A Microsimulation Evaluation of Efficiency, Inequality and Polarization Effects of Implementing the Danish, the French and the UK Redistribution System in Spain.

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Abstract[1]
This paper provides evidence about the effects of possible reforms of the Spanish direct redistribution system. We perform an ex ante evaluation of the impact upon efficiency, income distribution and polarization of the replacement of the Spanish system with 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. The results show that the simulated scenarios have little impact on the efficiency of the economy. We find that each of the new systems would reduce income inequality. However, when we take into consideration income polarization the effects of the reforms are ambiguous: in some case we observe a tendency toward a slightly increased polarization.
The results of the exercise highlight that, when polarization measures are seen as active instruments for policy design, rather than merely descriptive tools, the choice of the best reform appears more complex than considering income inequality alone. Moving from a positive to a normative analysis implies assessing how much a policy maker should weight this additional polarization information. Unfortunately, we still need a general framework for this type of social welfare analysis. This is an important argument for future research.

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

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1 Introduction

The Spanish social protection model belongs to what has been called "the Southern European (or Mediterranean)" welfare state regime (Esping Andersen 1990, 1999, Ferrera, 1996). This 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]).

Recent economic and socio-demographic trends in Spain determined the rise of new demands of social protection that the actual Spanish model is unable to fully cover.

Spanish experience with new social risks typifies many of the issue facing Mediterranean countries. New social risks have emerged strongly in relation to high levels of unemployment, especially among young people, and for the long-term unemployed where the rate is the highest in Europe after Italy, Greece and Germany. They are also beginning to appear in the conflict over reconciling work and family life for women. Family solidarity has traditionally sustained more vulnerable members, and helps to manage issues of poverty in the absence of robust state support. New policies that deregulate employment have intensified the risks for some groups. Limited access to secure jobs and weak assistance benefits contribute to one of the highest poverty rates in Europe and a highly unequal society.

Figures 1 and 2 show that Spain is still among the industrialized countries facing high levels of poverty and inequality. Table 1 and 2 show how the risk of poverty for older people has fallen, while poverty of young adults and families with children has risen.

These very crude stylized facts, as well as, the pressure for some kind of harmonization of the European social protection systems, have settled the ground, in the last years, for several proposals pushing for the reform of the Spanish welfare state.

The debate is centred on the possibility to learn from the experiences in other European countries in order to improve the performance and the coverage of the Spanish social protection.

Some reform proposals look toward a more market oriented system. 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

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

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 characterized 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 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 (in particular labour supply effects), 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).

To analyse the distributional effects of different reform scenarios we compute several measures based on individual and equivalence weighted household net incomes. Furthermore, as an innovative element of our analysis, we estimate the polarisation effects of each redistributive scenario following the rigorous conceptualization of the notion of polarization together with the corresponding measures provided by Esteban and Ray (1994) and Duclos et al. (2004). Loosely speaking, in any given distribution of income (but it could as well be political opinions or the ethnic composition of a society) we mean by polarization the extent to which population is clustered around a small number of distant poles.

The importance of including polarization analysis is straightforward: the more polarized a society is, the more likely it seems that a conflict can break out. In fact, the notion of polarization in Esteban and Ray (1994) is a deliberate attempt at capturing the degree of potential conflict inherent to a given distribution.

