# Redistribution and Polarization Impact of the European Redistribution Architecture: an Analysis Using Microsimulation Techniques

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**Abstract**[1]
In this paper we try to offer some elements of evidence about the effects of possible reforms of the Spanish direct redistribution system. We analyse the impact upon efficiency, income distribution and polarization of the replacement of the Spanish system with several European schemes. In particular, we simulate schemes similar to the ones enforced in France, UK and Denmark (corporatist, liberal and social-democratic model respectively).
The analysis is performed using microsimulation models in which labour supply is explicitly taken into account. Instead of following the traditional continuous approach (Hausman 1981, 1985a, and 1985b), we estimate the direct utility function employing the methodology proposed by Aaberge et al. (1995) and van Soest (1995).
To analyse the distributional effects of different reform scenarios we compute different distributional measures based on individual and household net incomes. Furthermore, we estimate the polarisation effects of each redistributive scenario. Microsimulation techniques will allow us to explore several important dimension of the polarization analysis.
The two main aims of the contribution are: 1) to contribute to 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.

***Keywords****: microsimulation; fiscal policy; labour supply; inequality, polarization, social policy;*
***JEL Classification****: D31, H21, H23, C25, H31, J22*

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## 1 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.

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Spain belongs to what has been called “the Southern European (or Mediterranean)” welfare state regime (Esping Andersen 1990, 1999, Ferrera, 1996). The Mediterranean social protection system is highly fragmented and, although there is no articulated net of minimum social protection, some benefits levels are very generous (such as old age pensions). Moreover, health care is institutionalized as a right of citizenship. However, in general, there is relatively little state intervention in the welfare sphere (a low level of decommodification – i.e. the degree to which a person can maintain a livelihood without reliance on the (labour) market[2]-). Another important feature is the high level of particularism with regard to cash benefits and financing, expressed in high levels of clientelism (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). The operation of the market is encouraged by the state, either actively – subsidizing private welfare schemes – or passively by keeping (often means tested) social benefits to a modest level for the demonstrably needy. This welfare regime is characterized by a low level of decommodification. The operation of the liberal principle of stratification leads to division in the population: on the one hand, a minority of low-income state dependants and, on the other hand, a majority of people able to afford private social insurance plans. In this type of welfare state, women are encouraged to participate in the labour force, particularly in the service sector.

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). This regime type is shaped by the twin historical legacy of Catholic social policy, on the one side, and corporatism and etatism on the other side. This blend had some important consequence in terms of stratification. Labour market participation by married women is strongly discouraged, because corporatist regimes – influenced by the Church – are committed to the preservation of traditional family structures. Another important characteristic of the conservative regime type is the principle of subsidiarity: the state will only interfere when the family’s capacity to service its members is exhausted (Esping-Andersen, 1990: 27).

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). Here, the level of decommodification is high, and the social-democratic principle of stratification is directed towards achieving a system of generous universal and highly distributive benefits not dependent on any individual contributions. In contrast to the liberal type of welfare states, ‘this model crowds out the market and, consequently, constructs an essentially universal solidarity in favour of the welfare state’ (Esping-Andersen, 1990: 28). Social policy within this type of welfare state is aimed at a maximization of capacities for individual independence. Women in particular – regardless of whether they have children or not – are encouraged to participate in the labour market, especially in the public sector.

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 analysis will be performed using microsimulation models in which labour supply is explicitly taken into account. Instead of following the traditional continuous approach (Hausman 1981, 1985a, and 1985b), we estimate the direct utility function employing the methodology proposed by Aaberge et al. (1995) and van Soest (1995).

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[2] This definition of decommodification has been elaborated by EA on a previous similar concept of Karl Polany (1944).

To analyse the distributional effects of different reform scenarios we will compute different distributional measures based on individual and equivalence weighted household net incomes. Furthermore, as an innovative element of our analysis, we will estimate the polarisation effects of each redistributive scenario following Duclos et al. (2004).
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.
Of course, from the beginning of the exposition we want to make clear to the reader that the ambition of our analysis is very limited: first, we do not pretend to assess the effects of the reform of the whole social protection system and even less in the welfare state. Income taxes and benefits are only a very small part of it.
The layout of the paper is as follows. Section 2 presents the data, the microsimulation model and principal characteristics of redistribution systems simulated. Section 3 describes the labour supply model, econometric methodology and results. Section 4 presents the polarization indices. Empirical results are reported in Section 5. Section 6 concludes.

## 2. Data, the microsimulation models and principal characteristics of redistribution systems

*The data*
We use Spanish data from the European Community Household Panel (ECHP). At the time we constructed the microsimulation model, the latest available Spanish wave was that for 1995. But the baseline tax-benefit system is the one enforced in 1999, when a new structure of the personal income tax (PIT, hereafter) was introduced in the Spanish system. Then, the monetary variables in the 1995 wave, which refer to 1994, have to be updated. We do it employing the nominal growth rate i.e. inflation plus real growth. In order to update incomes from 1994 to 1998 we use the factor 1.281, and for 1994 to 1999 the factor 1.335. In Table 1 we compare disposable household income for the 1999 ECHP wave (currently available but as yet not incorporated into the microsimulation model[3]) to its counterpart in our updated dataset.

*Table 1. Calibration of GLADHISPANIA (in billions of euros)*

| | | **1999** | |
|---|---|---|---|
| | Official Statistics | Gladhispania | Difference |
| | (4) | (5) | (6) = (5-4)/4 |
| | | | |
| Mean disposable household income[(a)] | 18,375 | 19,311 | 5.09% |
| Personal Income Tax collection[(b)] | 39.54 | 37.83 | -4.33% |
| Average income tax rate[(c) (d)] = (net tax/taxable income) | 23.15% | 23.87% | 3.12% |
| Employees' Social Security contributions[(e)] | 14.57 | 14.26 | -2.13% |

(a) Comparison of updated 1995 ECHP with 1999 ECHP (in euros); (b) Source: Informe Anual de Recaudación Tributaria, 2001; (c) Source: Memoria de la Administración Tributaria 2001; (e) Source: Anuario de Estadísticas Laborales y de Asuntos Sociales 2002;

Having updated disposable income, we convert this to gross income using the microsimulation model Gladhispania, as disposable income allows us to calculate social contributions, total

[3] Working with data from 1999 will avoid assuming that the demographic structure has not change from 1995, but it is well known that the Spanish ECHP data suffers from an important problem of attrition that made the data less representative of the whole population.

income tax and monthly taxation withheld at source, employing a fixed-point algorithm which iterates until it ascertains the withholdings, income tax and social insurance contribution patterns which best fit the disposable incomes observed in the data[4]. Table 1 gives the results of the model's calibration and compares them to the corresponding aggregate figures reported in official statistics. The initial number of households in the database is 6,522, of which 102 observations were discarded for lack of information regarding the household head (data which is needed to accurately calculate income tax), leaving 6,420 households, representative of the total number of Spanish households (12,068,375 in 1995, source Instituto National de Estadística, INE). The statistics describing the variables used in the econometric section are given in Table 2, while the scenarios we simulate using Gladhispania are described below.

*Table 2. Descriptive statistics of the variables used in the econometric section*

| **COUPLES** | | |
|---|---|---|
| Variable | Mean | Standard deviation |
| | | |
| Yearly disposable income | 24,030 | 15,756 |
| | | |
| Children (in %): | | |
| no children | 24.3 | |
| one child | 30.4 | |
| two children | 38.3 | |
| three or more children | 7.0 | |
| | | |
| **Head of the household**: | | |
| Weekly hours of leisure | 127.7 | 11.6 |
| Age | 38.9 | 8.3 |
| Education (in %): | | |
| university graduate | 30.8 | |
| secondary school | 19.9 | |
| less than secondary school | 49.3 | |
| Males (in %) | 92.8 | |
| | | |
| **Spouse**: | | |
| Weekly hours of leisure | 153.1 | 18.5 |
| Age | 36.6 | 8.1 |
| Education (in %): | | |
| university graduate | 25.6 | |
| secondary school | 20.7 | |
| less than secondary school | 53.7 | |
| Males (in %) | 7.2 | |
| | | |
| Number of observations | 1,015 | |

*Simulated scenarios*

As previously mentioned, four systems have been simulated with Gladhispania[5].

The baseline is the 1999 Spanish tax-benefit system. It takes into account personal circumstances conditions principally via tax allowances (amounts deducted from the gross tax due) rather than tax credits (amounts deducted from the tax base). Two "minimum income exemptions" exist: the

[4] A full description of the microsimulation model (Gladhispania), of the dataset and of the disposable to gross algorithm is contained in Oliver and Spadaro (2004*a*).

