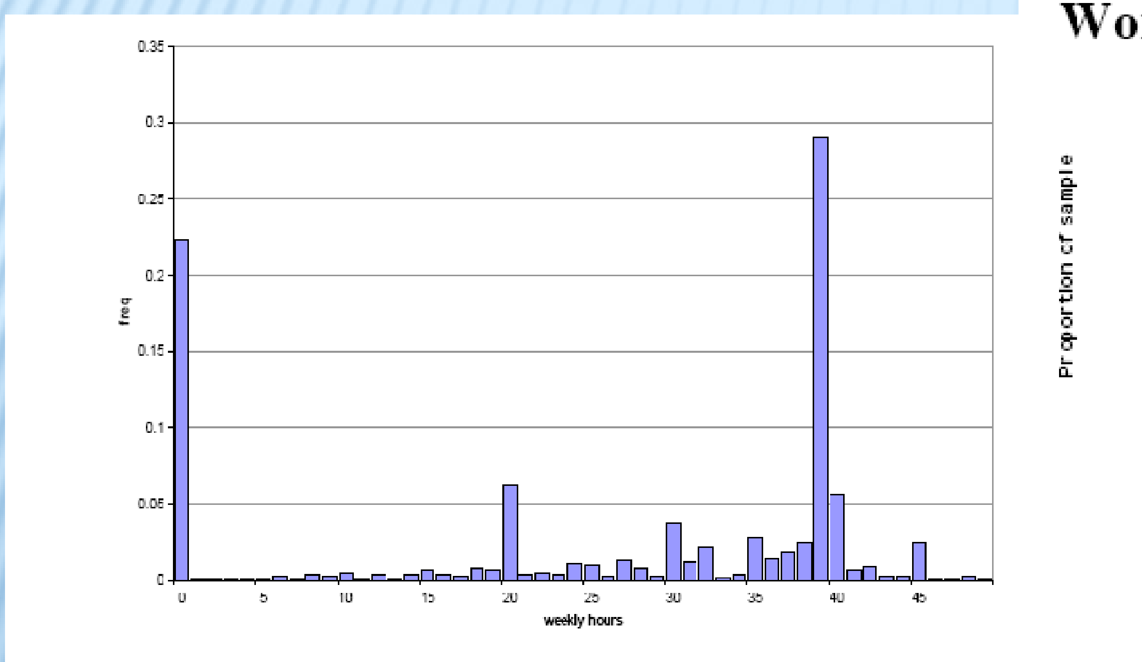
Spain





WORKING HOURS OF WOMEN LIVING IN COUPLES IN OTHER COUNTRIES

France

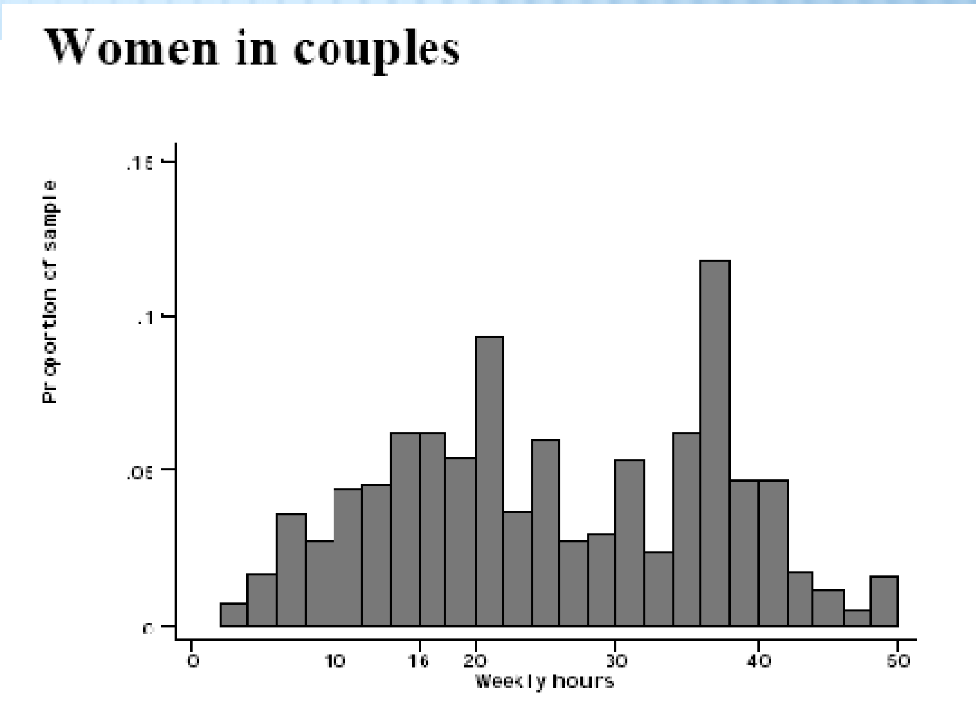


Distribution of Working Hours for Women with Employed Partners (selection)

Data from 1995

Source: Bargain (2006)

UK



Data from the early nineties

with 30% of no-participation

Source: Blundell et. al (2002)

AIM OF THE WORK

- Construct a behavioural microsimulation model to evaluate public policies *ex ante*
- Structural estimation of a discrete labour supply model
- Compute elasticities (on participation and working hours)
- Simulate the effect of a hypothetical reform of the in-work benefit

Results:

- An increase of the generosity of the system can encourage mothers to work without a big disincentive to their partners, but the cost of the reform can be high

RELATED WORK

UK

- Working family tax credit (WFTC, 2000)
  - Deeply analyzed by people from the IFS
  - Duncan & McCrae (1999) or Blundell et al. (2002)

US

- Earned Income Tax Credit (EITC)
  - Hoynes (1996)
  - Keane & Moffitt (1998)

France, Germany and Finland

- Bargain & Orsini (2006) analyze hypothetical in-work benefits in those countries using EUROMOD

In the current session:

Sweden: Aaberge & Flood (2009) - Recent reform

Italy: Figari (2009) – Hypothetical reform

Etc…

OUTLINE

1. Simulated scenarios
2. Discrete labour supply model
3. Data
4. Microsimulation model: NITSIM
5. Econometric Results
6. Policy simulations
7. Conclusions

1. SIMULATED SCENARIOS

Baseline: 2007 PIT and SS contributions

Main characteristics of the PIT:

- Capital income taxed at a flat rate (18%)
- Rest of income taxed progressively

Table 2: Tax schedule

2006		2007	
Up to	Tax rate	Up to	Tax rate
4,162	15%	17,360	24%
14,357.52	24%	32,360	28%
26,842.32	28%	52,360	37%
46,818	37%	Over 52,360	43%
Over 46,818	45%		

Table 1: Personal and family allowances

	2006	2007	Change
Personal allowance	3,400	5,050	49%
Age >65	800	900	13%
Increase for >75	+1,000	+1,100	10%
Children allowance:			
1st child	1,400	1,800	29%
2nd children	1,500	2,000	33%
3rd children	2,200	3,600	64%
4th children (or more)	2,300	4,100	78%
Increase for <3-year-old	+1,200	+1,400	17%

1. SIMULATED SCENARIOS (2)
REFORM: WORKING MOTHER TAX CREDIT

Actual

- 100 euros/month for working mothers
- Bounds:
  - Social security contributions paid by the employee
  - Having children <3 years old

Proposal

- 100 euros/month for working mothers **per children**
  - For each children below 15 years old
- Aid independent of the social contributions

2. DISCRETE LABOUR SUPPLY MODEL

- Characteristics:
  - A utility function (U) is estimated directly
  - There is a finite number of alternatives
- Procedure:
  - There are *i* households and *j* alternatives

$$Max_h \quad \mathrm{U(y, h_m, h_f, Z, \varepsilon)}$$

subject to $$y \leq w_m l_m + w_f l_f + \mu - T(l_m, l_f, w_m, w_f, \mu, Z)$$

  - It is assumed that individuals choose the alternative that maximizes their utility
  - If we assume a Weibull distribution of ε, the model is the conditional logit model (McFadden model) and it can be estimated by ML

2. DISCRETE LABOUR SUPPLY MODEL (3)
SPECIFICATION

- We use a quadratic utility function:

$$U^*(y,h_m,h_f,Z_m,Z_f,Z)=\alpha_{yy}y^2+\alpha_{h_mh_m}h_m^2+\alpha_{h_fh_f}h_f^2+\alpha_{yh_m}yh_m+$$
$$+\alpha_{yh_f}yh_f+\alpha_{h_hh_f}h_mh_f+\beta_y y+\beta_{h_m}h_m+\beta_{h_f}h_f+\varepsilon_{h_mh_f}$$

with observed heterogeneity in the betas

$$\beta_y=\beta_{y0}+\beta'_y Z$$
$$\beta_{h_m}=\beta_{h_m0}+\beta'_{h_m} Z_m$$
$$\beta_{h_f}=\beta_{h_f0}+\beta'_{h_f} Z_f$$

And fixed costs which are subtracted from the disposable income (for women who are working)

$$FC=Z_{fc}\beta_{fc}$$

3. DATA

- EU-SILC (Statistics on Income and Living Conditions)
  - We use the 2006 Spanish cross-sectional sample: more than 12000 households
  - We select couples which are between 25 and 65 years old which are potential workers: 3607 observations