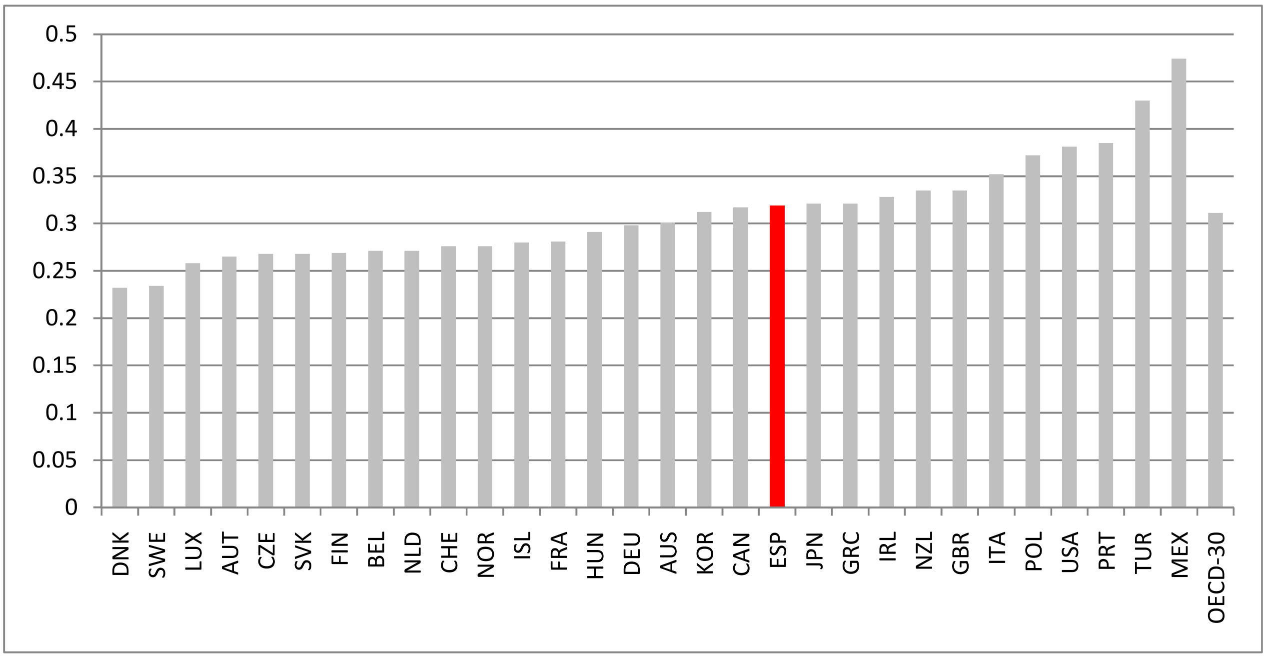
Indeed, most social scientists would agree that political or social conflict is more likely under a distribution of the population on two equally sized spikes -with maybe not completely extreme but sharply defined political opinions and involving population groups of significant size- rather than under a distribution showing extreme inequality –with all but one person holding one particular view and that one person at the other extreme of the spectrum. Thus, it is polarization –and not inequality- what matters for conflict.

With these consideration in mind, the fundamentals contributions of our paper can be resumed in two points. First, we want to offer some elements of clarification to the debate regarding the reforms of the welfare state in Spain by perform comparatives with other European welfare state regimes using polarization measures to enlarge the final picture of inequality results. Second, we want 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 limited. 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 small part of it.

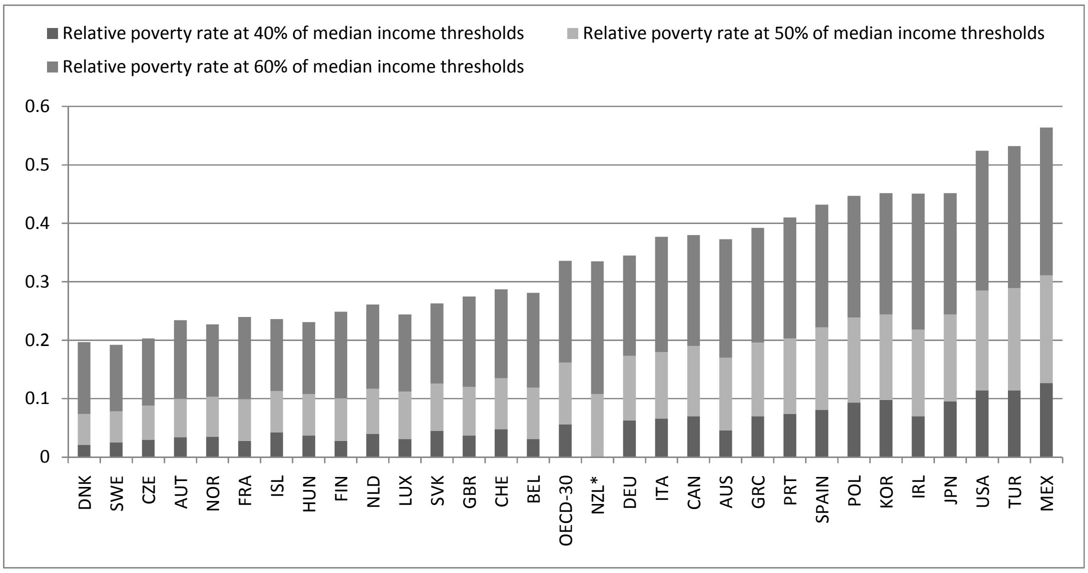
The layout of the paper is as follows. Section 2 presents the data, the microsimulation model and principal characteristics of redistribution systems simulated. Section 3 describes the labour supply model and the results of the econometric exercise. Section 4 presents the simulation results concerning efficiency, inequality and polarization. Section 5 concludes.