[5] Gladhispania is fully described in Oliver and Spadaro (2004a) an English abstracted version can be found in Oliver and Spadaro (2007).

first being individual and the second family-based. It reduces taxable income as follows; the minimum personal allowance is 3,305.57[6] euros (6,611.13 euros for joint declarations). The minimum family allowance is: (a) 601.01 euros per dependent relative, aged over 65 and with income below a given level. (b) 1,202.02 euros per child for the first two children and 1,803.04 euros per child after the third child, for dependent children under 25 with income below a given level. These sums are increased by 150.25 euros per child aged between 3 and 16 (for expenses regarding educational material), and 300.50 euros per child under 3. Finally, an increase of 2,103.54 or 2,704.55 euros is applied for each disabled dependent person, with income below a given level, included in (a) or (b) independently of their age. These deductions are made to gross income and therefore no longer exist as tax credits for the same items. The tax system is individualized. The tax brackets are 6, (see Table 3).

*Table 3. 2001 Tax rates schedule (in euros)*

| **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%.

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 UK income tax system is an individual system, with the incomes of married people being taxed independently. There is an individual personal allowance and non-refundable tax credits for married couples above the age of 65 ("Married couples allowance - MCA"). The personal allowance is higher for people aged over 65 and higher still for those aged over 75 ("Age allowance"), although the age additions are withdrawn as taxable income rises. The system has a relatively broad base and there is (for all practical purposes) a unified tax schedule. Some employer-provided goods in kind are included in the income base (such as company cars). The tax schedule consists of three rate bands: a narrow first band of 10%, a wide "standard rate" band of 22% and a higher rate of 40%, affecting only high income taxpayers. Income from financial capital is taxed at 20% if the taxpayer's marginal rate on that income is within the standard rate band (see Table 3 for further details).

Child benefit is a universal flat-rate benefit of 884 euros paid to the carer of each dependent child. There is a higher rate for eldest or only dependent children (440 euros), otherwise the rate does not vary. Child benefit is not taxable.

Income Support (IS) is the main social assistance benefit for people whose family incomes are lower than a specified level and who are not in work (or in work for less than 16 hours per week). It is intended to apply to pensioners, lone parents, sick and disabled people and others who are not expected to seek work. If family income is less than the applicable amount (7,100 euros for a couple without children), IS makes up the shortfall. The applicable amount is made up of personal allowances and premiums for certain groups with special needs. Some housing costs are included in the applicable amount, but we have not modelled.

[6] All the amounts given in this section are in anual euros of 1999.

Finally, working family tax credit is addressed to those household with low income not covered by the IS. It is a benefit for families with dependent children where at least one parent is in employment or self-employment for at least 16 hours per week. The benefit is tapered away with income increases above a minimum level; income is assessed after income tax and contributions; the maximum amount of benefit depends on the number of children (it starts from approximately 4,000 euros) nevertheless it is paid at the same rate for couples and lone parents; a higher amount is paid if at least 30 hours are worked per week by at least one parent. WFTC payments depend on income and circumstances in the few weeks before the claim; the entitlement period is 6 months, regardless of changes in income or circumstance. It is not itself part of the income tax base.

The French redistribution instruments that we model are: the “allocations familiales” (AF, hereafter), the “Revenue Minimum d’Insertion” (RMI), and the income tax.

The AF are non-mean tested benefits given to households with two or more dependent children. The amount depends on the number and the age of the children (with a minimum of 1,248 euros in a family with two dependent children).

RMI is a means-tested income which guarantees a minimum household income. Starting from a minimum of 4,494 euros for a single household without children, the amount increases with the number of children and if the household is a couple.

The French income tax is family based. As married couples are taxed together, it implies a strong work disincentive for the member of the household with zero or low income (if married with a high earning person. However, common law husbands are taxable separately (they are considered as two independent singles) and share the allowances if they have fiscally dependent children. Capital income is taxed at different tax rates depending of the origin (gain in value, dividends, rents…), but as we have no detail on these various capital incomes for each household, we simply apply a flat tax rate of 15%. Earned incomes (including unemployment benefits and pensions) have a 10% deduction with a minimum and a maximum amount. Moreover, a deduction of a 20% is applied afterwards with a maximum of 2,165 euros. The scheme of the French income tax is rather complicated and some deductions and tax credits are ignored due to the lack of data. Indeed, before getting the taxable income (after deductions) we have to take into account the “Quotient Familial” (QF) for horizontal equity purposes. The system gives a weight to each member of the family and adds them together to compute a QF. Then, we get the taxable income dividing it by the QF (i.e. a couple with two dependent children has a QF of 3, while a single without children has a QF of 1). Then, we are ready to compute the income taxes following the tax schedule provided in Table 3. Finally, the income tax is multiplied by the QF to get the household taxes.

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

The family allowances are non-mean tested benefits. The eligible households are families with dependent children. The amount depends on the age and the number of children. We simulate an average amount of 1,342 euros per child. The benefit is not taxable.

Danish social assistance is a very complex set of rules that covers several social events such as unemployment, illness or divorce for low incomes families. In order to get things easier a minimum income is guaranteed, which is tapered by a rate of 100%. The amount depends on age, and the working status of the spouse (12,414 euros for a single without children). As a special characteristic non-dependent children living with their parents are entitled to a benefit of 3,860 euros.

The income tax has three tax brackets, as it can be seen in Table 3. We have considered as taxable income all sources of income except family allowances and social assistance[7]. There are

[7] The rules stablish that social assistance has to be taxed, but doing so we got a marginal tax rates above 100% (a rate of 100% in which is tapered the social assistance plus the personal income marginal taxes which are over 35% when we include the local taxes).

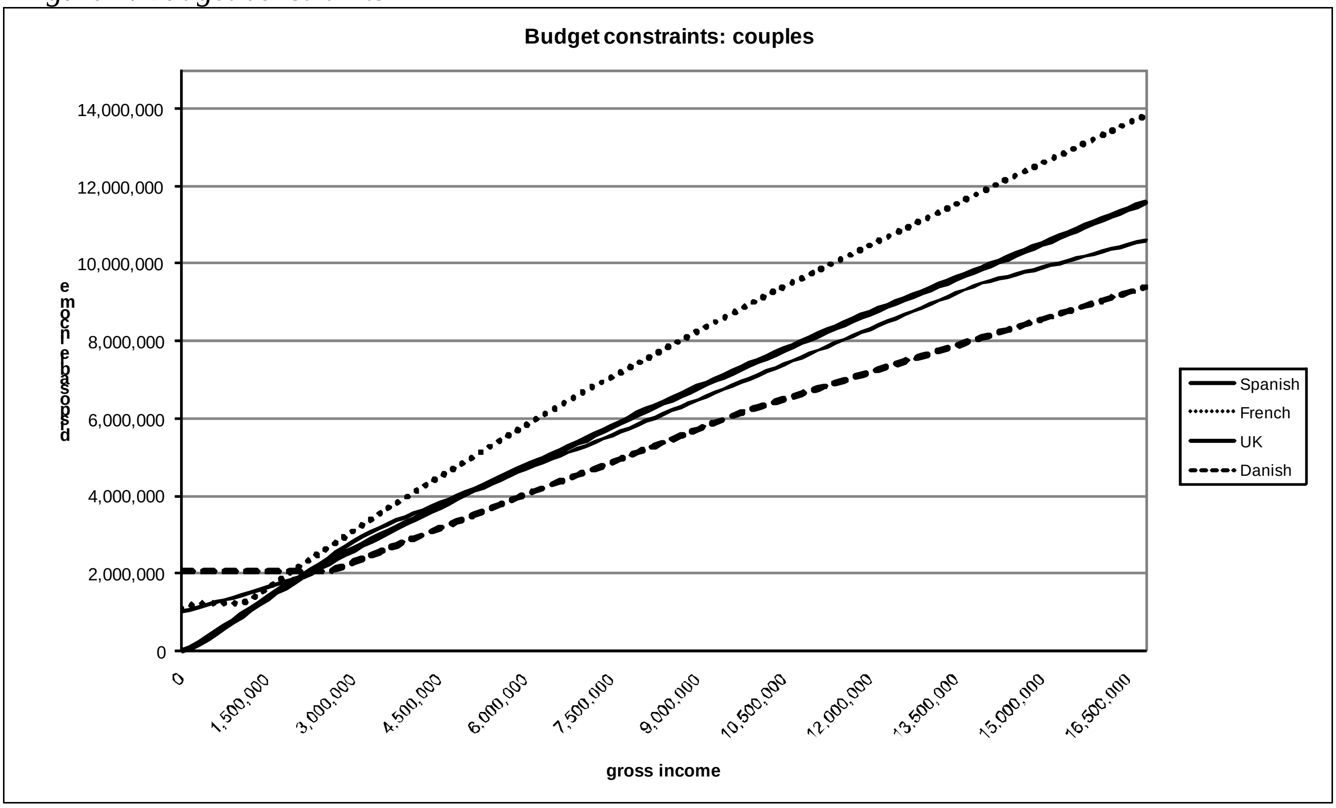
three levels of the state tax (bottom, middle and top tax) with their respective tax allowances. In addition, there are local taxes which vary across municipalities and counties. The average tax rate in 2001 was 33.2%, but we have chosen a tax of 31,75% in order to respect a taxation ceiling which establishes that no part of the income can however be taxed with a rate higher than 59%.