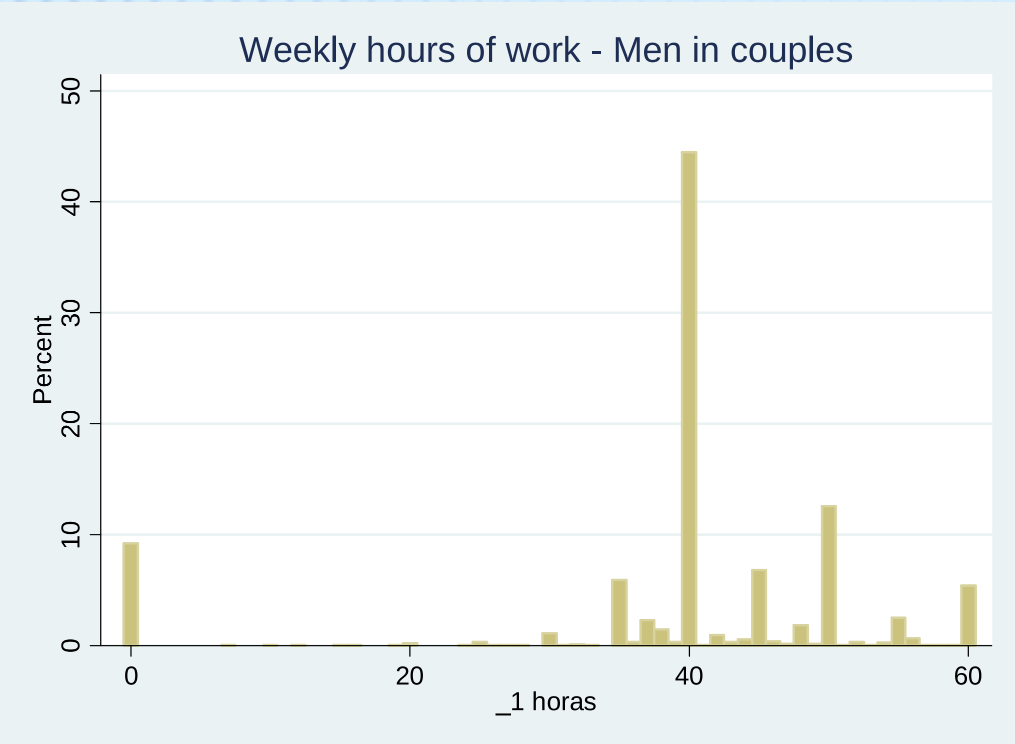
4. MICROSIMULATION MODEL

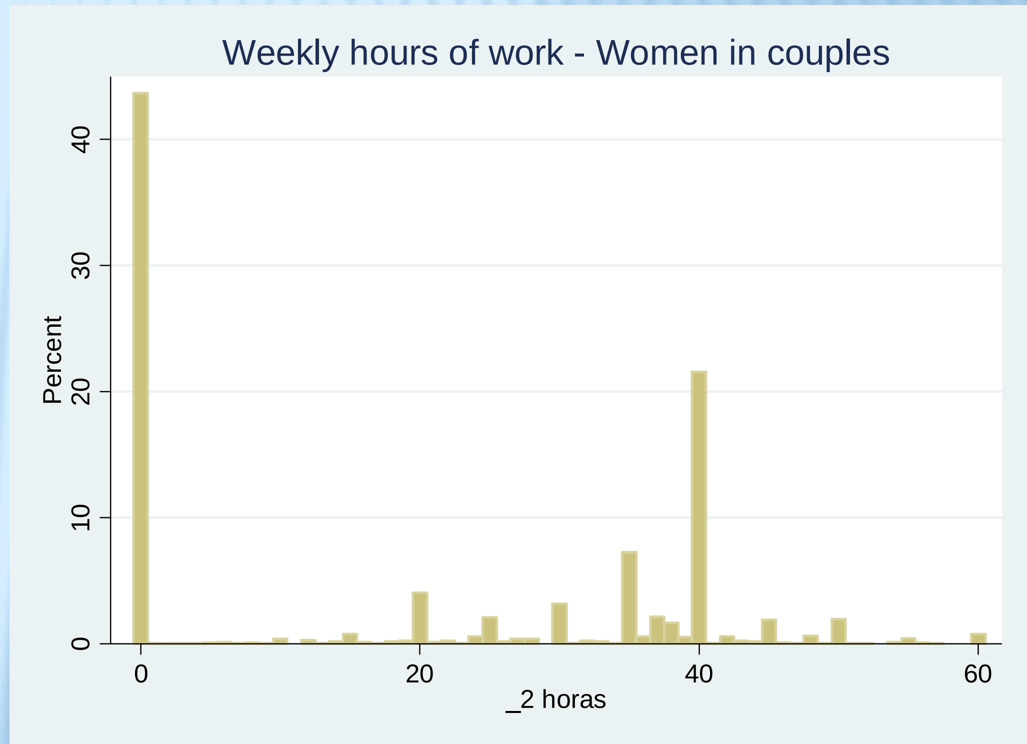
- Given a wage rate, we compute the gross income of each household under each alternative
  - Men: not-working (0 hours), full-time worker (40 hours) and working overtime (50 hours)
  - Women: not-working (0 hours), part-time worker (25 hours) and full-time worker (40 hours)

  $\Rightarrow$ 9 alternatives per household
- Wage rates are computed as:
  - Current weekly income / weekly hours of work
  - For those workers who are not actually working we predict the wage rate

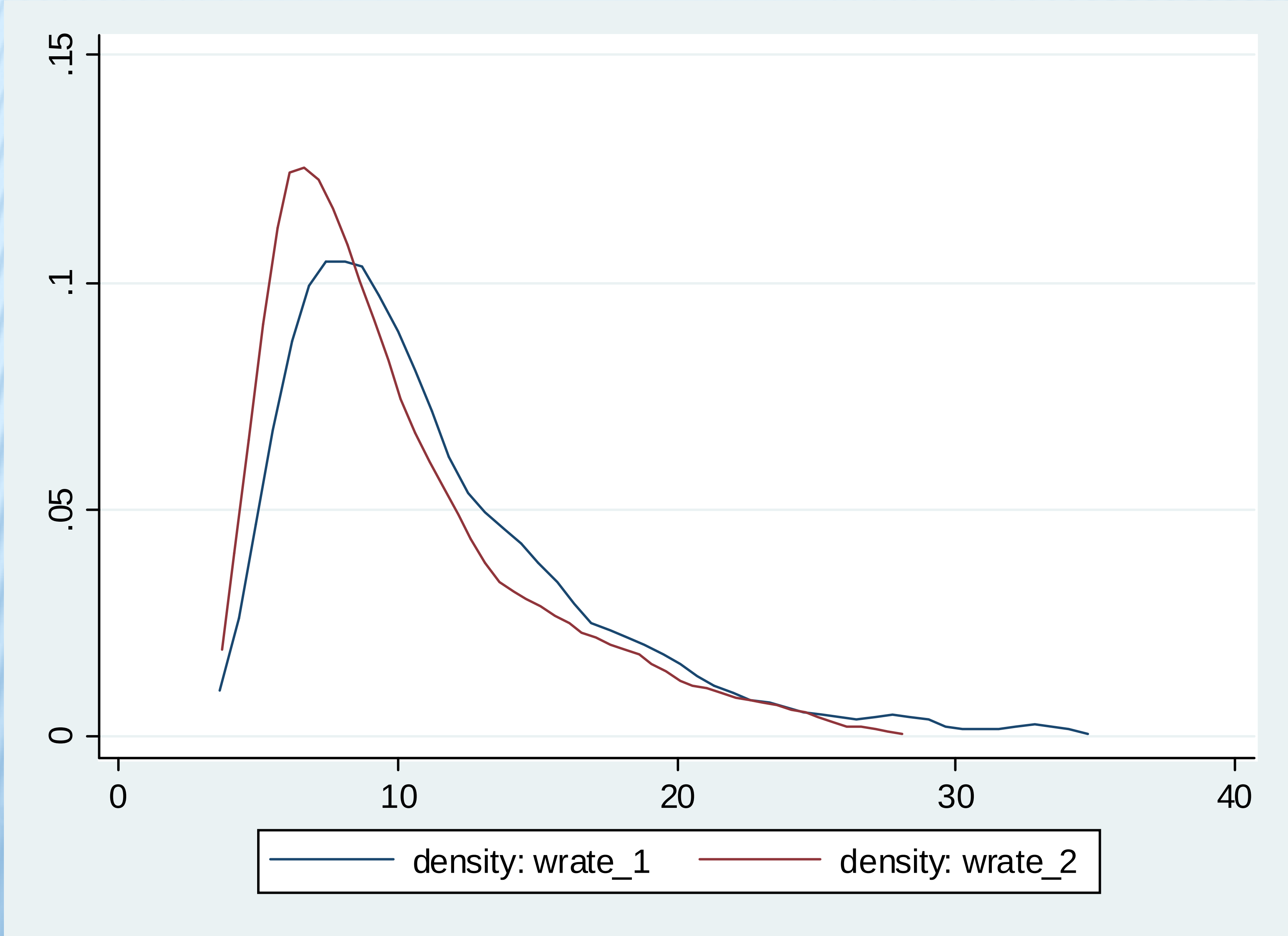
HOURS OF WORK

Spain





WAGE RATE DENSITIES (1 MEN; 2 WOMEN)



5. ECONOMETRIC RESULTS: THE UTILITY FUNCTION

Variable	Coefficient
$Income^2$	-0.317***
Hours of leisure of the $male^2$	-45.506***
Hours of leisure of the $female^2$	-82.296**
Income x Hours of leisure of the male	1.789***
Income x Hours of leisure of the female	1.027
Hours of leisure of the male x Hours of leisure of the female	-2.693
Income	2.095**
x Age of the male	0.042
x Age of the female	0.235*
x 1(Children 0-3)	-0.233
x 1(Children 3-15)	-0.391
Hours of leisure of the male	90.680***
x Age of the male	1.738***
x Age of the male square	0.838***
x 1(Children 0-3)	-0.233
x 1(Children 3-15)	-0.603***
Hours of leisure of the female	137.548**
x Age of the female	0.059
x Age of the female squared	0.924***
x 1(Children 0-3)	2.286
x 1(Children 3-15)	2.846***
Fixed costs	1.350***
x 1(big city)	-0.027
n. Children	0.104***
Number of observations	3607
Log likelihood	-6331.506

Note. The variables have been rescaled as follows:
Income = disposable income in euros/20,000;
Hours of leisure = (24x7 – weekly hours of work)/160;
Age = (age in years – 40)/10.

*parameter significant at 10%,
** parameter significant at 5%,
*** parameter significant at 1%

6. POLICY SIMULATIONS

Elasticities

Table 6: Responses in percentage points (elasticities)

	Change in	Increase in female wage rate w+1%	Increase in female wage rate w+10%	Increase in male wage rate w+1%	Increase in male wage rate w+10%
Females	**Participation**	**0.29**	**2.62**	0.01	-0.05
	Working hours	**0.56**	**5.12**	-0.03	-0.08
Males	**Participation**	-0.06	-0.60	**0.21**	**1.87**
	Working hours	-0.04	-0.44	**0.24**	**2.21**

Note: elasticities are computed using averaged simulated transitions

6. POLICY SIMULATIONS (2)

	Pre-reform	Post-reform	Change
Participation			
Male	91	90.93	-0.08%
Female	56.3	61	8.35%
Hours			
Male	3974.2	3968	-0.16%
Female	2028.2	2188.9	7.92%

Table XXX4: Transitions

Post-reform

Pre-reform	**0_0**	**0_25**	**0_40**	**40_0**	**40_25**	**40_40**	**50_0**	**50_25**	**50_40**	Total
0_0	4.55	**0.02**	**0.03**	0.00	**0.10**	**0.15**	0.00	**0.05**	**0.09**	4.99
0_25	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86
0_40	0.00	0.00	3.13	0.00	0.00	0.00	0.00	0.00	0.00	3.13
40_0	0.00	**0.06**	**0.13**	20.67	**0.52**	**0.91**	0.00	**0.32**	**0.53**	23.13
40_25	0.00	0.00	0.01	0.00	9.16	0.00	0.00	0.00	0.00	9.18
40_40	0.00	0.01	0.04	0.00	0.04	25.16	0.00	0.02	0.00	25.27
50_0	0.00	**0.05**	**0.12**	0.00	**0.40**	**0.65**	13.78	**0.21**	**0.36**	15.56
50_25	0.00	0.00	0.01	0.00	0.01	0.00	0.00	4.86	0.00	4.88
50_40	0.00	0.01	0.03	0.00	0.04	0.03	0.00	0.01	12.86	12.98
Total	4.55	1.02	3.5	20.67	10.26	26.92	13.78	5.46	13.84	100

6. POLICY SIMULATIONS (3)

Table XXX5: Cost and efficiency of the reform

	Pre-reform	Post-reform			
		without response	Change	with response	Change
Cost					
Income Tax	10,735,174	8,720,028	-18.77%	8,493,745	**-20.88%**
In-work mother benefit	321,254	2,336,400	627.27%	2,739,240	**752.67%**
Social security contributions	7,493,555	7,493,555	0.00%	7,597,341	**1.39%**
Tax collection	18,228,729	16,213,583	-11.05%	16,091,086	**-11.73%**
Efficiency					
Gross Income (in millions)	109.62618	109.62618	0.00%	111.00834	**1.26%**

Note: Data of the simulated couples in annual euros.

7. CONCLUSIONS

- We construct a behavioural microsimulation model for the Spanish population
- We estimate a discrete model of labour supply for the couples
- We analyze the effect of an in-work benefit. More precisely, we relax the bounds of the existing working mother tax credit (ages of the children and maximum amount)
- In-work benefits can increase female labour supply, but the reform we simulate has a high cost in terms of tax collection

REDISTRIBUTION AND POLARIZATION IMPACT OF THE EUROPEAN REDISTRIBUTION ARCHITECTURE: AN ANALYSIS USING MICROSIMULATION TECHNIQUES

Amedeo Spadaro
Paris School of Economics
and
Universitat de les Illes Balears, Palma de Mallorca

Xisco Oliver
Universitat de les Illes Balears, Palma de Mallorca

Luca Piccoli
Paris School of Economics

Introduction

Recent trends in economic and socio-demographic variables determined the rise of new demands of social protections that the actual Spanish model is unable to fully cover. For that reason, in the last years, the political and economic debate has been characterized by several proposals pushing for the reform of the Spanish welfare state.