Figure 1. Gini coefficients of income inequality in OECD countries, mid-2000s.



Note: Countries are ranked, from left to right, in increasing order in the Gini coefficient. The income concept used is that of disposable household income in cash, adjusted for household size with an elasticity of 0.5. Source: "Growing Unequal? Income Distribution and Poverty in OECD Countries" - OECD © 2008 - ISBN 9789264044180.

Figure 2. Relative poverty rates for different income thresholds, mid-2000s. Relative poverty rates at 40, 50 and 60% of median income thresholds



Note: Poverty rates are defined as the share of individuals with equivalised disposable income less than 40, 50 and 60% of the median for the entire population. Countries are ranked, from left to right, in increasing order of income poverty rates at the 50% median threshold. The income concept used is that of household disposable income adjusted for household size. Poverty rates based on a 40% threshold are not available for New Zealand. Source: "Growing Unequal? Income Distribution and Poverty in OECD Countries" - OECD © 2008 - ISBN 9789264044180

Table 1. Poverty rates for people of working age and for households with a working-age head, by household characteristics

	Poverty among people of working age		Poverty in households with a head of working age													
			All	No workers	One worker	Two workers	All	No workers	One worker	Two workers	Single			Two or more adults		
			Level, mid-2000s				Point changes since mid-1990s				Level, mid-2000s					
	Mid-2000s	Point changes since 1995									Not working	Working part-time	Working full-time	Not working	Only working part-time	At least one working full-time
Spain	**11**	**-0.4**	**11**	**49**	**18**	**4**	**-0.2**	**9.6**	**1.5**	**1.5**	**62**	**27**	**18**	**46**	**26**	**9**
Australia	10	1.2	10	55	7	1	0.4	9.0	-0.5	0.2	72	12	2	42	13	2
Austria	7	2.2	6	22	6	3	3.6	1.3	1.7	6.1	31	17	5	16	4	4
Belgium	7	0.5	8	25	8	2	0.0	6.7	0.7	-0.8	29	18	6	22	20	3
Canada	12	2.8	13	66	21	4	2.5	6.2	6.1	1.2	79	50	11	54	23	4
Czech Republic	5	0.7	6	38	7	0	0.9	2.9	-2.0	0.1	56	[..]	6	28	[..]	2
Denmark	5	1.2	5	18	8	1	1.0	4.8	1.5	0.3	22	28	1	15	6	0
Finland	7	1.7	6	34	10	1	1.8	13.4	1.2	-0.2	47	13	2	16	13	1
France	7	-0.6	7	22	10	2	0.1	7.6	0.1	-0.7	31	8	6	18	4	4
Germany	10	2.8	12	40	7	1	3.4	4.7	1.9	-0.1	49	32	5	32	25	2
Greece	9	-1.2	10	26	18	3	-0.5	4.7	3.6	-1.2	33	34	9	22	25	8
Hungary	7	1.0	7	19	6	4	0.2	-4.9	-4.6	-0.7	39	[..]	[..]	15	11	2
Iceland	7	..	7	28	19	4	..	..	..	..	23	25	10	40	13	5
Ireland	12	3.3	13	63	15	2	..	..	..	..	75	36	7	55	29	3
Italy	10	-2.8	11	36	16	1	-3.1	-2.2	-1.3	-3.1	40	50	4	36	33	8
Japan	12	0.4	12	42	14	9	0.8	2.2	1.3	-0.3	57	..	..	31	..	..
Korea	12	..	11	58	13	4	..	..	..	..	53	..	..	61	..	..
Luxembourg	8	2.8	9	19	15	3	3.3	7.3	7.3	1.6	28	35	12	14	28	10
Mexico	15	-2.2	18	37	26	10	-2.9	-3.5	-0.2	-3.5	30	..	..	41	..	..
Netherlands	7	0.6	8	34	13	2	1.0	-0.3	4.4	0.9	40	..	..	27	..	..
New Zealand	11	3.3	12	46	19	4	2.5	15.2	8.5	0.1	51	41	9	42	[..]	6
Norway	7	1.0	6	38	4	0	0.9	1.0	0.0	0.2	47	[..]	[..]	22	..	..
Poland	14	..	16	33	23	5	..	..	..	..	40	..	..	31	..	..
Portugal	11	-0.4	11	37	24	3	0.0	-2.4	3.3	0.2	58	31	16	33	26	8
Slovak Republic	8	..	9	38	15	1	..	..	..	..	35	21	20	40	21	6
Sweden	6	1.4	5	23	9	1	1.4	7.6	2.6	0.2	23	16	1	21	[..]	1
Switzerland	7	0.5	6	25	6	2	0.5	6.2	2.5	-3.0	26	[..]	[..]	25	[..]	[..]
Turkey	14	0.4	17	19	17	18	1.8	-11.5	-0.1	4.2	33	[..]	[..]	18	[..]	[..]
United Kingdom	7	-0.3	8	33	7	1	-1.2	-1.4	-1.9	0.0	38	11	3	28	22	2
United States	15	1.0	16	71	25	5	0.0	-3.2	-0.8	-0.4	80	54	14	63	12	7
OECD	9	0.8	10	36	14	3	0.7	3.2	1.5	0.1	46	28	8	33	19	4