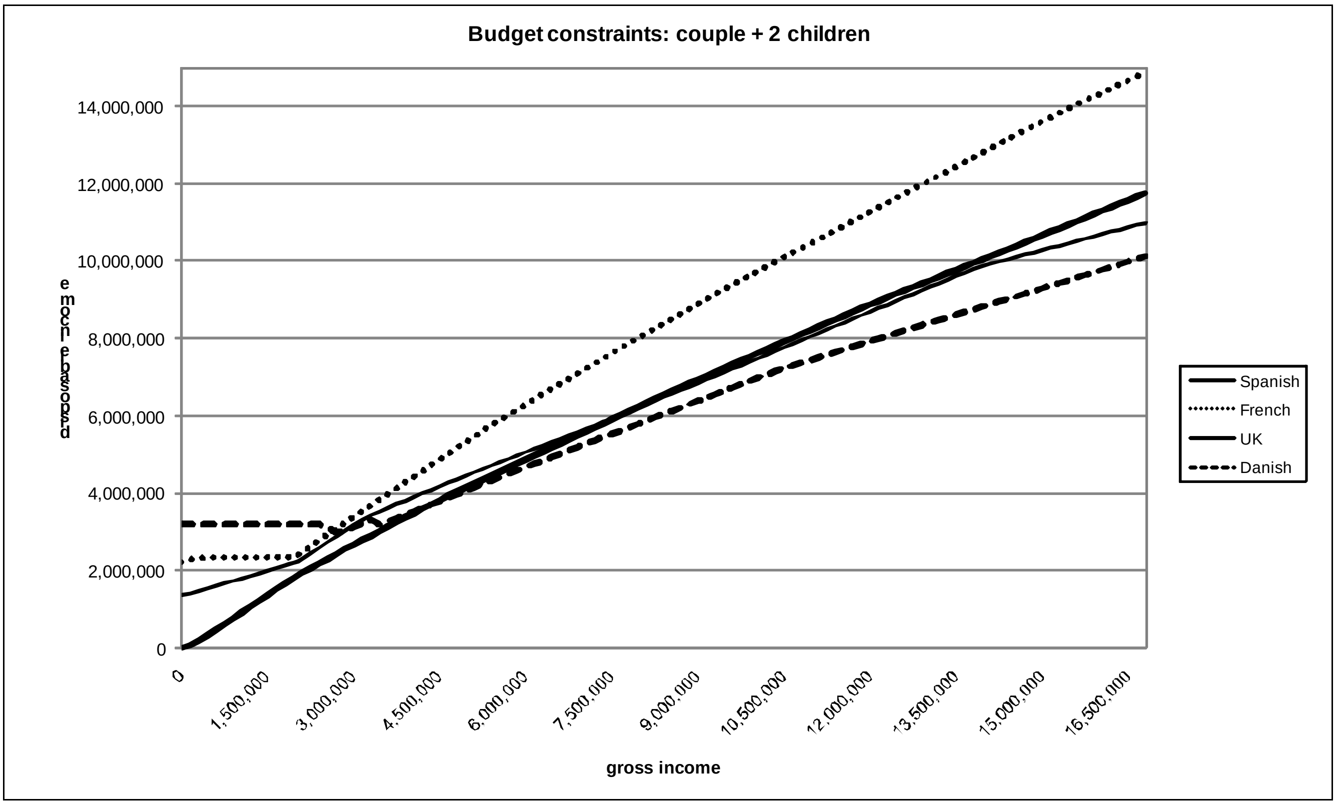
Despite social contributions are sometimes seen as a tax, their main goal is to collect funds in order to pay pensions. Obviously, the social contributions vary across Europe, as well as the generosity of the pension system, but they are not designed to redistribute income. In fact, in some countries like Spain, social contributions could even be regressive. In the present simulation exercise we opt for leaving constant them and we focus on the rest of the instruments of the tax-benefit system.

Spanish social security contributions are determined by a variety of factors and various "social security affiliation categories" exist, each regulated differently. The microsimulation model computes the tax base (closely related to gross salary) and the rate applicable to each individual taking into account personal circumstances. Social security contribution bases and rates are almost identical in the 1998 and 1999 direct redistribution systems, as only minor changes were made (in order to update the bases and take inflation into account).

To illustrate the changes implied by the systems, Figure 1 shows the budget constraints for two archetypal cases: couples and couples with two children. The horizontal axis shows gross annual family income and the vertical axis the family disposable income. The figure provides early intuitions and show nuances across systems.

*Figure 1. Budget constraints*






Systems with minimum income schemes (French, UK and Danish) are characterized by a relatively flat budget constraint at low income level, due to the high taper rates responsible for very high effective marginal tax rates.

Despite very different systems, the combination of the different tax-benefit instruments in the French and the UK lead to very similar budget constraints.

There is a clear contrast between Danish, French and UK regimes on the one hand (with large redistributive effects due to both contributory and non-contributory benefits) and the actual Spanish system. The Danish system clearly presents the highest level of social assistance and effective marginal tax rate. It is undoubtedly the one that perform better in terms of decommodification.

## 3. The labour supply model, econometric methodology and results[8]

### *3.1. The labour supply model*

We assume that individuals derive utility from household income, $y$, and from leisure, $L = T - h$, with $T$ total time available and $h$ hours of work, with the following utility function:

$$U = U(y, h; Z) \qquad (1)$$

where $Z$ represents individual characteristics. Consumers maximize utility, subject to the usual budget constraint, which is defined in terms of gross real wages, $w$, total household non-labour income, $\mu$, and the tax system $T(h, w, \mu, Z)$, where $h = T - L$. If there are no fixed costs, the budget constraint is:

$$y = wh + \mu - T(h, w, \mu, Z) \qquad (2)$$

where $T(h, w, \mu, Z)$ are tax payments net of benefits, which in the Spanish tax system depend on hours, wages, non-labour income and demographic characteristics. The consumer's problem then takes the form:

$$Max_h \;\; U(y,h,Z) \qquad \text{subject to } \; y \le \mu + wh - T(\mu,w,h,Z) \qquad (3)$$

[8] This section draws from Labeaga et al. (2008).

The solution to (3) is complex because *T(.)* is non-linear, although it is always possible to optimize for a given marginal tax rate (and to obtain a parametric Marshallian labour supply function). The discrete choice approach, instead of estimating the Marshallian labour supply parameters, starts by specifying utility *U(.)* and estimating its parameters. Below, we adopt the flexible quadratic utility function (as in Keane and Moffit, 1998, and Blundell *et al.*, 2000):

$$U^*(y, h, Z) = \alpha_{yy} y^2 + \alpha_{hh} h^2 + \alpha_{yh} yh + \beta_y(Z) y + \beta_h (Z) h + \varepsilon_{hi} \qquad (4)$$

for the singles subsample, and

$$\begin{aligned} U^*(y,h_h,h_c,Z_h,Z_c,Z) &= \alpha_{yy}y^2 + \alpha_{h_hh_h}h_h^2 + \alpha_{h_ch_c}h_c^2 + \alpha_{yh_h}yh_h + \alpha_{yh_c}yh_c + \alpha_{h_hh_c}h_hh_c + \\ &+ \beta_y y + \beta_{h_h}h_h + \beta_{h_c}h_c + \varepsilon_{h_hh_c} \end{aligned} \qquad (5)$$

for couples. The variables $h_i$ and $Z_i$, $i = h, c$, are, respectively, hours and demographic characteristics of the couple member *I*, while the household head is represented by *h* and the spouse by *c*. The parameters of income and hours may be linear functions of individual demographic characteristics, and thus:

$$\begin{aligned} \beta_y &= \beta_{y0} + \beta'_y Z \\ \beta_{h_h} &= \beta_{h_h 0} + \beta'_{h_h} Z_h \\ \beta_{h_c} &= \beta_{h_c 0} + \beta'_{h_c} Z_c \end{aligned} \qquad (6)$$

These functional forms are easily tractable and also allow a wide range of potential behavioural responses.[9]

Another important issue is the presence of fixed costs i.e. the costs an individual must pay in order to work, such as childcare costs or travelling expenses. We assume they are dependent on observed variables, and thus $FC = Z_{fc}\beta_{fc}$. In the model they are subtracted directly from disposable income for any choice that involves working. Individuals thus evaluate utility, $U = U(y - FC, h; Z)$, for all possible values of income (net of fixed costs). The effect of such costs for each individual (household) depends on the observables $Z_{fc}$, whose weights, $\beta_{fc}$, are estimated together with the remaining parameters of the utility function.