- Spain belongs to what has been called "the Southern European (or Mediterranean)" welfare state regime (Esping Andersen 1990, 1999, Ferrera, 1996).
- Some reform proposals look toward a system more market oriented. Their reference model is the liberal type of welfare capitalism, which embodies individualism and the primacy of the market (for example, the UK system).
- There are also supporters of the Continental Europe Bismarkian social protection models. They push for the adoption of the so-called world of conservative corporatist welfare states, which is typified by a moderate level of decommodification (for example, the French system).
- Finally there are proposals of reforms in the spirit of the universalism observed in the Northern European countries: the so-called social-democratic world of welfare capitalism (for example, the Danish system).

	Social democracy	Corporativist	Liberal	Southern-European
Degree of decommodification	**Strong**	**Medium**	**Weak**	**Weak**
Ideological reference point	Universalism	Familiarism	Individual responsibility	Familiarism
Representative Countries	Denmark	Finland, Germany, France	UK	Spain, Italy

Whatever reform is implemented, it is important to have a clear picture of the impact it may cause on the economy.

In what follow we try to offer some elements of evidence of these effects. We will analyse the impact upon efficiency, income distribution and polarization of the replacement of the actual Spanish redistribution system with several European schemes (one for each “model”). In particular we simulate schemes similar to the ones enforced in France, UK and Denmark (corporatist, liberal and social-democratic respectively).

The efficiency, inequality and polarization analysis will be performed using behavioural microsimulation techniques.

The two main aims of the contribution are:

1) to offer some elements of clarification of the debate regarding the reforms of the welfare state in Spain by perform comparatives with other European welfare state regimes and

2) to show the potential of behavioural microsimulation models as powerful tools for the ex ante evaluation of public policies and their distributional and polarization impacts.

Definitions (Bourguignon and Spadaro, JoEI 2006):

•Microsimulation models allow simulating the effects of a policy on a sample of economic agents (individual, households, firms) at the individual level.

•Policy evaluation is based on representations of the economic environment of individual agents, their budget constraints and possibly their behavior.

•A policy simulation then consists of evaluating the consequences of a change in the economic environment induced by a policy reform on a vector of indicators of the activity or welfare for each individual agent in a sample of observations.

GladHispania is a microsimulation model of the Spanish Tax-Benefit system

- It is a:
  - Static
  - Partial equilibrium
  - With behavior
- It focuses on direct taxation (PIT and SS)
- It allows to simulate any change in those figures
- It uses the Spanish ECHP as a database

Simulated scenarios: The baseline is the 1999 Spanish tax-benefit system.

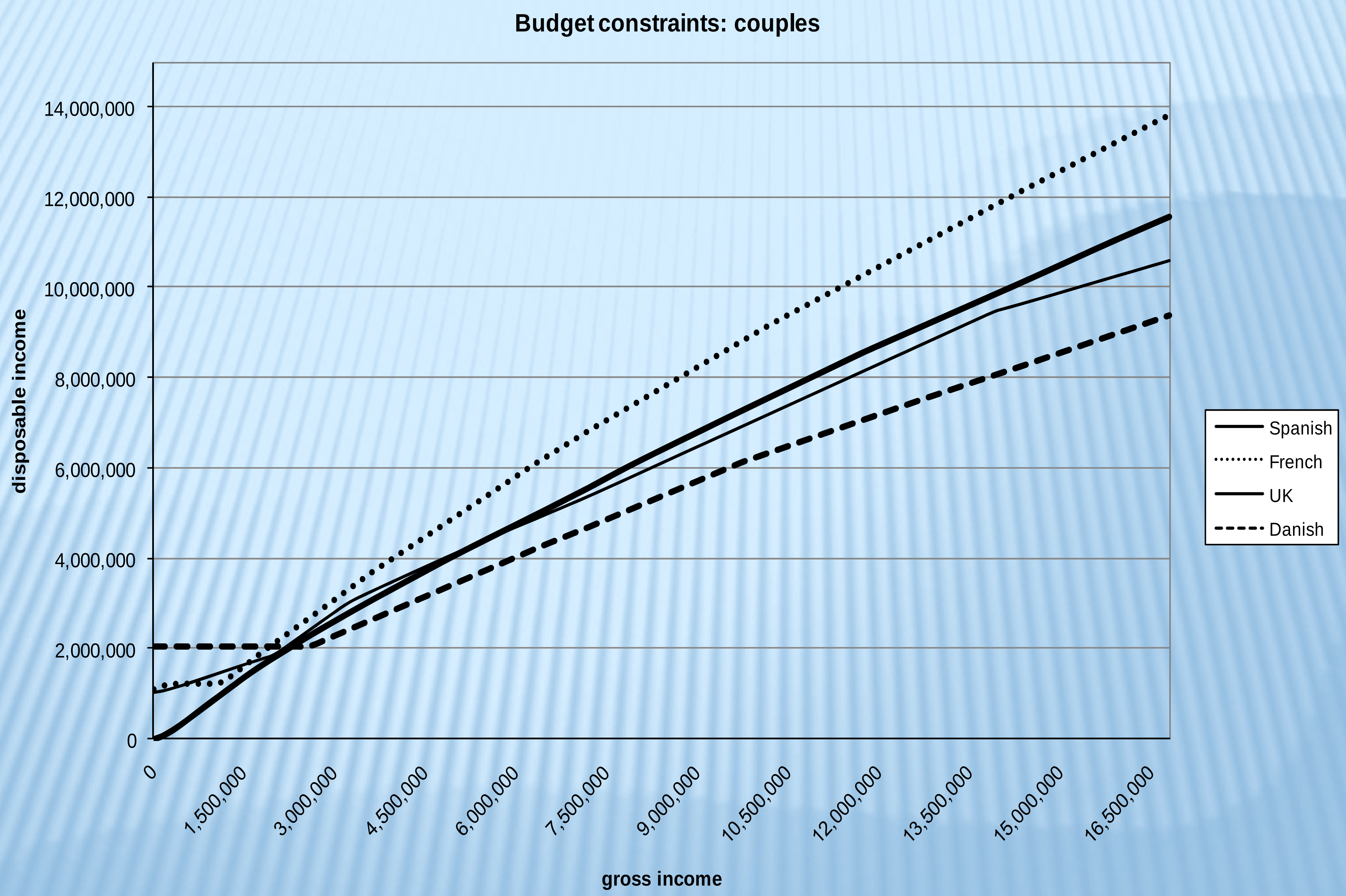
In order to simulate a system with the UK characteristics, we have simulated the following instruments: the income tax, the child benefit, the working families' tax credit and the income support.

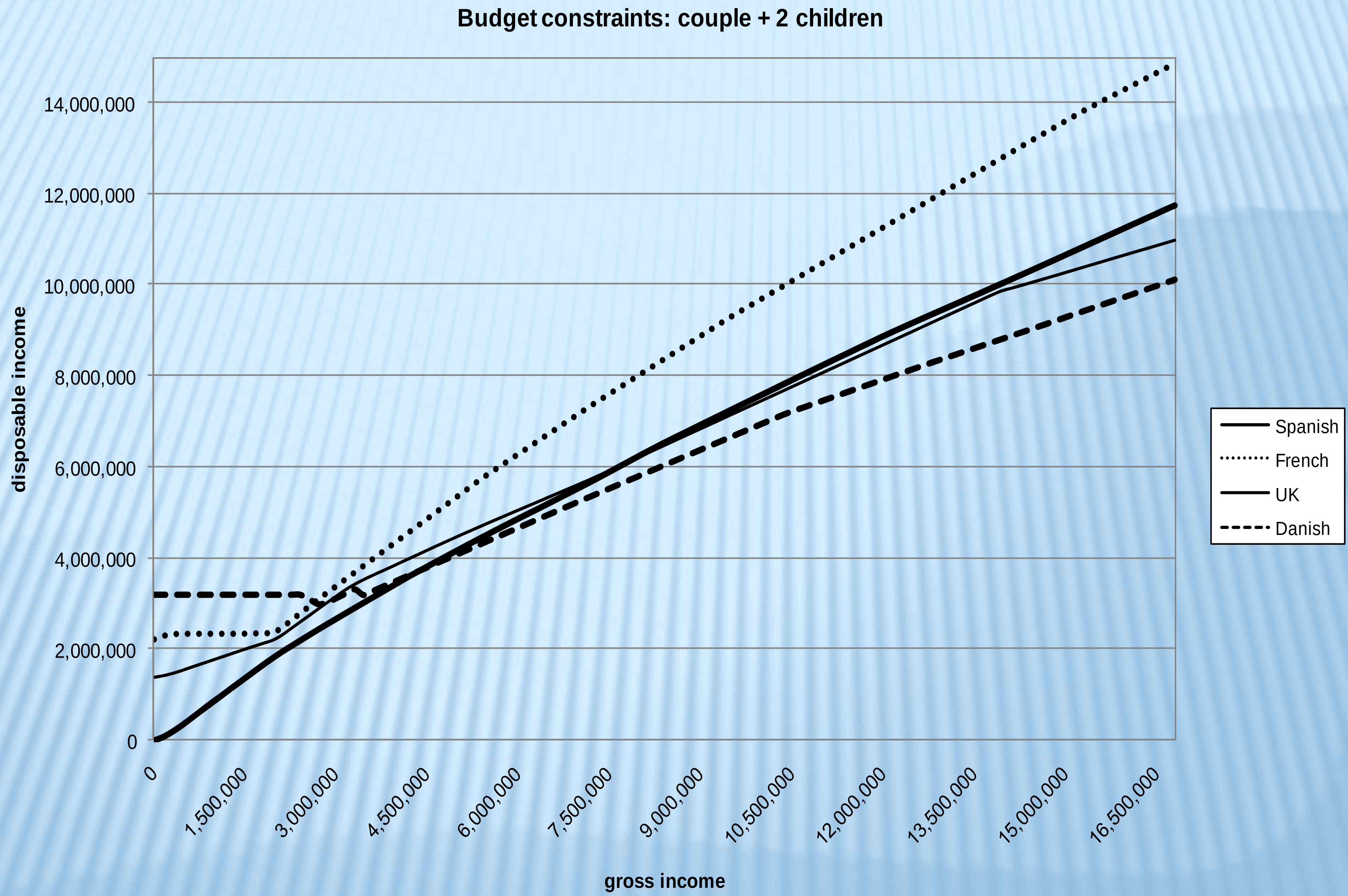
The French redistribution instruments that we model are: the "allocations familiales" , the "Revenue Minimum d'Insertion" , and the income tax.

The simulated social-democratic scenario is a simplification of the Danish one. In particular we model family allowances, social assistance and personal income taxation.

Spanish system[1]		UK system		French system[2]		Danish system	
up to	Tax rate	up to	Tax rate	up to	Tax rate	allowance	Tax rate
3,606	18.0%	2,956	10%	3,947	0.0%	4,481	6.25%
12,621	24.0%	48,284	22%	7,764	10.5%	23,867	6.00%
24,642	28.3%	over 48,284	40%	13,667	24.0%	37,148	15.00%
39,666	37.2%			22,129	33.0%		
66,111	45.0%			36,007	43.0%	4,481	31.75%[3]
over 66,111	48.0%			44,404	48.0%		
				over 44,404	54.0%		

Notes: (1) PIT tax rates schedules in 1999 are the same in 2001 (2) The tax schedule for France refers to the 1998 system. (3) In Denmark there is an important local tax that varies across regions. We have taken an average tax rate of 31.75%, which respect the total maximum marginal tax of 59%.