Note: Poverty thresholds are set at 50% of the median income of the entire population. Data for changes refer to the period from the mid-1990s to around 2000 for Austria, Belgium, the Czech Republic, Ireland, Portugal and Spain (where 2005 data, based on EU SILC, are not comparable with those for earlier years); and to changes from 2000 to 2005 for Switzerland. For Switzerland, figures on poverty in households with a head of working age are restricted to households without children. [..] indicates that the sample size is too small.

Source: Computations from OECD income distribution questionnaire.

Table 2. Poverty rates for children and people in households with children by household characteristics

	Poverty among children		Poverty in households with children									
			All		Single		Couple			By number of children		
	Mid-2000s	Point changes since mid-1990s	Level, mid-2000s	change from 1995	Level, mid-2000s							
					Not working	Working	No workers	One worker	Two and more workers	One	Two	Three and more
Spain	**17**	**1.9**	**15**	**1.1**	**78**	**32**	**71**	**23**	**5**	**10**	**16**	**29**
Australia	12	-1.2	10	-1.0	68	6	51	8	1	9	10	11
Austria	6	6.0	6	6.1	51	11	36	4	3	6	5	6
Belgium	10	-0.8	9	0.1	43	10	36	11	3	7	9	11
Canada	15	2.2	13	1.6	89	32	81	22	4	11	13	18
Czech Republic	10	1.7	8	1.4	71	10	43	9	1	8	6	[..]
Denmark	3	0.8	2	0.7	20	4	21	5	0	2	2	4
Finland	4	2.1	4	1.9	46	6	23	9	1	5	3	3
France	8	0.3	7	-0.2	46	12	48	12	2	6	7	10
Germany	16	5.1	13	4.2	56	26	47	6	1	13	13	14
Greece	13	0.9	12	0.9	84	18	39	22	4	8	13	19
Hungary	9	-1.6	8	-1.1	44	16	22	6	3	5	6	14
Iceland	8	..	7	..	23	17	51	29	4	7	6	10
Ireland	16	2.3	14	..	75	24	55	16	2	12	12	19
Italy	16	-3.4	14	-3.1	[..]	16	78	24	1	..	..	..
Japan	14	1.6	12	1.2	60	58	50	11	10	..	..	..
Korea	10	..	9	..	29	26	65	10	4	..	..	..
Luxembourg	12	4.5	11	3.8	69	38	27	16	5	7	13	14
Mexico	22	-3.8	19	-2.4	30	34	53	27	11	11	16	26
Netherlands	12	1.0	9	1.2	62	27	65	12	2	..	..	..
New Zealand	15	2.3	13	1.5	48	30	47	21	3	..	..	..
Norway	5	0.9	4	0.6	31	5	29	4	0	4	2	6
Poland	22	..	19	..	75	26	51	28	6	15	18	31
Portugal	17	0.0	14	0.4	[..]	26	53	34	5	10	17	[..]
Slovak Republic	11	..	10	..	66	24	66	18	2	..	..	..
Sweden	4	1.5	4	1.5	18	6	36	14	1	4	3	3
United Kingdom	10	-3.6	9	-3.7	39	7	36	9	1	4	6	20
United States	21	-1.7	18	-1.1	92	36	82	27	6	14	15	26
OECD	12	1.0	11	0.8	54	21	48	16	4	8	10	15

Note: Poverty thresholds are set at 50% of the median income of the entire population. Data for changes refer to the period from the mid-1990s to around 2000 for Austria, Belgium, the Czech Republic, Ireland, Portugal and Spain (where 2005 data, based on EU SILC, are not comparable with those for earlier years); and to changes from 2000 to 2005 for Switzerland. [..] indicates that the sample size is too small. Data based on cash income (see note 13 for the implications of this). Source: Computations from OECD income distribution questionnaire.