*3.2. Econometric methodology*

We directly estimate the parameters of the utility function (4) or (5) for different subsamples of the Spanish population, and select a sample consisting only of potential wage-earners.[10] However, since it is likely that marital status significantly affects labour supply (mainly for the wife but also for the husband), we construct additional subsamples. We estimate the utility function separately for singles (4) and couples (5), which affects both the coefficients and the necessity of including fixed costs. As we estimate a discrete choice model, we must first decide the finite set $h_i \in \{h^1, h^2, ..., h^{Ki}\}$, $i = h, c$, according to which individuals choose their hours. The observability rule in a typical multinomial model is:

$$\begin{aligned} h_i &= h^1 \text{ if } h \le h^B{}_1 \\ &= h^2 \text{ if } h^B{}_1 < h \le h^B{}_2 \\ &\ldots\ldots \\ &= h^{K-1} \text{ if } h^B{}_{K-1} < h \le h^B{}_{K-1} \\ &= h^K \text{ if } h > h^B{}_{K-1} \end{aligned}$$

The appropriate number of intervals is evaluated by examining the histograms of hours for both singles and the two members of the couple (see Figure 2). Having decided the choice set, we have $K_i$ alternative values for hours for agent *i* ($K_h \cdot K_c$ for the household), which determine total income for the individual (household):

$$y[h_i] = w_i h_i + \mu - T(h_i, w_i, \mu; Z_i) \qquad \text{for} \qquad h \in \{h^1, h^2, ..., h^{K_i}\} \qquad (7)$$

$$y[h_{h(\cdot)}, h_{c(\cdot)}] = w_h h_{h(\cdot)} + w_c h_{c(\cdot)} + \mu - T(h_{h(\cdot)}, h_{c(\cdot)}, w_h, w_c, \mu; Z_h, Z_c, Z) \qquad (8)$$

---

[9] See Stern (1986) for a discussion of the properties of these and other functions.

[10] Self-employed, retired people, individuals under 25 years or over 65 are omitted from this sample.

for all possible combinations of $h_{h(.)} \in \{h^1_{h(.)}, h^2_{h(.)}, \ldots, h^{Kh}_{h(.)}\}$, and $h_{c(.)} \in \{h^1_{c(.)}, h^2_{c(.)}, \ldots, h^{Kc}_{c(.)}\}$. The variables $w_h$ and $w_c$ are, respectively, gross wages of the household head and the spouse. To take into account unobserved market wage rates for non-working individuals, we adopt the common approach of estimating the wage equation separately and using estimated wages as if they were true values of unobserved wages.[11] The individual (household) maximizes (4) or (5) over the set of hours $h_i \in \{h^1, h^2, ..., h^{Ki}\}$. To estimate the model we must add stochastic terms to the utility function. In what follows, we only add shocks specific to the state or hours regime for each of the possible choices, which we assume are generated by extreme value distributions. Following these assumptions, we derive the choice probability for agent *i* as:

$$\Pr\left[h_i = h^j, Z\right] = \Pr\left[U_{i^j} > U_{i^k} \forall k \neq j, k \in \{1,2,...,K\}\right] = \\ = \frac{\exp\left[U(y_{i^j}, T - h^j; Z)\right]}{\sum_{k=1}^{K} \exp\left[U(y_{i^k}, T - h^k; Z)\right]} \quad (9)$$

where $U(.) = U^*(.) - \varepsilon_{hi}$.

Similarly, for a couple, we can write the joint probability of choosing a combination of hours $(h_{h(.)}, h_{c(.)})$ as:

$$\Pr\left[h_{h(\cdot)} = h^j_{h(\cdot)}, h_{c(\cdot)} = h^k_{c(\cdot)}, Z_h, Z_c, Z\right] = \Pr\left[U_{\{h^j_h, h^k_c\}} > U_{\{h^j_h, h^k_c\}} \forall s \neq j, t \neq k\right] = \\ = \frac{\exp\left[U\left(y\left[h^j_h, h^k_c\right], T - h^j_h, T - h^k_c; Z_h, Z_c, Z\right)\right]}{\sum_s \sum_t \exp\left[U\left(y\left[h^s_h, h^t_c\right], T - h^s_h, T - h^t_c; Z_h, Z_c, Z\right)\right]} \quad (10)$$

where now $U(.) = U^*(.) - \varepsilon_{hhhc}$. Under the hypothesis of independent errors, we can write the log-likelihood function of each model, respectively, as:

$$\ln \Phi_s = \sum_{i=1}^{N} \sum_{k=1}^{K} d_k \left[\ln \Pr(h_i = h^{ki}; Z_i\right] \quad (11)$$

$$\ln \Phi_c = \sum_{i=1}^{N} \sum_{k=1}^{K} d_{jk} \left[\ln \Pr(h_{h(\cdot)} = h^j_{h(\cdot)}, h_{c(\cdot)} = h^k_{c(\cdot)}; Z_h, Z_c, Z\right] \quad (12)$$

where the sub-indices *s* and *c* stand for singles and couples, respectively. The variables $d_k$ and $d_{jk}$ are (1, 0) dummies: $d_k = 1$ if $[h_i = h^{ki}]$ and $d_{jk} = 1$ if $[h_{h(.)} = h^j_h$ *and* $h_{c(.)} = h^k_c]$. As usual, all parameters in the utility functions are estimated by maximum likelihood.

### *3.3. Econometrics Results*

The estimation of the model initially requires the set of labour supply alternatives for each individual to be identified; this is achieved by examining the data for working hours (see Aaberge *et al.*, 2006, for example). Figure 2*a* presents the distribution of hours of work for singles; Figures 2*b* and 2*c*, respectively offer analogous figures for the household head (as part of a couple) and spouse. Considerable differences can be observed in the non-participation rate, which is approximately 20% for singles and 6% for household heads (as part of a couple), a figure which rises to 59% for the spouse.

The model is similar across the three distributions; a considerable percentage of observations return a figure of between 35 and 42 hours worked, which corresponds to full-time work in Spain. We establish different choice sets for singles and for the two members of couples, on the basis of

[11] The results of these estimations are available upon request. In the case of the spouse of the household head, non-observed wage rates are predicted using Heckman’s (1979) approach to take into account potential sample selectivity bias. Note that in this case non-participation is high (see Figure 1c). In the case of singles and the household head we finally opted to run a simple OLS method to predict wage rates, since we found no evidence of selection bias (the Mills ratio is non-significantly different from zero). We are aware that there are alternative methods of imputing wages for non-workers. We opt for this alternative because there is no agreement about an optimal procedure.

these distributions. For singles we construct brackets for 0-4, 5-34, 35-44 and >44 hours, which correspond to actual hours values (in the utility function) of 0, 30, 40 and 50, respectively. For couples, the choice set of the household head is 0, 40 and 50, since there is no part-time employment. These choices correspond to the intervals 0-4, 5-44 and >44. For the second member of the couple, the "0" option corresponds to bracket 0-4, the option "25" corresponds to the interval 5-34 and the option "40" corresponds to the bracket "over 35 working hours".
We obtain estimates of the parameters of the utility function for singles (eq. 4) by optimizing (11) and for couples (eq. 5) by optimizing (12). The subsample of singles corresponds to households with only one adult, with or without children, (16.6% with one or more children and 83.4% without children), whereas the subsample of couples corresponds to couples with or without children (75.7% with one or more children and 24.3% without children). We exclude self-employed or retired, to then estimate the models using subsamples of potentially active individuals. We also exclude observations for which hourly wages are very low and we do not have information about labour status for each month.[12] The typology of households used both for simulation and estimation is reported in Table 4.