Budget constraints: couples
disposable income
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
0
1,500,000
3,000,000
4,500,000
6,000,000
7,500,000
9,000,000
10,500,000
12,000,000
13,500,000
15,000,000
16,500,000
gross income
Spanish
French
UK
Danish



Budget constraints: couple + 2 children
disposable income
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
0
1,500,000
3,000,000
4,500,000
6,000,000
7,500,000
9,000,000
10,500,000
12,000,000
13,500,000
15,000,000
16,500,000
gross income
Spanish
French
UK
Danish

Figure 2a: Singles

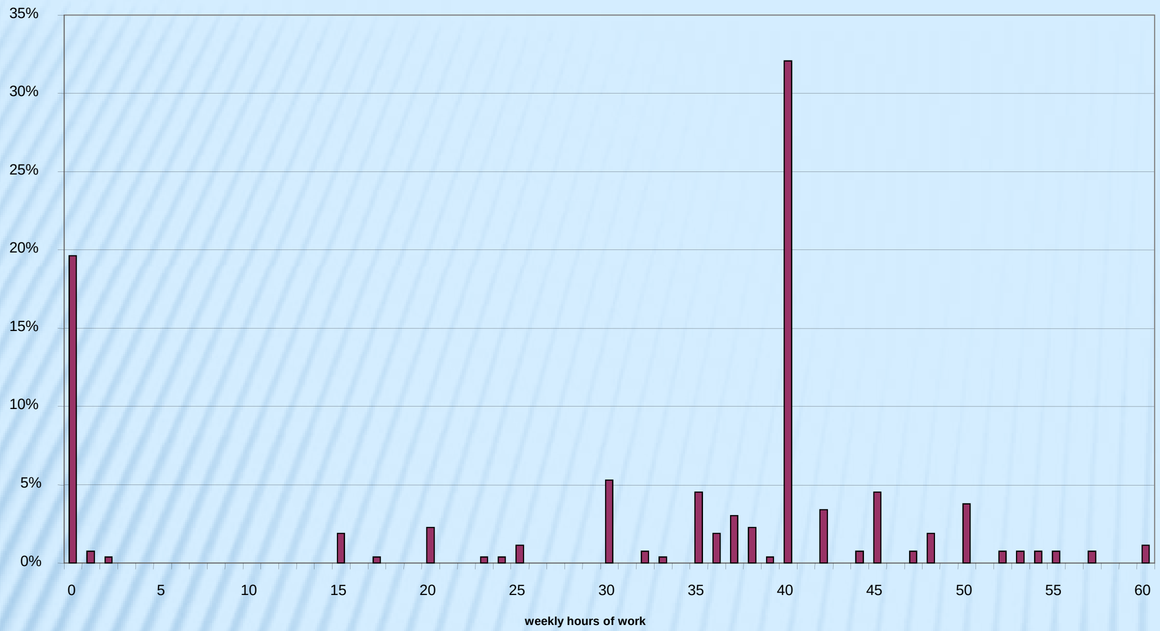


Figure 2b: Couples - Spouse

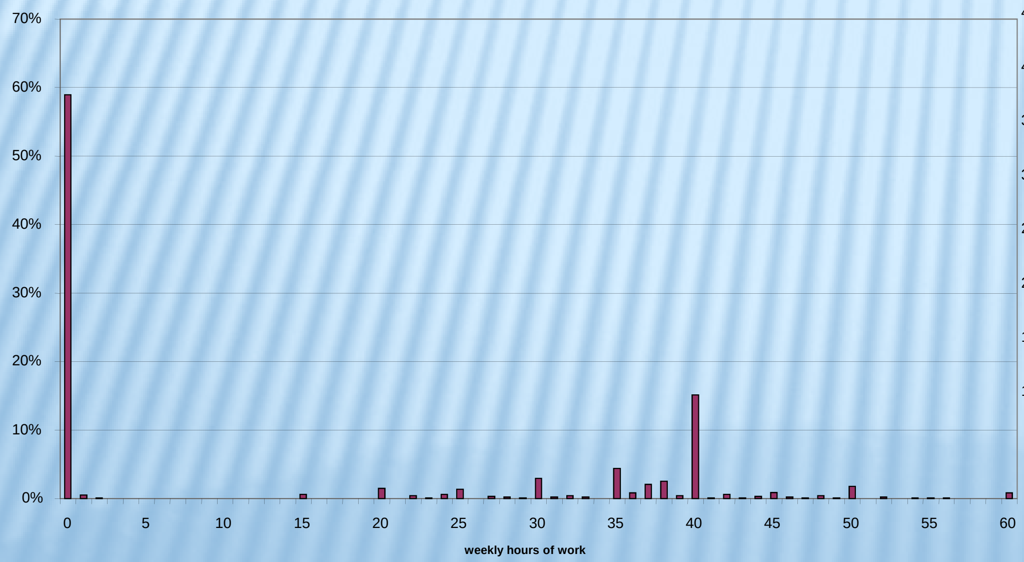
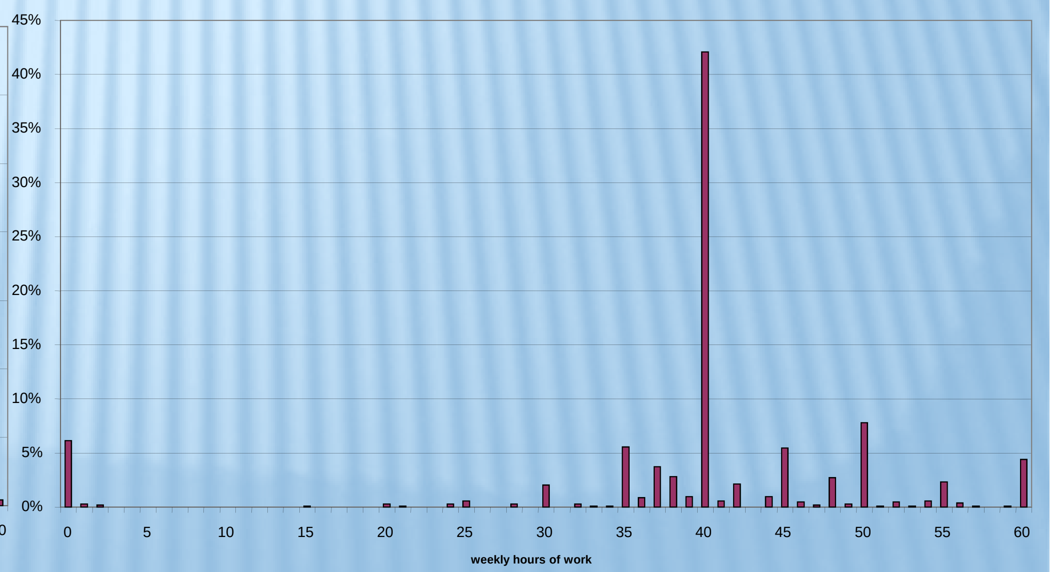


Figure 2b: Couples – Household head



MODEL SPECIFICATION AND ESTIMATION: AABERGE ET AL. (1995) AND VAN SOEST (1995).

- Characteristics:
  - An utility function is estimated directly
  - There are a finite number of alternatives (K)

    $h_j = \{h_1, h_2, \ldots, h_K\}$
- Procedure:
  - There are *i* individuals and *j* alternatives
- We adopt the flexible quadratic utility function (as in Keane and Moffit, 1998, and Blundell *et al.*, 2000):

$$U^*(y, h, Z) = \alpha_{yy}\, y^2 + \alpha_{hh}\, h^2 + \alpha_{yh}\, yh + \beta_y(Z)\, y + \beta_h\, (Z)\, h + \varepsilon_{hi}$$

for the singles subsample, and

$$U^*(y, h_h, h_c, Z_h, Z_c, Z) = \alpha_{yy} y^2 + \alpha_{h_h h_h} h_h^2 + \alpha_{h_c h_c} h_c^2 + \alpha_{yh_h} y h_h + \alpha_{yh_c} y h_c + \alpha_{h_h h_c} h_h h_c + \beta_y y + $$
$$+ \beta_{h_h} h_h + \beta_{h_c} h_c + \varepsilon_{h_h h_c}$$

for couples.

  - *y = disposable income – fixed costs*
  - It is assumed that individuals choose the alternative that maximizes his utility

MODEL SPECIFICATION AND ESTIMATION: LOG-LIKELIHOOD

- We assume that ε follows a Weibull distribution

$$P_{ik} = \Pr(V_{ik} \geq V_{ij}, \forall j = 1,\ldots, J) = \frac{\exp\left[U(y_{ik,} L_k, X_i; v_k)\right]}{\sum_{i=1}^{J} \exp\left[U(y_{ij,} L_j, X_i; v_j)\right]}$$

- The log-likelihood function:

$$\ln L = \sum_{i=1}^{N} \sum_{j=1}^{J} d_j \ln(P_{ij})$$

- This is the McFadden or conditional logit model

SINGLES ESTIMATION

Variable	Coefficient	Standard error
$Income^2$	-0.41	0.50
Hours of $leisure^2$	-236.95	32.44
Income x Hours of leisure	29.06	5.81
Income	-25.54	6.77
x Age	0.50	0.25
x Education	0.04	0.84
x Children	0.19	0.16
Hours of leisure	458.94	65.24
x Age	-0.49	1.53
x Educ1	-4.19	3.93
x Educ2	0.39	2.89
Fixed costs	2.40	0.50
Number of observations	259	
Log likelihood	-273.84	

COUPLES ESTIMATION

Variable	Coefficient	Standard Error
$Income^2$	-0.71	0.16
Hours of leisure of the household's $head^2$	-83.69	6.30
Hours of leisure of the $spouse^2$	91.98	8.01
Income x Hours of leisure of the household's head	-2.74	1.51
Income x Hours of leisure of the spouse	-1.69	1.01
Hours of leisure of the household's head x Hours of leisure of the spouse	-44.8	7.98
Income	8.20	2.37
x Age of the household's head	-0.60	0.48
x Age of the spouse	1.54	0.55
x Age of the spouse ^{2}	-0.63	0.19
Hours of leisure of the household's head	197.53	17.25
x Education of the household's head	-5.68	1.81
x Age of the household's head	2.19	0.67
Hours of leisure of the spouse	-117.38	17.65
x Education of the spouse	-11.1	1.20
x Age of the spouse	2.02	0.61
x 1(one dependent child)	2.82	0.95
x 1(two or more dependent children)	5.05	0.90
Fixed costs	-0.35	0.26
Number of observations	1024	
Log likelihood	-1553.81	

Results: Efficiency

		Spanish system									
Combination of working hours (household head_spouse)		0_0	0_25	0_40	40_0	40_25	40_40	50_0	50_25	50_40	total
Danish system	0_0	0.62	0.00	0.00	0.10	0.00	0.10	0.31	0.00	0.00	1.14
	0_25	0.00	0.10	0.00	0.21	0.00	0.00	0.00	0.00	0.10	0.41
	0_40	0.10	0.00	3.52	0.31	0.31	0.41	0.10	0.10	0.00	4.86
	40_0	0.00	0.00	0.00	36.71	0.00	0.10	0.21	0.10	0.10	37.23
	40_25	0.00	0.00	0.00	0.00	6.72	0.00	0.00	0.00	0.10	6.83
	40_40	0.00	0.00	0.10	0.00	0.00	17.37	0.10	0.00	0.00	17.58
	50_0	0.00	0.00	0.00	0.00	0.00	0.00	22.23	0.00	0.00	22.23
	50_25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.28	0.00	2.28
	50_40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.45	7.45
	total	0.72	0.10	3.62	37.33	7.03	17.99	22.96	2.48	7.76	100.00