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

Gladhispania is a microsimulation model that has been developed at the University of Balearic Islands (see Oliver and Spadaro 2004). It is built on the Spanish wave of the European Community Household Panel (ECHP). It simulates the personal income tax and the social insurance contribution on wages.

Table 3 gives the results of the model's calibration and compares them to the corresponding aggregate figures reported in official statistics.

Table 3. Calibration of GLADHISPANIA (in billions of Euros)

		1999	
	Official Statistics	Gladhispania	Difference
	(4)	(5)	(6) = (5-4)/4
Mean disposable household Income	18,375[a]	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) INE; (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;

The statistics describing the variables used in the econometric section are given in Table 4, while the scenarios simulated are described below.

Table 4. 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	

Four systems have been simulated with Gladhispania.

Spanish system

The baseline is the 1999 Spanish tax-benefit system. It takes into account personal conditions mainly 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 first being individual and the second family-based. They reduce taxable income as follows; the minimum personal allowance is 3,305.57 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. The tax system is individualized with 6 tax brackets (see Table 5).

Table 5. Tax rates schedule (in Euros)

Spanish system (1999)		**UK system (2001)**		**French system (1998)**		**Danish system (2001)**	
up to	Tax rate	up to	Tax rate	up to	Tax rate	State tax bracket	Tax rate
3,606	18.0%	2,956	10%	3,947	0.0%	Bottom: 4,481	6.25%
12,621	24.0%	48,284	22%	7,764	10.5%	Middle: 23,867	6.00%
24,642	28.3%	over 48,284	40%	13,667	24.0%	Top: 37,148	15.00%
39,666	37.2%			22,129	33.0%		
66,111	45.0%			36,007	43.0%	Local tax bracket: 4,481	31.75%
over 66,111	48.0%			44,404	48.0%		
				over 44,404	54.0%		

UK system

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

The UK income tax scheme is an individual system, with the revenues 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 a unified tax schedule. 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 5 for further details).

Child benefit is a universal flat-rate benefit of 884 Euros paid to the carer of each dependent child. 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 working (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 for a job. If family income is less than the threshold (7,100 Euros for a couple without children), IS makes up the shortfall.

Finally, a working family tax credit (WFTC) 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.

French System

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

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 per month. The scheme of the French income tax is rather complicated and some deductions and tax credits are ignored due to the lack of data. It is based on the "Quotient Familial" (QF). The system gives a weight to each member of the family and adds them together to compute a QF. The taxable income is obtained dividing the total household gross income 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, the income tax due is computed following the tax schedule provided in Table 5.

Danish System

The simulated social-democratic scenario is a simplification of the Danish system. 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 complex set of rules that covers several social events such as unemployment, illness or divorce for low incomes families. 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). Non-dependent children living with their parents are entitled to a benefit of 3,860 Euros.

The income tax is again a complex device. Taxable income includes all sources of income except family allowances and social assistance. There are 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% (see Table 5). To better understand the functioning of the "Danish simulated" tax system the following example is useful: a single worker with an annual income of 100,000 Euros will pay a total income tax of: (100,000 - 4,481)*0.0625 + (100,000 - 23,867)*0.06 + (100,000 - 37,148)*0.15 + (100,000 - 4,481)*0.3175 = 50,293 Euros.

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 legal base (closely related to gross salary) and the rate applicable to each individual taking into account personal circumstances.

For the sake of simplicity we performed all the simulation leaving unchanged the social contribution rules levied under the Spanish system[3].

To illustrate the changes implied by the four systems, Figure 3 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.