*Table 4. Typology of households*

| | **Total households** | **Potential workers** |
|---|---|---|
| Singles | 1,000 | 259 |
| Couples | 3,195 | 1,024 |
| Other households | | |
| Fiscal unit treated as couples | 1,852 | |
| Fiscal unit treated as singles | 373 | |
| Other individuals treated as singles | 3,392 | |
| **Total** | 9,812 | 1,283 |

We consider age, gender, education and number of children[13] as the observables entering vectors $Z_m$, $Z_f$ and $Z$ in equation (6), capturing differences in preferences. Tables 5 and 6 present the results of the estimations, for the subsamples of singles and couples respectively, giving the values of the coefficients which correspond to hours of leisure. In general terms, the results are consistent with economic theory; the marginal utility of income increases at a decreasing rate and is almost always positive. Some demographic variables affecting both income and hours of leisure are significant in the singles specification. In particular, common fixed costs significantly affect utility; these can be attributed to unobservables such as the cost of commuting. Such fixed costs cannot be more precisely identified (see, for example, Blundell *et al.*, 2000) as some of their possible determinants, such as variables for region or size of the municipality of residence, are not provided by the dataset.

*Table 5. Estimation for singles*

| Variable | Coefficient | Z | |
|---|---|---|---|
| | | | |
| $\text{Income}^2$ | -0.413 | -0.81 | |
| Hours of $\text{leisure}^2$ | -236.955 | -7.31 | *** |
| Income x hours of leisure | 29.061 | 5.00 | *** |
| | | | |

[12] Since we use weekly hours and annual wages these observations probably correspond to individuals who are not working for the whole year.
[13] We also tried additional variables, but only retained those which had significant coefficients.

| | | | |
|---|---|---|---|
| Income | -25.546 | -3.77 | *** |
| x Age | 0.506 | 1.96 | ** |
| x Education | 0.045 | 0.05 | |
| x Children | 0.199 | 1.19 | |
| | | | |
| Hours of leisure | 458.942 | 7.04 | *** |
| x Age | -0.490 | -0.32 | |
| x Educ1 | -4.197 | -1.07 | |
| x Educ2 | 0.398 | 0.14 | |
| | | | |
| Fixed costs | 2.401 | 4.75 | *** |
| | | | |
| Average wage elasticity (hours) | 0.0 | | |
| Average wage elasticity (participation) | 0.0 | | |
| Number of observations | 259 | | |
| Log likelihood | -273.84 | | |

Note. The variables have been rescaled as follows: Income = disposable income in euros/30,000; Hours of leisure = (24x7 – weekly hours of work)/150; Age = (age in years – 38)/10; Education = average number of years of study/10; Educ1 = university graduate; Educ2 = secondary school; Children = number of children (under 16) in the household.
* parameter significant at 10%, ** parameter significant at 5%, *** parameter significant at 1%
Average wage elasticities are computed by increasing the gross wage rate by 1%.

*Table 6. Estimation for couples*

| Variable | Coefficient | z | |
|---|---|---|---|
| | | | |
| $\text{Income}^2$ | -0.228 | -1.92 | * |
| Hours of leisure of the household $\text{head}^2$ | -89.641 | -12.45 | *** |
| Hours of leisure of the $\text{spouse}^2$ | 87.964 | 10.97 | *** |
| Income x Hours of leisure of the household head | -0.155 | -0.14 | |
| Income x Hours of leisure of the spouse | -0.309 | -0.35 | |
| Hours of leisure of the household head x Hours of leisure of the spouse | -31.879 | -3.47 | *** |
| | | | |
| Income | 2.097 | 1.12 | |
| x Age of the household head | -0.419 | -0.79 | |
| x Age of the household $\text{head}^2$ | -0.025 | -0.09 | |
| x Age of the spouse | 1.443 | 2.44 | ** |
| x Age of the spouse $^2$ | -0.391 | -1.30 | |
| | | | |
| Hours of leisure of the household head | 204.505 | 10.23 | *** |
| x 1 (male) | -13.553 | -8.74 | *** |
| x Education of the household head | -8.330 | -3.89 | *** |
| x Age of the household head | 3.644 | 4.63 | *** |
| | | | |
| Hours of leisure of the spouse | -122.422 | -6.77 | *** |
| x 1 (male) | -11.268 | -5.28 | *** |
| x Education of the spouse | -13.036 | -10.15 | *** |
| x Age of the spouse | 1.923 | 2.86 | *** |
| x Age of the $\text{spouse}^2$ | 0.573 | 1.08 | |
| x 1(one dependent child) | 2.929 | 2.42 | ** |
| x 1(two or more dependent children) | 5.570 | 3.89 | *** |

| | | | |
|---|---|---|---|
| | | | |
| Fixed costs | -1.6302 | -1.82 | |
| x 1(one dependent child) | 0.6132 | 0.62 | |
| x 1(two or more dependent children) | 1.2990 | 1.50 | * |
| | | | |
| Average wage elasticity of the head (hours) | 0.01 | | |
| Average wage elasticity of the spouse (hours) | 0.29 | | |
| Average wage elasticity of the head (participation) | 0.11 | | |
| Average wage elasticity of the spouse (participation) | 0.26 | | |
| Number of observations | 1024 | | |
| Log likelihood | -1456.2512 | | |

Note. The variables have been rescaled as follows: Income = disposable income in euros/30,000; Hours of leisure = (24x7 – weekly hours of work)/150; Age = (age in years – 38)/10; Education = average number of years of study/10.
* parameter significant at 10%, ** parameter significant at 5%, *** parameter significant at 1%
Average wage elasticities are computed by increasing the gross wage rate by 1%.

The coefficients in the regression corresponding to couples show that the marginal utility of income is positive for 94% of the sample, while the utility function is concave at standard significance levels. The older the spouse and the younger the household head, the higher is the marginal utility of income. The marginal utility of hours of leisure of the household head is positive, yet negative for the spouse, although this increases in line with the age of the spouse; this suggests that, as women's labour market participation has increased recently, they need to remain in employment longer in order to obtain retirement benefits. Alternatively, the negative coefficient of leisure, which increases with age, may be explained by childbearing, causing women to temporarily leave the labour force or to work only part-time, to then return when their children grow up. The effect of hours on marginal utility is dominant, and is not significantly affected by childrearing. Both low-educated men and women prefer to work longer hours than high-educated individuals. Fixed costs do not seem to affect utility for couples. Most of these results are similar to those provided by the existing literature (see Blundell *et al.*, 2000), although they also reflect the specific nature of the Spanish labour market, which, concretely, is inflexible with regard to the supply of hours (due partly to the rigidity of labour demand). Moreover, although the rate of labour market activity of women in Spain has notably increased in the last decades, this is still low relative to similar countries; the majority of the spouses in the couples subsample are women.

Finally, Tables 5 and 6 also show wage elasticities (for both hours of work and participation). Although it is possible to compute a distribution of these figures, we only report the values computed at sample means. We observe that the elasticity of singles' labour supply is approximately zero and that elasticities are higher in the case of couples: the average hours elasticity of the household head is approximately 0.1, and 0.29 for the spouse. These results are basically a result of participation elasticity, which is 0.11 for the head and 0.26 for the spouse. These results are in line with the empirical literature on the econometrics of labour supply (see Blundell and McCurdy, 1999), although, when comparing our results for married females with other similar studies, in which values range from 0.2 (see Bargain, 2005, for France) to 0.7 (see Das and van Soest, 2001, in the German case), very low levels should be observed. Our results probably reflect the rigidity of the Spanish labour market mentioned earlier.