		Spanish system									
Combination of working hours (household head_spouse)		0_0	0_25	0_40	40_0	40_25	40_40	50_0	50_25	50_40	total
French system	0_0	0.72	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.83
	0_25	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
	0_40	0.00	0.00	3.62	0.10	0.00	0.00	0.00	0.00	0.00	3.72
	40_0	0.00	0.00	0.00	36.40	0.00	0.00	0.00	0.10	0.00	36.50
	40_25	0.00	0.00	0.00	0.00	6.83	0.00	0.10	0.00	0.00	6.93
	40_40	0.00	0.00	0.00	0.00	0.00	17.79	0.10	0.00	0.00	17.89
	50_0	0.00	0.00	0.00	0.83	0.00	0.10	22.75	0.00	0.00	23.68
	50_25	0.00	0.00	0.00	0.00	0.10	0.00	0.00	2.38	0.00	2.48
	50_40	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	7.76	7.86
	total	0.72	0.10	3.62	37.33	7.03	17.99	22.96	2.48	7.76	100.00

		Spanish system									
Combination of working hours (household head_spouse)		0_0	0_25	0_40	40_0	40_25	40_40	50_0	50_25	50_40	total
UK system	0_0	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72
	0_25	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
	0_40	0.00	0.00	3.62	0.21	0.00	0.10	0.00	0.00	0.00	3.93
	40_0	0.00	0.00	0.00	37.13	0.00	0.00	0.31	0.10	0.10	37.64
	40_25	0.00	0.00	0.00	0.00	7.03	0.00	0.00	0.00	0.10	7.14
	40_40	0.00	0.00	0.00	0.00	0.00	17.89	0.00	0.00	0.00	17.89
	50_0	0.00	0.00	0.00	0.00	0.00	0.00	22.65	0.00	0.00	22.65
	50_25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.38	0.00	2.38
	50_40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.55	7.55
	total	0.72	0.10	3.62	37.33	7.03	17.99	22.96	2.48	7.76	100.00

RESULTS: EFFICIENCY

With such evidence, two points should be stressed:

1. the majority of households are on the diagonal, which implies that they do not alter their labour supply;
2. the higher the marginal tax rate, the greater are the labour supply effects.

It is also interesting to look at changes in labour supply behaviour of spouses. It must be noted that, in around 95% of the sample, they are women. It is clear that female labour supply and participation is stimulated under the Danish system. 0.53% of women increase their labour supply after the reform (Danish system) against 0.1% under the French system and -0.11% under the UK system.

The measure of polarization

According the axiomatic discussion in Duclos, Esteban and Ray (2004) the functional form of $T(i, a)$ is chosen such that

$$P_\alpha(f) \equiv \iint f(x)^{1+\alpha} f(y)|x-y|dydx,$$

where α is arbitrary chosen such that $\alpha \in [.25,1]$.[6]

Finally, considering any distribution function F with associated density f and mean μ, the polarization index can be written as

$$P_\alpha(F) = \int_y f(y)^\alpha a(y) dF(y),$$

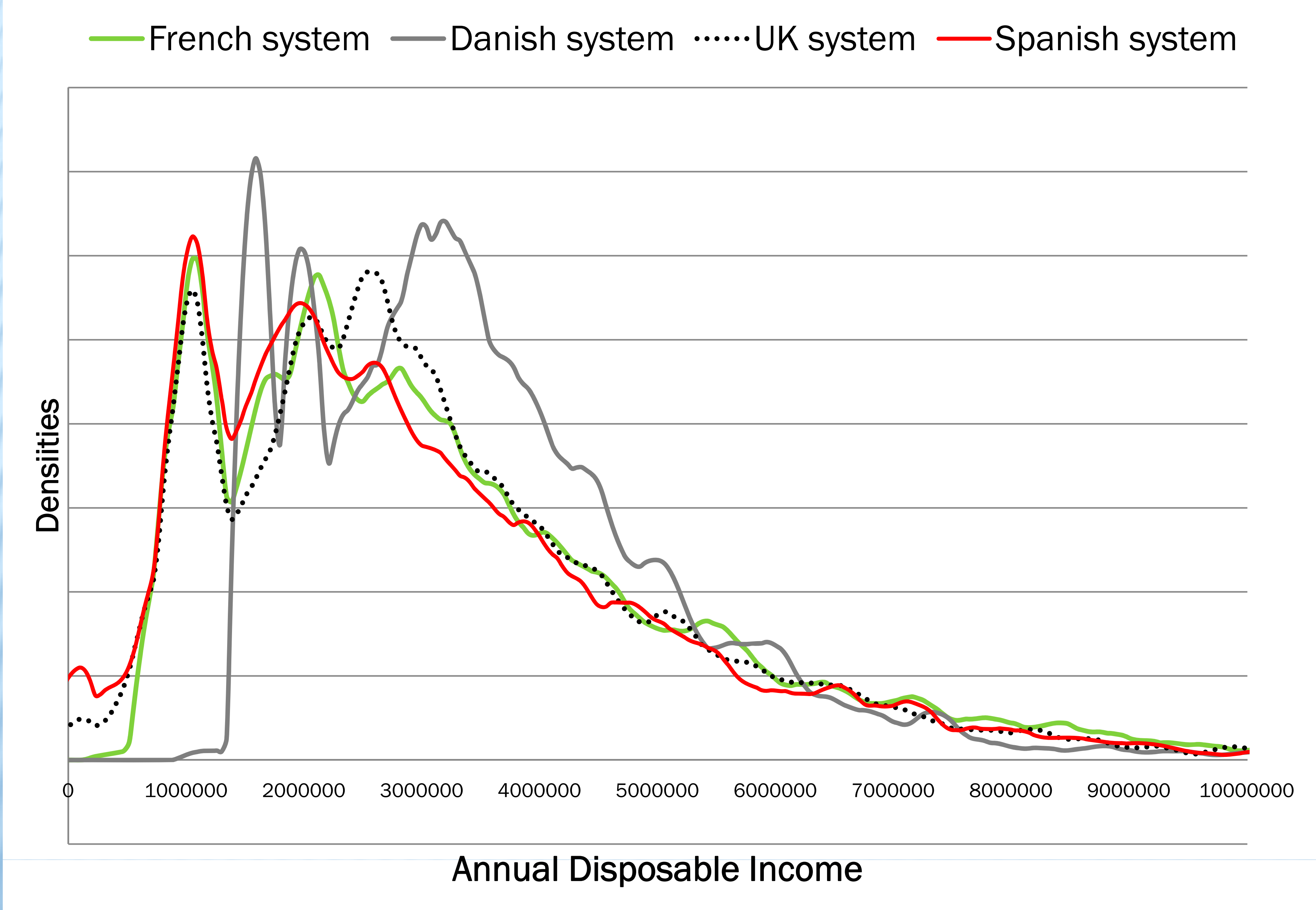
with $a(y) = \mu + y(2F(y) - 1) - 2\int_{-\infty}^{y} x dF(x)$.

An individual located at x in the distribution of the characteristic feels alienation with respect to another individual located at y according to their distance $|x - y|$ and identifies with the group depending on the density at x, $f(x)$.

A hybrid measure of polarization in which both identification and alienation may depend on income and other characteristics is

$$P^*(\boldsymbol{F}) = \sum_{j=1}^{M} \sum_{k \neq j} \iint_{x\,y} f_j(x)^\alpha |x-y| dF_j(x) dF_j(y).$$

Results: Inequality and Polarization



Results: Inequality and Polarization

Table 8. Inequality and Polarization indexes					
	Gini	alpha = 0.25	alpha = 0.5	alpha = 0.75	alpha = 1
Spanish system	0.3604 (0.0053)	0.2735 (0.0031)	0.2206 (0.0022)	0.1845 (0.0018)	0.1577 (0.0018)
UK system	0.3084 (0.0037)	0.2463 (0.0024)	0.2086 (0.0018)	0.1831 (0.0016)	0.1644 (0.0017)
French system	0.3373 (0.0044)	0.2631 (0.0027)	0.2172 (0.0020)	0.1854 (0.0017)	0.1616 (0.0016)
Danish system	0.2230 (0.0040)	0.1982 (0.0027)	0.1901 (0.0024)	0.1909 (0.0027)	0.1975 (0.0034)

Table 11. Polarization by age class					
		Spanish system	Danish system	French system	UK system
Gini	Less than 35	0.3291 (0.0132)	0.1811 (0.0094)	0.2731 (0.0073)	0.2643 (0.0087)
	Between 35 and 60	0.3467 (0.0073)	0.2193 (0.0057)	0.3120 (0.0060)	0.2975 (0.0050)
	More than 60	0.3680 (0.0081)	0.2272 (0.0057)	0.3733 (0.0071)	0.3236 (0.0070)
alpha=.5	Less than 35	0.2125 (0.0064)	0.1615 (0.0064)	0.1983 (0.0042)	0.1881 (0.0043)
	Between 35 and 60	0.2143 (0.0031)	0.1792 (0.0032)	0.2066 (0.0028)	0.2003 (0.0023)
	More than 60	0.2372 (0.0042)	0.2447 (0.0052)	0.2478 (0.0041)	0.2422 (0.0046)
alpha=1	Less than 35	0.1533 (0.0046)	0.1681 (0.0066)	0.1619 (0.0045)	0.1514 (0.0034)
	Between 35 and 60	0.1541 (0.0024)	0.1764 (0.0035)	0.1599 (0.0023)	0.1559 (0.0019)
	More than 60	0.1866 (0.0045)	0.3643 (0.0129)	0.1968 (0.0047)	0.2303 (0.0069)

Table 12. Polarization by gender for singles (no children)

		Spanish system	Danish system	French system	UK system
Gini	Couples	0.3478 (0.0056)	0.2141 (0.0043)	0.3228 (0.0047)	0.2981 (0.0040)
	Males	0.4021 (0.0161)	0.2373 (0.0134)	0.3801 (0.0154)	0.3427 (0.0135)
	Females	0.4275 (0.0245)	0.1620 (0.0228)	0.4237 (0.0255)	0.3088 (0.0274)
alpha=.5	Couples	0.2157 (0.0023)	0.1868 (0.0026)	0.2123 (0.0021)	0.2034 (0.0019)
	Males	0.2467 (0.0093)	0.2364 (0.0127)	0.2481 (0.0102)	0.2328 (0.0088)
	Females	0.2982 (0.0216)	0.2724 (0.0394)	0.3336 (0.0252)	0.2811 (0.0283)
alpha=1	Couples	0.1566 (0.0019)	0.2027 (0.0041)	0.1617 (0.0018)	0.1615 (0.0017)
	Males	0.1750 (0.0076)	0.2974 (0.0206)	0.1860 (0.0083)	0.1888 (0.0098)
	Females	0.3084 (0.0297)	0.7559 (0.1099)	0.3927 (0.0380)	0.4082 (0.0471)

Table 13. Polarization by education

		Spanish system	Danish system	French system	UK system
Gini	Graduate	0.3139 (0.0131)	0.2550 (0.0106)	0.3025 (0.0104)	0.2750 (0.0087)
	Secondary	0.2988 (0.0116)	0.2029 (0.0080)	0.2792 (0.0092)	0.2631 (0.0088)
	Primary	0.3304 (0.0052)	0.1913 (0.0036)	0.3049 (0.0040)	0.2814 (0.0040)
alpha=.5	Graduate	0.2061 (0.0066)	0.1897 (0.0060)	0.2041 (0.0054)	0.1912 (0.0043)
	Secondary	0.2010 (0.0056)	0.1804 (0.0060)	0.1981 (0.0050)	0.1903 (0.0043)
	Primary	0.2108 (0.0021)	0.1846 (0.0026)	0.2071 (0.0019)	0.2004 (0.0019)
alpha=1	Graduate	0.1557 (0.0048)	0.1609 (0.0047)	0.1546 (0.0036)	0.1487 (0.0029)
	Secondary	0.1482 (0.0032)	0.1799 (0.0076)	0.1527 (0.0035)	0.1515 (0.0030)
	Primary	0.1529 (0.0017)	0.2165 (0.0047)	0.1568 (0.0015)	0.1647 (0.0020)

Table 14. Polarization by working position					
		Spanish system	Danish system	French system	UK system
Gini	Other positions	0.3696 (0.0064)	0.2087 (0.0033)	0.3444 (0.0056)	0.3057 (0.0045)
	Employee	0.2851 (0.0082)	0.2134 (0.0051)	0.2788 (0.0069)	0.2489 (0.0044)
	Self employed	0.3755 (0.0183)	0.1918 (0.0101)	0.2779 (0.0132)	0.2927 (0.0095)
alpha=.5	Other positions	0.2286 (0.0029)	0.2059 (0.0028)	0.2280 (0.0029)	0.2163 (0.0025)
	Employee	0.1950 (0.0040)	0.1737 (0.0028)	0.1940 (0.0034)	0.1805 (0.0020)
	Self employed	0.2324 (0.0097)	0.1739 (0.0070)	0.1981 (0.0077)	0.1992 (0.0046)
alpha=1	Other positions	0.1681 (0.0028)	0.2565 (0.0062)	0.1763 (0.0028)	0.1866 (0.0032)
	Employee	0.1585 (0.0034)	0.1694 (0.0031)	0.1574 (0.0027)	0.1510 (0.0015)
	Self employed	0.1670 (0.0073)	0.1939 (0.0085)	0.1669 (0.0066)	0.1629 (0.0043)

The results show that the scenarios simulated have little impact on the efficiency of the economy (as measured by labour supply effects).