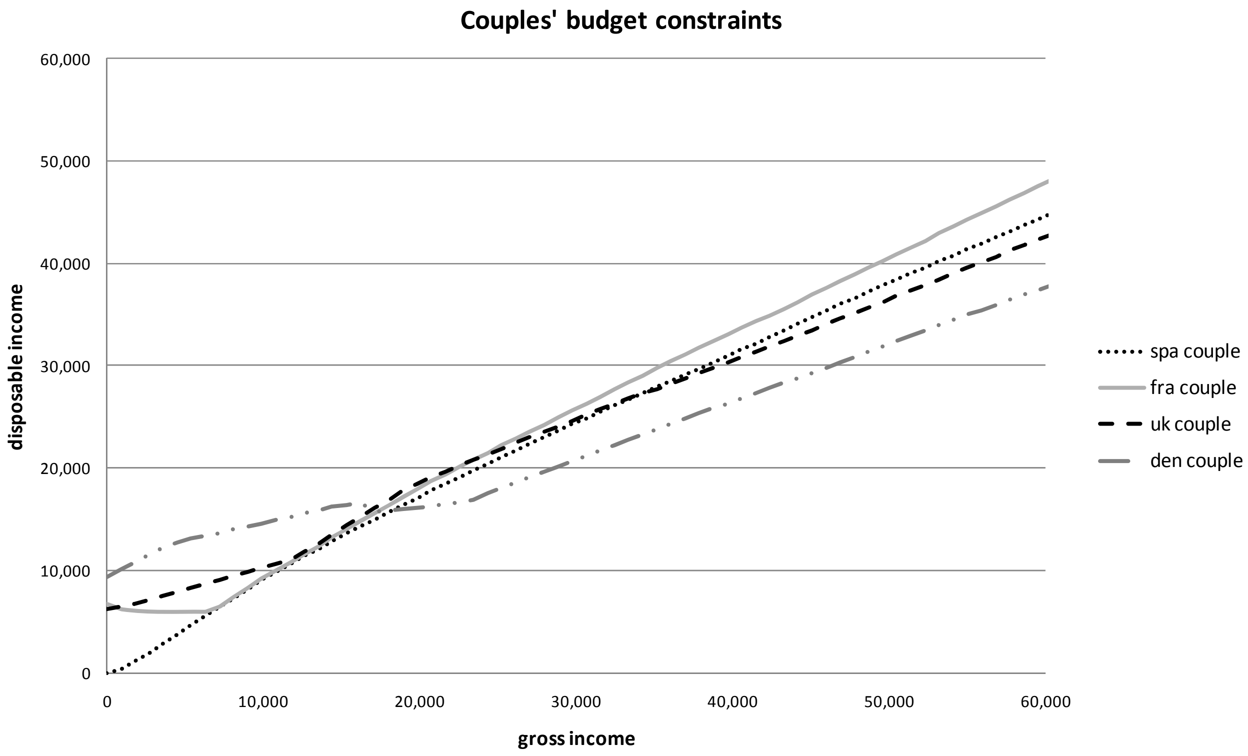
Contrary to the UK and Danish ones, the French RMI minimum income scheme implies a relatively flat budget constraint at low income level, due to the high taper rates responsible for very high effective marginal tax rates (around 100%). The UK and the Danish effective marginal tax rate on low income are lower than 100% (these systems are built to reduce the disincentive effects of the minimum income schemes)

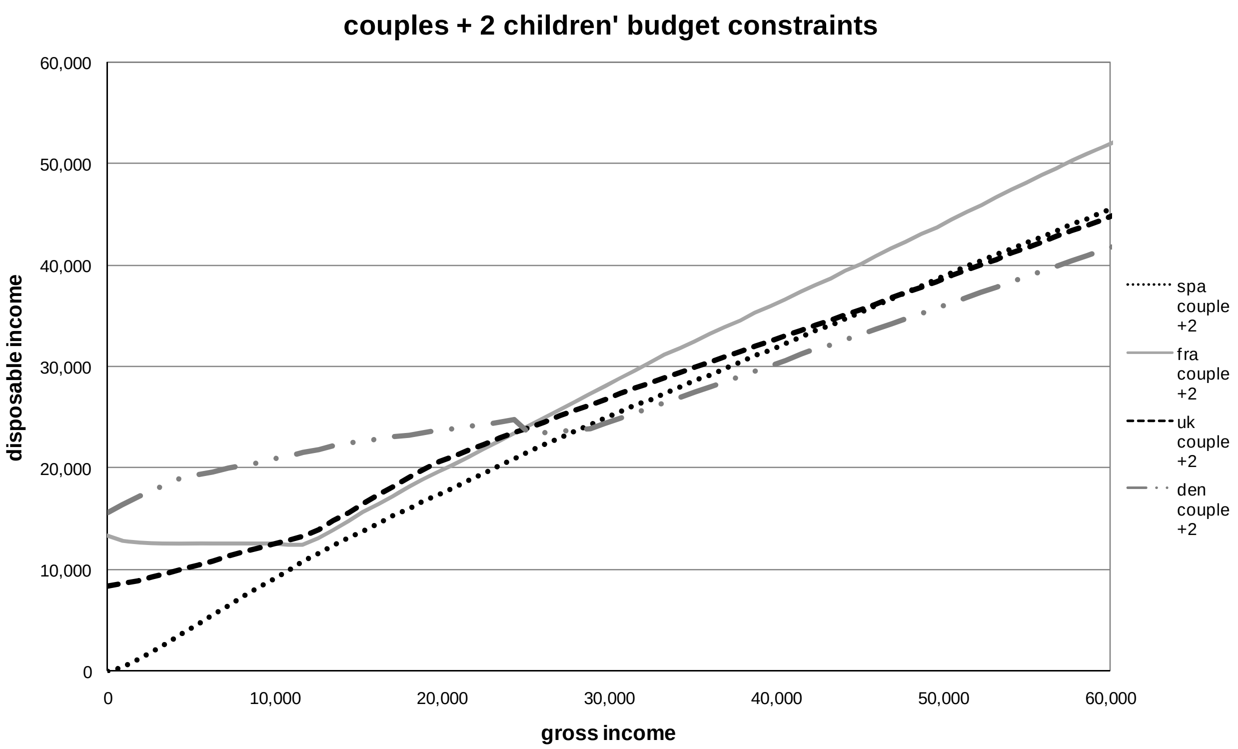
There is a clear contrast between Danish, French and UK regimes on the one hand (with large redistributive effects due to both contributory and non-contributory benefits) and the actual Spanish system.