*Figure 2: Weekly hours of work of singles and couples (household head and spouse)*

**Figure 2a: Singles**

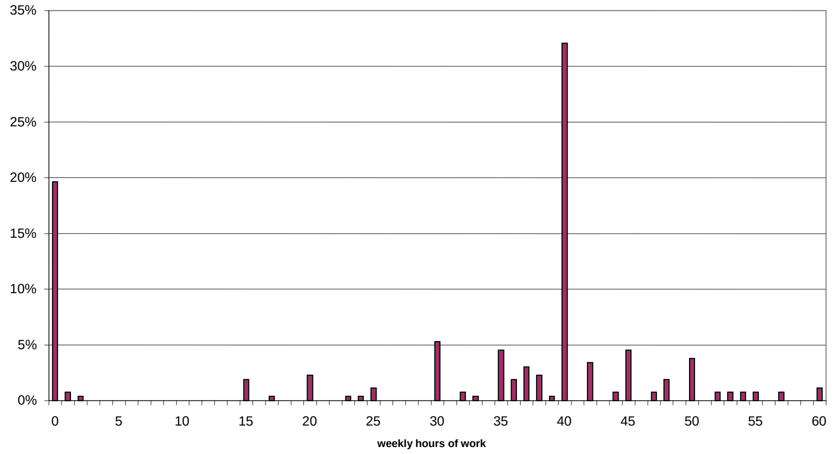



**Figure 2b: Couples – Household head**

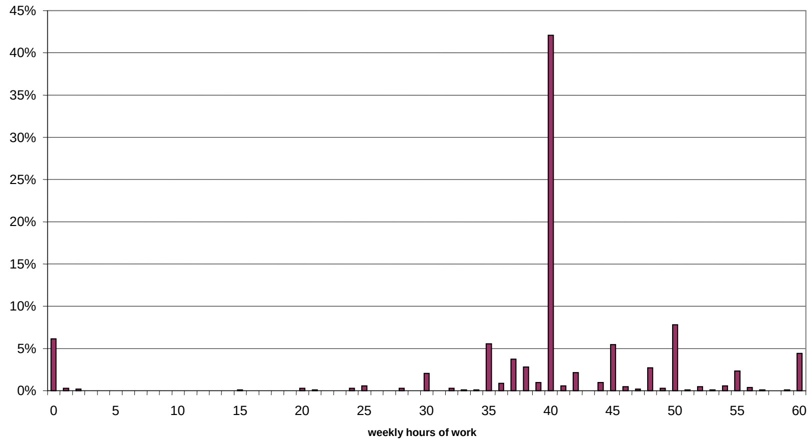
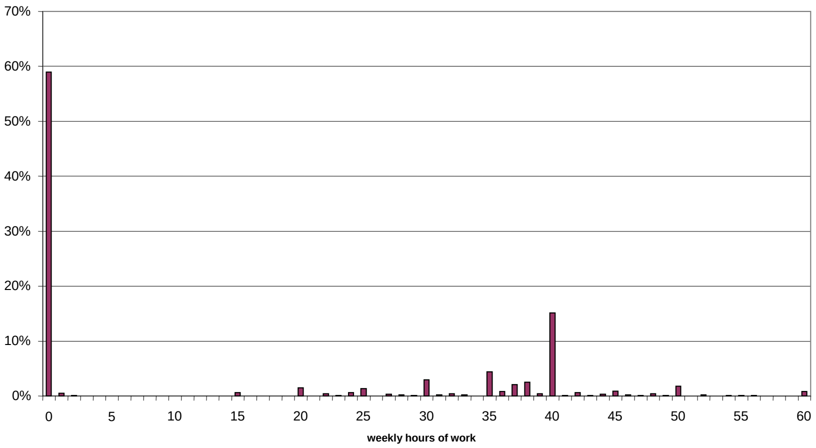



**Figure 2b: Couples - Spouse**



# 4 Polarization indices

*4.1 Introduction*

The study of income Polarization was introduced by Esteban and Ray (1994) and Wolfson (1994) as a complement to inequality indices to further characterize income distributions analysis. This is undertaken by explicitly modelling the possibility that a population could be grouped into clusters of significant size within which individuals tend to identify with the group and may feel alienated with respect to other groups or individuals. This behavioural/distributional hypothesis is known as the *identification-alienation* framework. One of the main features of such an approach is that it allows taking into account for possible social tensions between population groups as in the case of organized strikes, demonstration, revolts. Intuitive examples of possibly antagonistic groups are rich and poor, workers and entrepreneurs, religious groups, ethnic groups, regional groups and so on.

In this framework, the *within-group identification* occurs when a significant part of the population have similar characteristics, for example per-capita income or consumption levels, while *alienation* occurs when the member of such groups feels that their position is unfair with respect to other individuals or groups. In terms of income distribution, supposing that two modes are present, identification of the two groups is represented by the probability density function at, say, $x$ and $y$, while alienation is represented by the distance between $x$ and $y$. This situation is described in Figure 3. The more a group generates identity between its members and the more alienated the individuals belonging to one group are, the more polarization is strong. For this reason an increased polarization can be seen as a bad signal for a social planner which may be worried by possibly increasing social contrasts.[14]

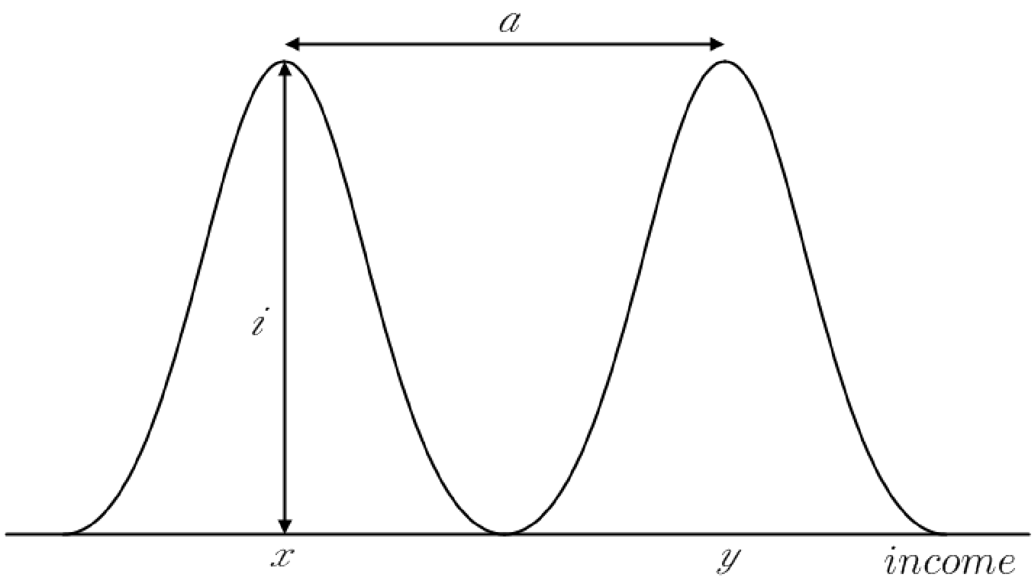



**Figure 3**

Our contribution focuses on the use of a microsimulation model to evaluate ex-ante the polarization effects that a policy reform may have on a socio-economic system. We chose some hypothetical policy reforms and show that, through micro-simulation tools, polarization measures can be used for the ex-ante evaluation of such policies, producing useful information which can be important in determining the final choice. Therefore our proposal raises the role of polarization measures from descriptive tools to active instruments for policy design, similarly to what has been done widely with inequality indices.

[14] It is worth emphasizing that polarization measures are not meant to substitute inequality indices, but rather to complement their information to better characterize the overall population wellbeing.

*4.2 The measure of polarization*

To measure polarization for the proposed scenarios of policy reforms we follow Duclos, Esteban and Ray (2004). The adopted framework is the identification-alienation described above. A characteristic of interest (for example per-capita income) with density function $f$ is chosen and the aim is to measure its polarization $P(f)$.

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 $x, f(x)$.

To measure polarization define a function of *effective antagonism* of $x$ toward $y$, $T(i,a)$, which depends on the degree of identification ($i$) and alienation ($a$), where $i=f(x)$ and $a=|x-y|$. The polarization index is defined as a measure proportional to the sum of all effective antagonisms

$$P(f)=\iint T(f(x),|x-y|)f(x)f(y)dxdy.$$

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 $\alpha$ is arbitrary chosen such that $\alpha\in[.25,1]$.[15] Finally, considering any distribution function $F$ with associated density $f$ and mean $\mu$, the polarization index can be written as

$$P_{\alpha}(F)=\int_{y} f(y)^{\alpha}a(y)dF(y),$$

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

Up to now we assumed that both identification and alienation depend on the same variable of interest. However it can be interesting to take into account that within-group identification and alienation may also depend upon other characteristics, as gender, ethnicity, religion, age.

Suppose that the population can be divided into $M$ social groups according to some demographic characteristics. Each group $j$ is composed by $n_j$ individuals, with the overall population normalized to one. Let $F_j$ describe the distribution of income in group $j$ (with $f_j$ the accompanying density). A hybrid measure of polarization in which both identification and alienation may depend on income and other characteristics is

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

For comparison purposes, we normalize polarization indices by multiplying them by $.5\mu^{\alpha-1}$, such that homogeneity of degree zero is achieved and that the polarization index calculated for $\alpha$ equal zero is the Gini coefficient.