Concerning inequality the Danish system is the best one. To a lower degree, a result in this same direction can be achieved also adopting the French and UK systems.

However, when we take into consideration income polarization the situation is much less clear:

The results of our analysis in term of polarization show how important it is to consider not only redistribution effects. The decision of which reform should be implemented appears not so easy as if we were considering only income inequality.

Question: how much a policy maker should weight this additional polarization information?

To finish we cite a Nobel Prize:

"...There are, it seems to me, only two promising approaches to making well-based recommendations about public policy. One is to use a welfare function of some form and develop the theory of optimal policy. The other is to model the existing state of affairs in some manageable way, and on that basis to display the likely effects of changes in government policy, these effects being displayed in sufficient detail to make rational choice among alternative policies possible. If a welfare function were used to evaluate the changes predicted, the second approach would come fairly close to the first, and in fact, there is a closer theoretical relationship"

in Mirrlees, (1986) "The Theory of Optimal Taxation", in Handbook of Mathematical Economics, vol. III, Arrow and Intriligator eds, North Holland, Amsterdam. Chap. 24, pag. 1198.

Evaluating the Redistributive Impact of Public Health Expenditure using an Insurance Value Approach

Amedeo Spadaro

Jointly with: Ignacio Moral, Marta Adiego, Angela Blanco, Lucia Mangiavacchi

IEF, Madrid May, 2011

The work:

This article analyzes the redistributive impact of public health expenditure in Spain following an insurance value approach to impute expenditure outlays on individual and household's budget.

We model the intensity of use of different health care services using a discrete choice framework on a nationally representative health care survey and then predict probabilities on the 2006 Spanish EU-SILC sample.

This allows us to construct an income extended with public health coverage and to compare it with household disposable income.

The results show that public health expenditure in Spain acts progressively on the income distribution and that public health outlays has a good capacity to get families out from poverty.

Introduction 1

How health expenditure is distributed between different socio-economic groups in the population? Difficult question!!

Total public health care expenditure accounted on average for 6.6 per cent of GDP in OECD countries in 2007

Spanish health care expenditure is just below the OECD average with 6.1 per cent of GDP.

As in most European countries, Spanish government uses health care as an instrument to redistribute income among citizens; citizens pay taxes according to their financial capacity and receive health services as they need.

- Wagstaff and Van Doorslaer (1992) found that the 1980 Spanish health care financing, based on social insurance, was regressive

- De Gaeve and Van Ourti (2003) get back on a cross-country comparison of equity on health financing and evaluated the 1990 Spanish system, now shifted to a direct and indirect tax financing, to be slightly progressive.

- Costa-Font and Gil (2009) analysed heterogeneity in regional inequalities in health care access and financing in Spain using data from 2001, and found that inequalities in health are mostly driven by income inequalities and regional health care capacity.

None of aforementioned studies aim at measuring the benefits that are derived from public spending on health care and thus none of them can analyze its distributive impact.

Intro 2: Public Health Care Expenditure and Extended Income

1) Aaron and McGuire (1970) ⇒ approach based on the measurement of individual preferences and on the individuals' willingness to pay for publicly funded services. This type of approach, called "**behavioural approach**" by Van de Walle (1998), requires knowledge of underlying demand functions of individuals or households and is subjected to biased estimations due to the endogeneity of program placement.

2) LeGrand (1978), Meerman (1979), Selowsky (1979), etc., ⇒ approach based on the **actual use of public health services**. This approach combines the cost of providing public services with information on their use in order to generate comparable distributions and evaluate the impact of the public program on welfare distribution.

3) Arrow (1963), set up the theory of the **ideal insurance in medical care** ⇒ probability of being recipients, as a function of demographic and socioeconomic variables.

Smeeding et. al. (1993) in a study aimed to evaluate the impact of noncash income on living standards in seven OECD countries.

Aaberge and Langørgen (2006) followed the same idea to evaluate how local public in-kind benefits affect the distribution of income in Norway.

Spadaro et al. (2011): The main distinguishing characteristic of our model is that use of health services is treated as a discrete choice problem (MacFadden (1976), Van Soest (1995); …)

Data and Empirical Strategy

The empirical analysis relies on two different household surveys:

1. the 2006 Spanish National Health Survey (SNHS), established from 1987 to record the distribution of morbidity, of certain health behaviours and detailed information on the use of health services, associated with demographic and territorial characteristics.
2. the European Survey of Income and Living Conditions (EU-SILC) for Spain.

SNHS and EU-SILC for Spain are nationally representative and based on the same sampling method. They come with a set of common variables (region of residence, individual age, gender, marital status, household type and size) that are fully comparable.

Health care categories selected for the analysis are: primary health care, outpatient specialized care, inpatients care, pharmaceuticals and the rest of health functions, mainly collective health services.

Table A.1: Distribution of number of visits to the family doctor in the four weeks.

Intensity	Number of visits	Adults	Children
1	0	19103	6011
2	1	8062	2471
3	≥2	2313	640

Table A.2: Distribution of number of visits to the outpatient specialized care system in the last four weeks

Intensity	Number of visits	Adults	Children
1	0	24266	8098
2	1	4021	784
3	≥2	880	142

Table A.3: Distribution of the number of days in hospital in the last year

Intensity	Number of days in hospital	Adults	Children
1	0	26447	8617
2	0-12	2425	452
3	≥13	591	46

Table A.4: Distribution of the number of medicines prescribed during the last four weeks.

Intensity	Number of medicines prescribed	Adults	Children
1	0	13972	5830
2	1	6635	1822
3	2	4226	812
4	3	2344	367
5	≥4	2301	291

The probabilistic model

Let define **Y** as the set of the different health care categories to which it is possible to estimate an intensity of use, such that

$$Y = \left\{ \begin{array}{c} Primary\ health\ care \\ Outpatient\ specialized\ care \\ Inpatient\ specialized\ care \\ Pharmaceuticals \end{array} \right\}$$

There is a further residual category, mainly composed of collective health services, for which it is not possible to estimate an intensity of use and whose premium is attributed on an uniform basis[1].

[1] It accounts for roughly a 10% of public expenditure on health.

The multinomial logistic probability modeling allows to estimate the probability to fall in each of these three categories of intensity of use given some characteristic, or explanatory variables, x, such that

$$P_j^i = Prob(Y^i = j) = \frac{e^{X^i \beta_j}}{1 + \sum_{j=1}^{J} e^{X^i \beta_j}}, \quad j = 1, \ldots, J$$

This model can be estimated via Maximum Likelihood for each healthcare service category[2].

Once the estimates are obtained, since the same explanatory variables are present in EU-SILC, it is possible to predict the out-of-sample probabilities of intensity of use of healthcare services $\hat{P}_j^i$ to each individual. Knowing the cost of the specific service i for each intensity j, C_j^i, it is possible to know for each person in EU-SILC her potential insurance premium for each service, or, in other word, the monetary value of the benefit of this service, as

$$B^i = \sum_{j=0}^{J} \hat{P}_j^i C_j^i$$

and the total value of the healthcare benefit, as

$$B = \sum_{i=1}^{4} \sum_{j=0}^{J} \hat{P}_j^i C_j^i + o$$

where, o is the value of collective healthcare services attributed to each individual.

[2] The values of j corresponding to 0 are used as a baseline for the estimation.

The Distributional Impact of Public Expenditure on Health in Spain

Tables 1-4 present estimations of the probabilities of use of health care services on the SNHS individual sample, modelled according to a multinomial logistic probability model. Numbers in second and fourth columns are partial effects, that is the percentage change in the probability of a choice (outcome) due to a unitary increase in the explanatory variable.

Table 1: Number of visits to the family doctor (multinomial logit regression-partial effects)

	Intensity 2		Intensity 3	
	dy/dx	se	dy/dx	se
Male	-0.046***	0.004	-0.016***	0.003
Age	-0.018***	0.000	-0.005***	0.001
Age^2	0.000***	0.000	0.0001***	0.000
Age^3	0.000***	0.000	0.000***	0.000
Child under 1	0.138***	0.019	0.066***	0.013
Northen Area	-0.027***	0.006	-0.008**	0.003
Central Area	-0.016**	0.007	-0.004	0.004
Mediterranean Area	-0.036***	0.007	-0.001	0.004
Madrid Area	-0.018*	0.011	0.004	0.006
High population density	-0.021***	0.005	-0.008***	0.003
Medium population density	-0.011*	0.006	0.003	0.003
Has university degree	-0.079***	0.007	-0.017***	0.004
Married	0.012**	0.005	0.007**	0.003
Observations	36349			
Pseudo R2	0.055			
***p<0.01, **p<0.05, * p<0.1				

Table 2: Number of visits to outpatient specialized care system (multinomial logit regression-partial effects)

	Intensity 2		Intensity 3	
	dy/dx	se	dy/dx	se
Male	-0.025***	0.003	-0.004**	0.001
Age	-0.003***	0.001	-0.001***	0.000
Age^2	0.000***	0.000	0.000***	0.000
Age^3	0.000***	0.000	0.000***	0.000
Child under 1	0.006	0.013	0.002	0.006
Northen Area	0.008*	0.005	-0.001	0.002
Central Area	0.001	0.005	-0.001***	0.000
Mediterranean Area	0.006	0.005	0.007***	0.003
Madrid Area	-0.004	0.007	0.006	0.004
High population density	0.002	0.004	0.003*	0.002
Medium population density	0.001	0.004	0.002	0.002
Has university degree	-0.021***	0.005	-0.004*	0.002
Married	0.013***	0.004	0.005***	0.002
Observations	36081			
Pseudo R2	0.0202			
***p<0.01, **p<0.05, * p<0.1				

Table 3: Number of days in hospital (multinomial logit regression-partial effects)				
	Intensity 2		Intensity 3	
	dy/dx	se	dy/dx	se
Male	-0.014***	0.003	0.005***	0.001
Age	0.001**	0.001	0.000*	0.000
Age^2	0.000**	0.000	0.000	0.000
Age^3	0.000***	0.000	0.000	0.000
Child under 1	0.055***	0.016	0.053**	0.022
Northen Area	0.002	0.004	0.002	0.002
Central Area	-0.006	0.004	0.000	0.002
Mediterranean Area	0.004	0.004	0.002	0.002
Madrid Area	-0.001	0.006	0.002	0.002
High population density	0.003	0.003	0.001	0.001
Medium population density	-0.001	0.004	0.001	0.001
Has university degree	0.001	0.004	-0.007***	0.001
Married	0.023***	0.003	-0.001	0.000
Observations	36441			
Pseudo R2	0.029			
***p<0.01, **p<0.05, * p<0.1				