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.

Figure 3. Budget constraints

[3] The difference in their size and importance as a redistributive device in France, Denmark and UK makes their inclusion in our analysis really difficult to treat and discuss properly.





3. The results of the labour supply microeconometric estimation[4]

3.1. The labour supply model

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

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:

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

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, μ, and the tax system $T(h, w, \mu, Z)$, where $h = T - L$. If there are no fixed costs, the budget constraint is:

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

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:

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

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. As usual, we perform separate estimations on singles and households. For singles, we adopt the flexible quadratic utility function (as in Keane and Moffit, 1998, and Blundell *et al.*, 2000):

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

For couples, the specification is the following:

$$\begin{aligned} U^*(y,h_h,h_c,Z_h,Z_c,Z) &= \alpha_{yy}y^2 + \alpha_{h_h h_h} h_h^2 + \alpha_{h_c h_c} h_c^2 + \alpha_{y h_h} y h_h + \alpha_{y h_c} y h_c + \alpha_{h_h h_c} h_h h_c + \\ &+ \beta_y y + \beta_{h_h} h_h + \beta_{h_c} h_c + \varepsilon_{h_h h_c} \end{aligned} \quad (5).$$

The variables h_i and Z_i, $i = h, c$, are, respectively, hours of leisure 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:

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

These functional forms are easily tractable and also allow a wide range of potential behavioural responses.[5]

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, β_{fc}, are estimated together with the remaining parameters of the utility function. The details of the econometric methodology are presented in the Appendix 1.

3.2 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 4*a* presents the distribution of hours of work for singles; Figures 4*b* and 4*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 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

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

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.[6] The typology of households used both for simulation and estimation is reported in Table 6.

Table 6. 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[7] as the observables entering vectors Z_m, Z_f and Z in equation (6), capturing differences in preferences. Tables 7 and 8 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 7. Estimation for singles

Variable	Coefficient	Z	
Income^2	-0.413	-0.81	
Hours of leisure^2	-236.955	-7.31	***
Income x hours of leisure	29.061	5.00	***
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	***