*4.3 Empirical Strategy*

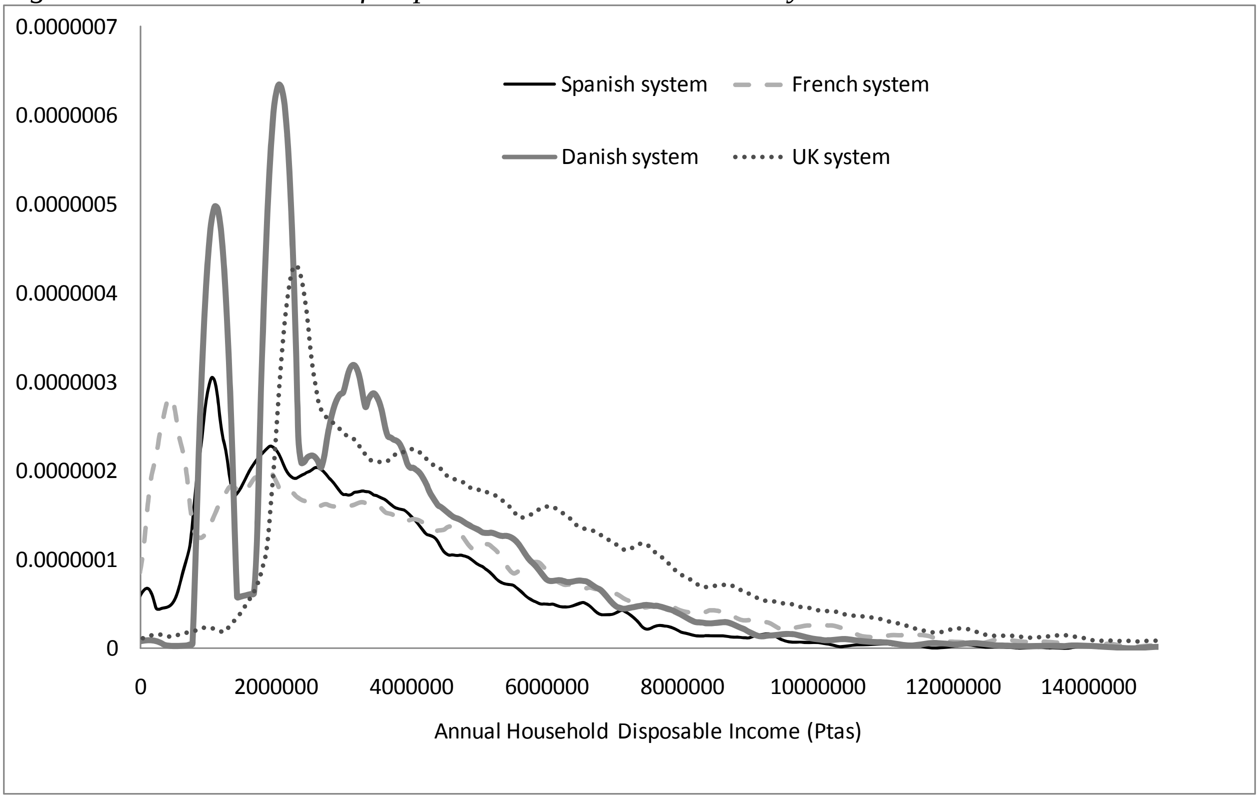
One of the main objectives of the paper is to show the benefits of taking into account of a measure of polarization in the ex-ante evaluation of the effects of a policy reform. We find particularly interesting the joint analysis of inequality and polarization with respect to the results of the simulated policies. It has been shown (for example in Seshanna and Decornez, 2003; Duclos, Esteban and Ray, 2004; Esteban, Gradin and Ray, 2007) that not only inequality and polarization measure different characteristics of income distribution, but they may also be in contrast and evolve independently toward different directions. Hence a country may have a low

---

[15] It is not clear if there is an optimal value of $\alpha$ to be chosen, however it is common practice to propose several index measures for different values of $\alpha$. For a deeper discussion see Duclos, Esteban and Ray (2004).

index of inequality but still have a high degree of polarization, or show at the same time a decreasing inequality and an increasing polarization over time, or *vice-versa*.
As a consequence, we find it useful and informative to use polarization indicators (along with traditional inequality indices) whenever a possible policy reform is evaluated ex ante through a microsimulation model. Our exercise follows this intuition and after computing the effects of the proposed policy reforms to each household in the Spanish sample, we calculate the Gini index and the DER (Duclos, Esteban and Ray) polarization index. Figure 4 show the Kernel density distribution of the disposable income under the four systems simulated.

*Figure 4. Kernel densities of disposable income under the 4 systems simulated*




On a first run we calculate the DER indices on disposable households' income taking into account four values of parameter $\alpha$, i.e. {.25, .5, .75, 1}. Then, for each index we calculate the ranking of the reforms taken into account with respect to the computed indices, showing that increasing values of $\alpha$ (meaning an increasing weight given to *identification* with respect to *alienation*, or, loosely speaking, an increased importance given at the additional information that polarization brings with respect to inequality) can change the ranking itself. When polarization is considered important, the preferred reform could be different from the one chosen when only inequality counts.
Taking the Spanish system a baseline, we then compute the difference in DER indices in order to evaluate if the reforms imply significant changes in the Gini and DER indices. This is likely to be the case when large general reforms are taken into account, as in our case, but still for some indices we find that the difference is not significant.
Finally, our polarization analysis concludes with an attempt to localize more explicitly the groups of population for which polarization is more important. We do this by selecting some demographic characteristics and by computing the DER and Gini indices on disposable income for the subgroups of population. This kind of analysis is particularly useful when the policy reform to be taken into account is targeted to rather specific groups of population, but as we show, it is useful also when large general reforms are analyzed. The variables that we selected are the age of the household head (three age classes: less that 35 years old, between 35 and 60 and

older than 60), gender (for singles without children), education of the household head (graduate studies or more, secondary education, primary education) and working status (employee, self employed and others - including inactive people).[16] To save on space we report the DER indices only for $\alpha$ equal to .5 and 1.

## 5 Evaluation of the reforms: efficiency, distributional and polarization effects

*5.1 Efficiency*

One of our main goals is to quantify the efficiency costs (measured in terms of hours of work) of the reforms. The reference scenario is 1999 Spanish system. Table 7 present the couples' labour supply transition matrices for the simulated reforms. Rows (i) contain the predicted distribution for each simulated scenario, whereas columns (j) show the observed distribution of working hours under the baseline scenario. Each cell $a_{ij}$ of the matrix displays the percent of individuals (households) changing from the observed alternative j to the predicted alternative i. The diagonal elements refer to the percent of observations whose labour supply is unchanged following the reform (single' transition matrices are omitted given that all the elements except the diagonal was zero – i.e. no labour supply reactions has been observed for singles).

Note that, as there are nine possible alternatives, for various combinations of the hours of work of the household head and his/her spouse, this table is somewhat complicated. Not all of the elements to the right (or left) of the diagonal represent a fall (or an increase) in the total hours of work. We can observe substitution between spouses' working hours.

*Table 7. Labour Supply Transition Matrices*

| | | 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 | 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 |

[16] The choice of these variables was not driven by the attempt of making an exhaustive population groups' polarization analysis, but rather by the will of showing by examples how much results can be enriched thanks to this kind of analysis. Many other characteristics could have been object of our analysis, but we leave them for future work.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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** |

Comparing the Spanish and the Danish scenarios, we can observe that only 0.1% percent of the individuals who do not work under the Spanish system, enter the labour market at different number of hours under the Danish one; 0.51% of observations exit from the labour market while 2.56% of them reduce their labour supply after the reform. Under the French scenario, participation falls by 0.1%, while reduction in labour supply affects an additional 0.4% of the individuals. Under the UK scenario, around 0.92 % of individuals reduce their labour supply. Interestingly, there are no effects on participation decisions.

With such evidence, two points should be stressed: firstly, the majority of households are on the diagonal, which implies that they do not alter their labour supply; secondly, the higher the marginal tax rate, the greater are the labour supply effects. The Danish system is the one with higher marginal tax rates and higher labour supply negative effects. The UK system follows and the French system closes the ranking as the one with lower marginal tax rates (overall for high earnings households).

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 French is evidence is explained by the combination of less family friendly policies, social norms and high taxation on secondary earners due to joint taxation. In the case of the UK system, the negative impact on spouse labour supply is to the higher marginal tax rates faced by low (or zero) income agents.

*5.2 Inequality and Polarization*

The other main goal of the paper is to evaluate ex-ante the income distribution effects that the reforms would have with respect to the Spanish system. To accomplish this issue we calculate a series of indices of income distribution and polarization as described in Section 4. To be more precise, after simulating the four systems of interest we calculate the Gini inequality index and several DER indices computed with different values of the reference parameter $\alpha$ and for different subgroups of the population.