Table 4: Number of prescribed medicines (multinomial logit regression-partial effects)								
	Intensity 2		Intensity 3		Intensity 4		Intensity 5	
	dy/dx	se	dy/dx	se	dy/dx	se	dy/dx	se
Male	-0.020***	0.005	-0.034***	0.004	-0.028***	0.003	-0.048***	0.003
Age	0.004***	0.001	-0.008***	0.001	-0.005***	0.001	-0.007***	0.001
Age^2	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Age^3	0.000***	0.000	0.000***	0.000	0.000***	0.000	0.000***	0.000
Child under 1	0.119**	0.021	0.031*	0.017	0.008***	0.011	-0.041***	0.009
Northen Area	0.013*	0.008	-0.009	0.006	0.034***	0.004	-0.059***	0.003
Central Area	-0.008	0.008	-0.016**	0.006	0.035***	0.004	-0.066***	0.003
Mediterranean Area	0.002	0.008	-0.009	0.006	-0.030***	0.004	-0.064***	0.003
Madrid Area	-0.016	0.011	-0.034***	0.008	-0.031***	0.005	-0.046***	0.003
High population density	0.004	0.006	0.005	0.005	0.000***	0.004	0.010***	0.003
Medium population density	0.000	0.007	0.001	0.006	0.001***	0.004	0.015***	0.004
Has university degree	0.008	0.008	-0.027***	0.006	-0.017***	0.005	-0.037***	0.004
Married	0.021***	0.006	0.004	0.005	-0.004***	0.003	-0.009***	0.003
Observations	36441							
Pseudo R2	0.121							
***p<0.01, **p<0.05, * p<0.1								

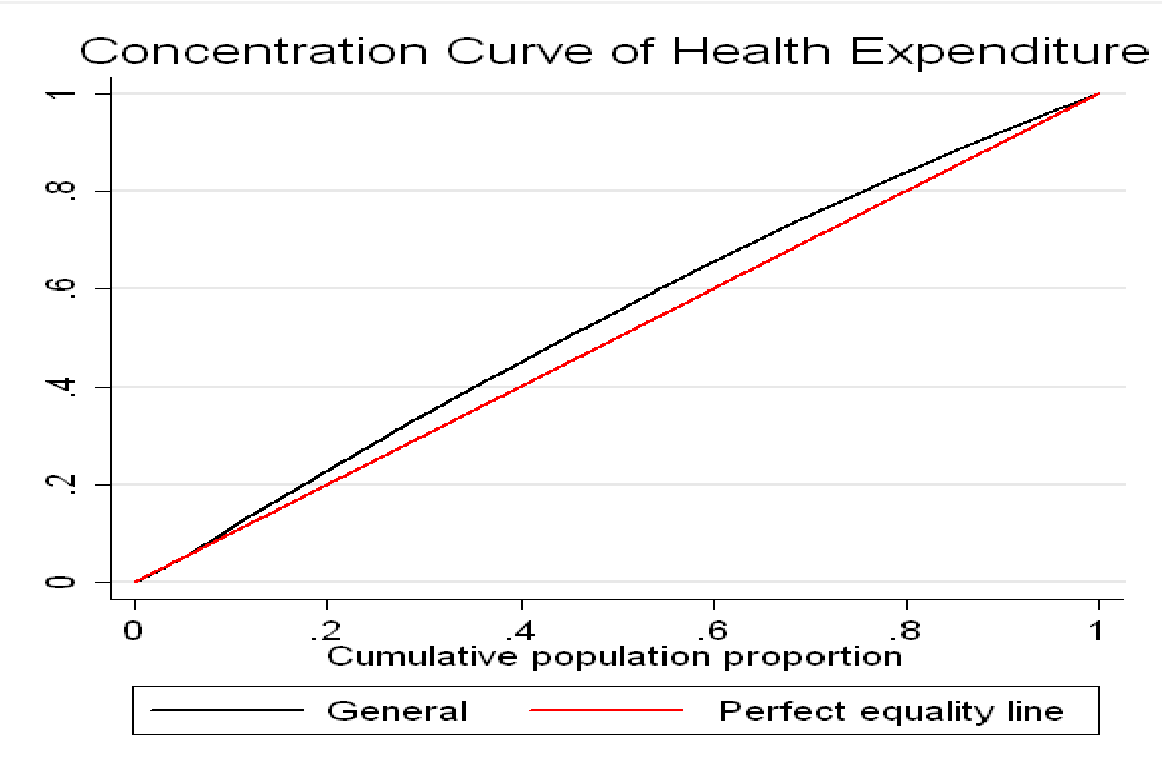
Poverty and inequality

Table 5: Poverty and Inequality impact

	Disposable income (before health subsidy)	Disposable income (after health subsidy)
Headcount ratio %[a]	18.209	8.121
Poverty gap ratio %[a]	5.592	2.370
Gini coefficient	0.319	0.279
Theil index (GE(a), a = 1)	0.175	0.133

The modified OECD scale is calculated using the following formula: HH size = 1+0.5*(number of members older than 13 years -1)+0.3*(number of household members –number of members older than 13).

Figure 1: Concentration curve for public health care coverage



the concentration index of health expenditure is negative (-0.053), as well as the Kakwani Index (-0.38), suggesting that the health subsidies received through the use of health services in Spain is a progressive instrument.

Table 6: Equivalent disposable income with public health coverage by gross income deciles

Equivalent Gross Income Deciles	Average disposable income	Average disposable income with health	Share of subsidy on total disposable income (%)
Decile 1 (0 – 5 113 Euros)	4060	5766	42%
Decile 2 (5 120 – 6 870 Euros)	6070	7900	30%
Decile 3 (6 872 - 8 550 Euros)	7414	9193	24%
Decile 4 (8 555 - 10 360 Euros)	8829	10481	19%
Decile 5 (10 361 – 12 333 Euros)	10405	11997	15%
Decile 6 (12 333 – 14 548 Euros)	12061	13559	12%
Decile 7 (14 550 – 17 322 Euros)	13896	15334	10%
Decile 8 (17 323 – 20 994 Euros)	16260	17575	8%
Decile 9 (21 000 – 27 242 Euros)	19814	21057	6%
Decile 10 (27 243 – 21 2880 Euros)	29962	31120	4%

Figure 2: Semi-parametric regression of health care coverage on equivalent gross income

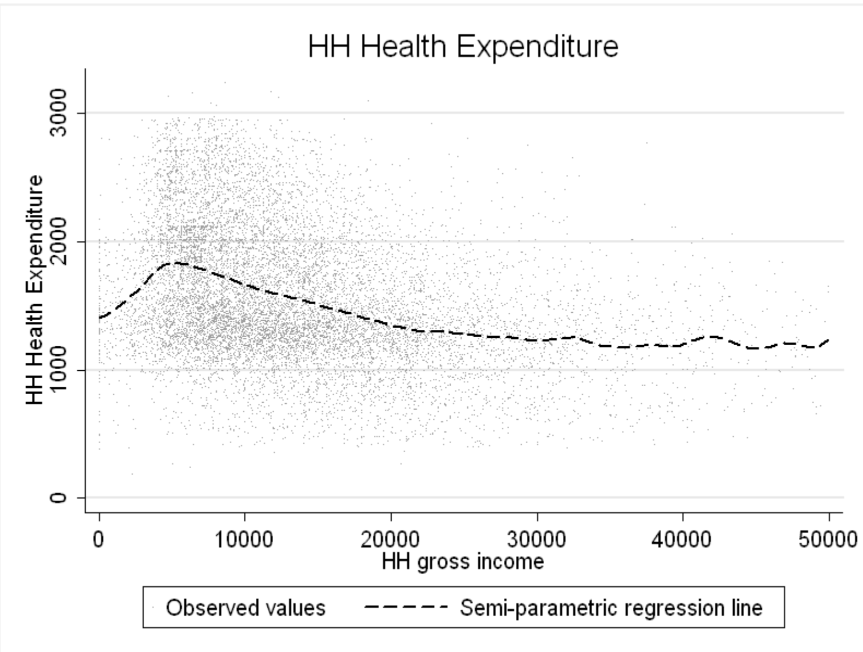


Table 7: Public health transfer by expenditure components and income deciles (Euros)

Equivalent Gross Income Deciles	Total	Drugs	Family doctor	Hospital	Specialized visits
Decile 1 (0 – 5 113 Euros)	1706	427	310	614	354
Decile 2 (5 120 – 6 870 Euros)	1830	473	327	672	357
Decile 3 (6 872 - 8 550 Euros)	1778	443	321	653	360
Decile 4 (8 555 - 10 360 Euros)	1651	391	305	596	358
Decile 5 (10 361 – 12 333 Euros)	1592	370	294	574	353
Decile 6 (12 333 – 14 548 Euros)	1498	340	278	537	341
Decile 7 (14 550 – 17 322 Euros)	1437	321	267	515	333
Decile 8 (17 323 – 20 994 Euros)	1315	287	245	467	313
Decile 9 (21 000 – 27 242 Euros)	1242	266	235	439	300
Decile 10 (27 243 – 21 2880 Euros)	1158	248	220	402	286

Table 8: Public health care transfer by expenditure components and household size (Euros)

Number of household members	Total	Drugs	Family doctor	Hospital	Specialized visits
1	1391	376	240	519	255
2	2554	624	443	952	534
3	2919	658	552	1031	677
4	3283	701	647	1131	802
5	4308	969	820	1507	1010
6	5241	1182	1016	1848	1194
7 or more	5880	1216	1230	2042	1390

Figure 3: Semi-parametric regression of health care coverage on age, by gender

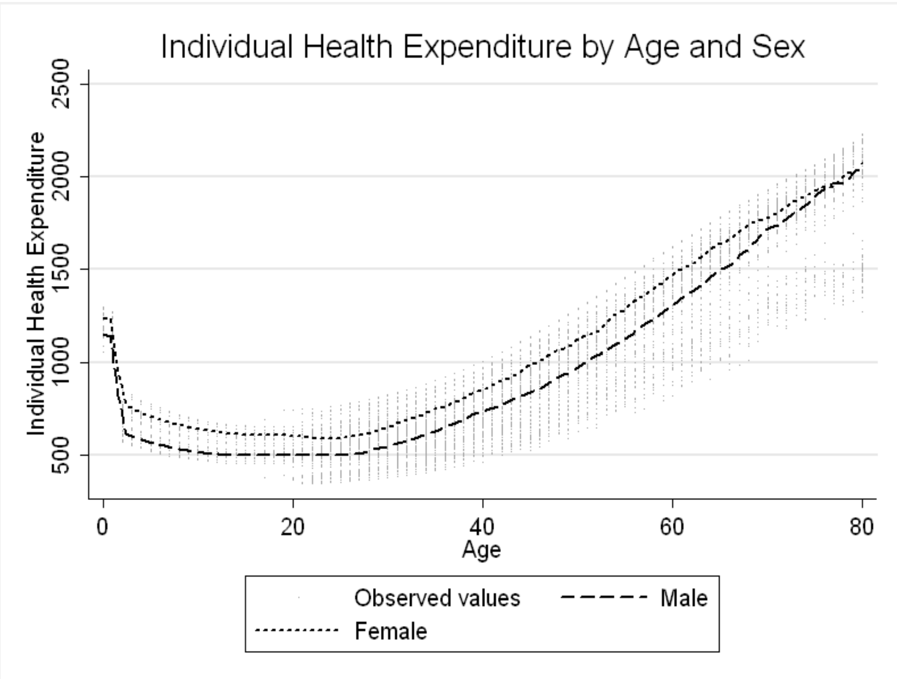


Table 9: Public health care transfer by expenditure components and age classes (Euros)