Before entering into the details of the obtained results, we recall that this kind of analysis highly depends on the initial distribution and characteristics of the population and that the simulated reforms cover only partially the tax/benefit schedules taken into account.[17] Hence, when we say, for example, that the Danish system shows a higher polarization, we mean that applying the main characteristics of the Danish system to Spanish data, we observe a higher polarization index, not that Denmark has an income distribution more polarized than Spain.

Table 8 reports the Gini inequality index and four DER indices of polarization, one for each value of the parameter $\alpha$, that we interpret as the relative weight given to polarization with respect to inequality.

What emerges rather clearly is that each of the considered reforms reduces the overall inequality, and in the case of the Danish system the reduction is dramatic, bringing the Gini index from .36 to 0.22.

The same conclusion cannot be stated for the DER indices. In fact the result changes in relation to the chosen value of $\alpha$, with a completely reverted ranking in the case of $\alpha = 1$ (Table 9). In this case the Danish system shows the highest polarization index with a large difference from the Spanish system (Table 10).

For other values of $\alpha$ the situation is less clear, with an unchanged ranking for the values .25 and .5, and a rather uncertain ranking when $\alpha = .75$, where, as shown in Table 10, the difference from the Spanish system are non significant except for the Danish one.

*Table 8. Inequality and Polarization indexes - Disposable Income*

| | 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 9. Ranking - Disposable Income*

| | Gini | alpha = 0.25 | alpha = 0.5 | alpha = 0.75 | alpha = 1 |
|---|---|---|---|---|---|
| Spanish system | 4 | 4 | 4 | 2 | 1 |
| UK system | 2 | 2 | 2 | 1 | 3 |
| French system | 3 | 3 | 3 | 3 | 2 |
| Danish system | 1 | 1 | 1 | 4 | 4 |

*Table 10. Difference from Spanish system*

| | Gini | alpha = 0.25 | alpha = 0.5 | alpha = 0.75 | alpha = 1 |
|---|---|---|---|---|---|
| UK system | -0.0520 (0.0065) | -0.0271 (0.0039) | -0.0121 (0.0028) | -0.0014 (0.0024) | 0.0067 (0.0024) |
| French system | -0.0231 (0.0069) | -0.0104 (0.0041) | -0.0034 (0.0029) | 0.0010 (0.0025) | 0.0039 (0.0024) |

[17] The microsimulation model covers the main instruments of a welfare system, but it is virtually impossible to take into account any and all of the very specific measure that can be part of it. This is partially due to the fact that the data may not contain the minimum information needed to determine the amount/eligibility of a tax/benefit.

| | | | | | |
|---|---|---|---|---|---|
| Danish system | -0.1374 (0.0066) | -0.0753 (0.0041) | -0.0305 (0.0032) | 0.0065 (0.0032) | 0.0399 (0.0038) |

The fact that the UK system is more redistributive than the French one (the Gini is 0.3084 against 0.3373) should not surprise since the progressivity in the French schedule kicks in for relatively high values of income. The marginal tax rate for middle-high incomes is on average lower for the French system than the UK one, while for high incomes the situation is reverted. Moreover, it should be noted that Spain, especially in 1999, has significantly lower values of per-capita income than UK and France, hence the thresholds of the income tax rates in these systems might be too high to work properly with Spanish data.
The effect of French and UK systems on polarization is much less evident than the Danish one and a significant positive difference in the polarization indices can be observed only when $\alpha = 1$, even though the values are small.
To deepen the inequality and polarization analysis we focus on some population subgroups. We do not pretend to be exhaustive on this side, but rather to report some interesting examples, which put in evidence the meaningfulness of this analysis.

*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 11 reports the Gini index and the DER indices for $\alpha$ equal to .5 and 1 for the subgroups of the population based on the age of the household head. Three age class were generated corresponding to household head aged below 35, between 35 and 60, and above 60 years old. The Spanish system seems to generate a slightly higher inequality for the middle-aged and elderly classes, with a similar result (maybe a bit stronger) with respect to polarization. All the proposed reforms reduce inequality, with intensity similar to the general case described above. A slight preference seems to be given to young and middle-aged households.
Things change when we look at the DER indices. It can be seen immediately the big jump that the Danish system brings for the elderly: the polarization index is almost doubled for $\alpha = 1$. The young and middle-aged also show an increased polarization. While the French system seems to produce rather small polarization effects, the UK system shows an increase in polarization only for the elderly.

*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) |
| alp ha | 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) |

In Table 12 we divide the population into single men, single women (both without dependent children) and the rest of the sample. What appears first is that, singles, especially women, have a higher inequality index under the Spanish system, while it is not the case for the others, where single men always show the highest inequality. Under the Danish system, we even observe that women are characterized by the lower inequality index.
For these groups, polarization in clearly higher for single women in all the scenarios, with a rather surprising .76 for the Danish system (which increases polarization of the other groups as well when $\alpha - 1$). The French and the UK systems affect significantly single men as well, even to a lower degree respect to women, but seem to have a negligible impact on the rest of the sample.

*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 13 shows the inequality and polarization indices dividing population according to the education level of the household head. The Spanish system reveals a higher inequality for low-educated and highly educated household. All the proposed reforms reduce inequality. For the Danish system the reduction is more evident for primary and secondary education households, while the French and UK systems reduce inequality keeping the proportion between groups substantially unchanged, with the UK system being slightly more generous.
The polarization is not much different between these groups for the Spanish system and the situation is preserved (with small changes) with the French reform. Things are different considering the Danish system. Here polarization increases substantially for all the groups, with a stronger effect to the low-education households. The UK system, instead, diminishes polarization among graduates, but increases it slightly among low-education households.

*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) |

Finally, Table 14 reports the results for a population divided among employee, self employed[18] and a residual group (including, inactive people and atypical workers, which were too few in 1999 to be considered as a group themselves). As expected, the Spanish system shows a much higher inequality for self employed respect to employee.[19] Interestingly enough, with the Danish system, the situation would be reverted, even though the values would be very close and, overall, both substantially lower. The French system proposes almost identical values of the Gini index, while the UK system reduces both proportionally, keeping a relevant difference in favour of the employee.

Concern polarization, we see that the difference in the Spanish system is not large when $\alpha = 1$. The difference is larger when we consider the Danish reform, where both indices are larger, but self employed show quite a large jump. The French and UK systems do not shows significant differences in polarization of employee and self employed with respect to the Spanish system.

**6 Conclusions**

This paper analyses the impact upon efficiency, income distribution and polarization of the replacement of the actual Spanish redistribution system with several European schemes. We have simulated schemes similar to the ones enforced in France, UK and Denmark (corporatist, liberal and social-democratic model respectively).

The analysis has been performed using a microsimulation model in which labour supply has been explicitly taken into account. Instead of following the traditional continuous approach (Hausman 1981, 1985a, and 1985b), we have used the results of (Labeaga et a. 2008) that estimated the direct utility function employing the methodology proposed by Aaberge et al. (1995) and van Soest (1995).

To analyse the distributional effects of different reform scenarios we have computed different distributional measures based on household net incomes. Furthermore, as an innovative element of our analysis, we have estimated the polarisation effects of each redistributive scenario.

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

Concerning inequality and polarization, we have shown that the redistribution system which reduces the most inequality is the Danish one. To a lower degree, a result in this same direction can be achieved also adopting the French and UK systems. Adopting any of the systems evaluated would reduce income inequality with respect to the Spanish system, but, according to our results, the preferred system should be the Danish one.

However, when we take into consideration income polarization the situation is much less clear. In fact, in this respect the Danish system has the higher probability of generating an higher income polarization, with some particular groups of population which seem particularly affected. The other scenarios produce unclear polarization impacts even if, with respect to the baseline system, there is a generalized tendency toward a slightly increased polarization.

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.

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[18] It shoud be noted that the microsimulation model is not capable of simulating the behavioral response of the self-employed, due to the extreme difficulty of estimating a shadow salary for this group of workers, hence the proposed analysis lacks some potential information. However, how shown in the previous section, even among dependent workers very few decided to change their working behavior. We deduct that the analysis of these results is still meaningful even though it could eventually be improved.

[19] Here we do not analyze the residual group because it is too heterogeneous and suggested us to avoid specific conclusions about its indices.

However we want to stress that it goes beyond the aim of the paper to assess how much a policy maker should weight this additional polarization information. The point is that it has to be considered in some way (see Gajdos 2000).

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