Age Class	Total	Drugs	Family doctor	Hospital	Specialized visits
1 (0, 6]	758	141	240	207	169
2 (6, 13]	580	112	150	172	145
3 (13, 18]	553	103	121	190	138
4 (18, 30]	559	104	102	210	142
5 (30, 50]	817	170	139	293	213
6 (50, 65]	1308	329	235	434	308
7 (65,)	1874	498	317	729	328

Figure 4: Semi-parametric regression of health care coverage on age, by expenditure components and gender

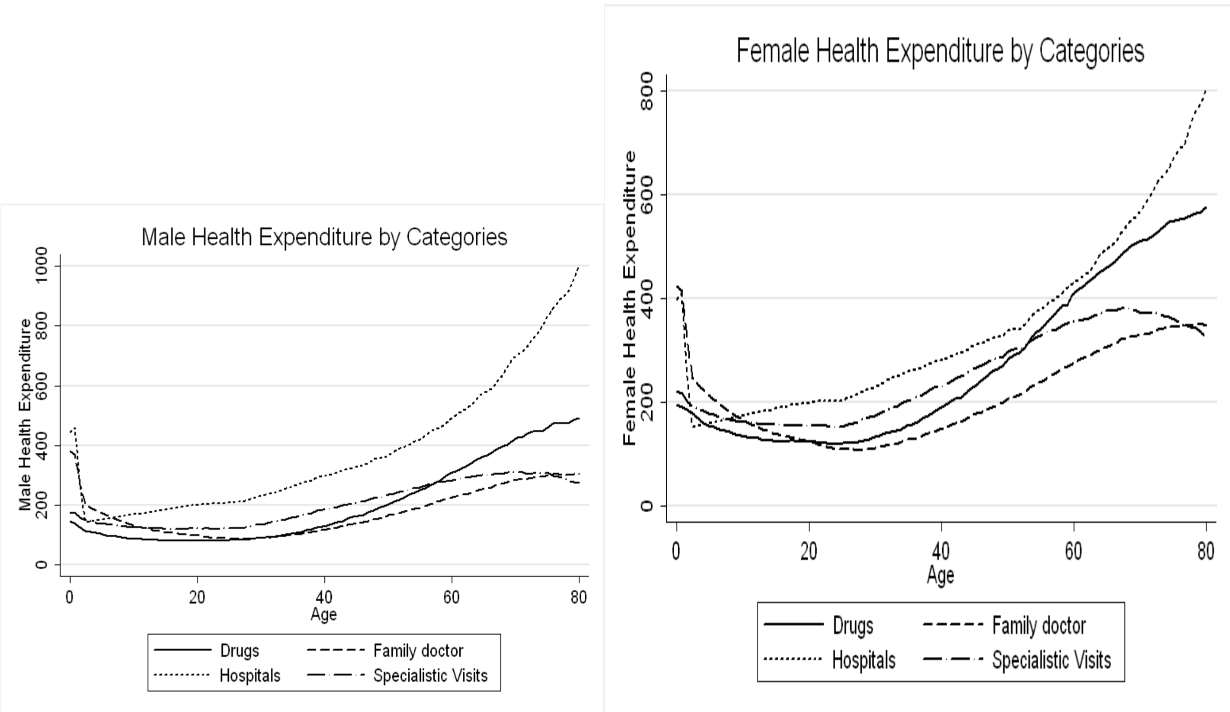


Figure 5: Distribution of health care coverage by professional status

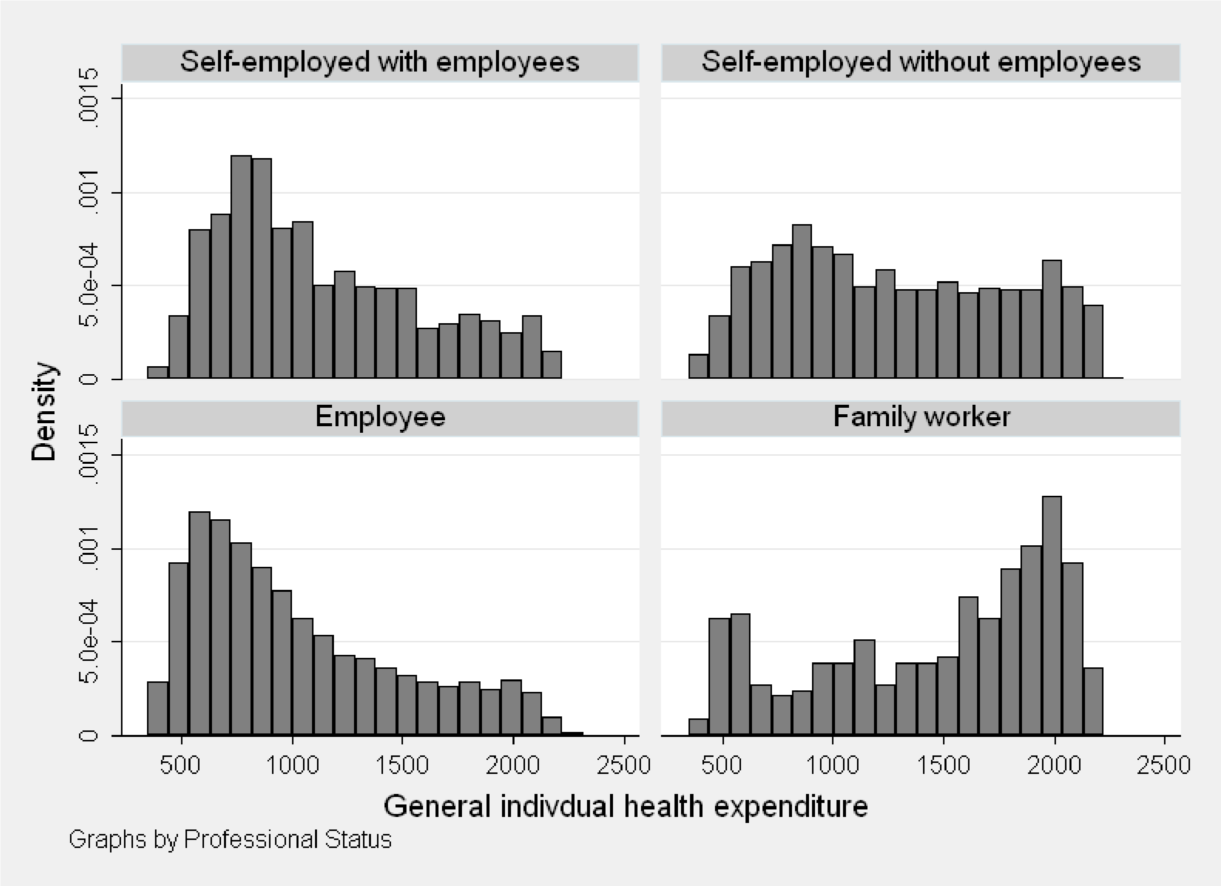
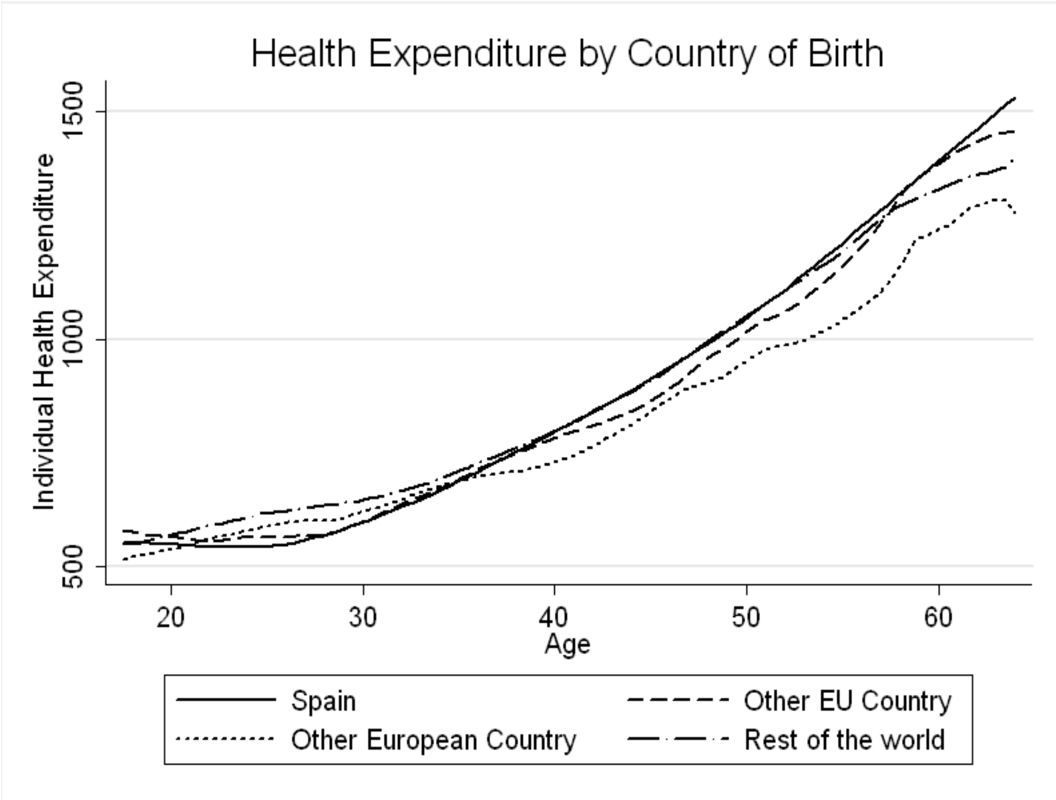


Table 10: Public health care transfer by expenditure components and level of education (Euros)

	Total	Drugs	Family doctor	Hospital	Specialized visits
Primary	1233	323	227	405	276
Lower secondary	685	142	133	239	170
Secondary	586	112	118	208	147
Post-secondary no tertiary	605	124	112	214	153
First stage of tertiary	570	111	105	207	146

Figure 6: Semi-parametric regression of health care coverage on age by country of birth



Concluding Remarks

This study represents the first attempt to give a broad estimate of distributional impact of the whole public health care system in Spain, treating health expenditure as a private insurance and health transfers as insurance premium fostered by the government.

The study exploits a reach survey on health care services utilization in Spain in order to impute the value of health care coverage to EU-SILC household survey for Spain in 2006.

Once computed the extended income and individual health care transfers, the study analyzes how public health care acts against poverty/inequality and the differences in distribution of the in-kind transfer among socio-economic groups, by age and gender.

⇒ **Public health care expenditure in Spain acts progressively on income distribution and has a good capacity to get out families from poverty**. In fact the amount of in-kind subsidy received by the household on average is considerable and its adequacy is good. Health care subsidy accounts for 42% of household disposable income for the families in the first decile. Provision of public health care reduces substantially poverty incidence and poverty severity in Spain, granting a more equal distribution of living standards.

- Among expenditure categories, public subsidized medicine is the category with more redistributive power while subsidies for specialized visits are more proportionally distributed.
- Health expenditure benefits large families, especially families with more than two children and families with all members retired.
- Among individuals, the higher amount of subsidy is devoted to children under six years old and adults older than 50 years old.
- In-kind transfers from public health sector generally increase with age and are higher for women throughout all the life cycle.
- Age impacts in particular expenditure for medicines and hospitals, while the benefits from family doctor have a flatter distribution respect to age increase. Females are more likely to be subsidized for drugs consumption.
- Retired people and domestic workers receive also a considerable amount of benefits while among paid workers small self-employed are those who benefit more from public health care expenditure.
- Young immigrants from non European countries receive a larger amount of benefits respect to Spanish coetaneous while from 35 years old those born in Spain are more granted.