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

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 8. Estimation for couples

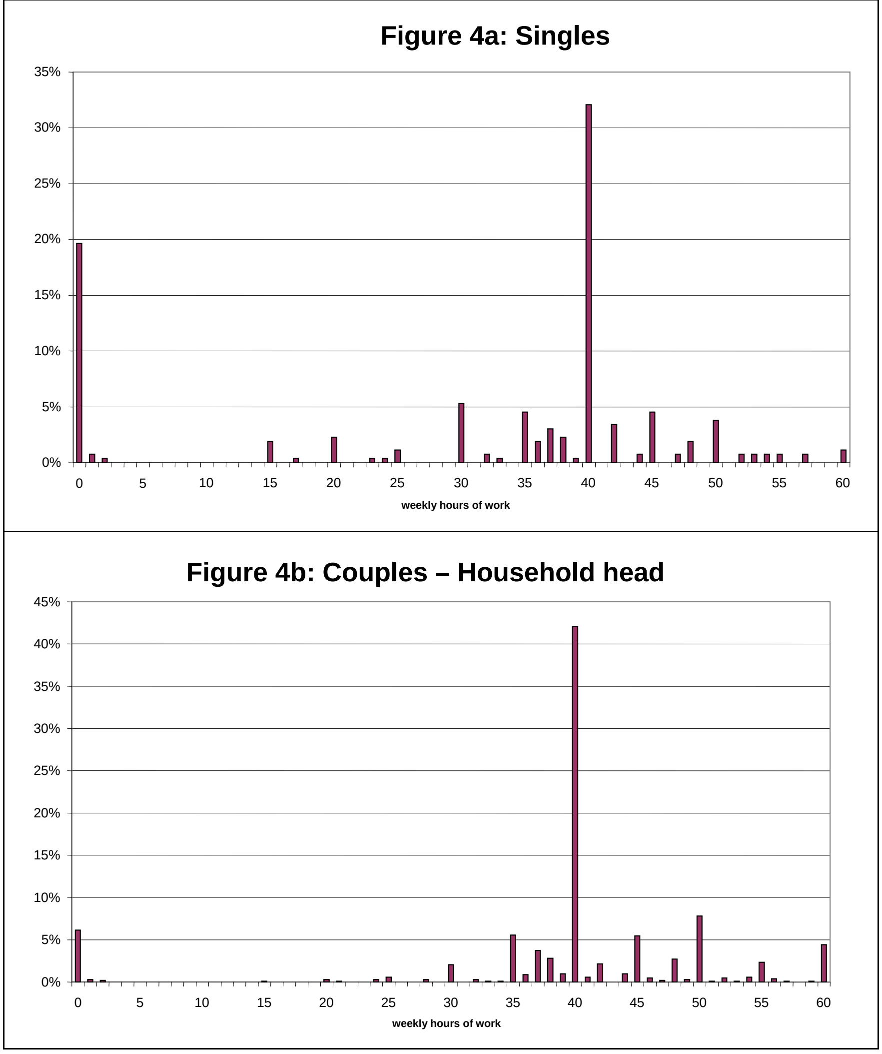
Variable	Coefficient	z	
Income^2	-0.228	-1.92	*
Hours of leisure of the household head^2	-89.641	-12.45	***
Hours of leisure of the spouse^2	87.964	10.97	***
Income x Hours of leisure of the household head	-0.155	-0.14	
Income x Hours of leisure of the spouse	-0.309	-0.35	
Hours of leisure of the household 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 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 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	

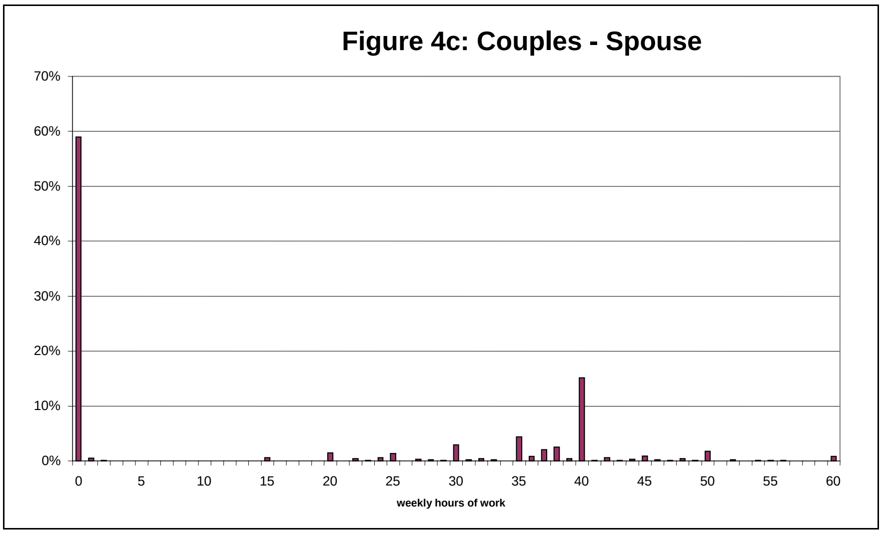
x 1(two or more dependent children)	1.2990	1.50	*
Average wage elasticity of the head (hours)	0.01		
Average wage elasticity of the spouse (hours)	0.29		
Average wage elasticity of the head (participation)	0.11		
Average wage elasticity of the spouse (participation)	0.26		
Number of observations	1024		
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 7 and 8 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 4: Weekly hours of work of singles and couples (household head and spouse)





4 Evaluation of the reforms: efficiency, distributional and polarization effects

4.1 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 9a and 9b present, respectively, the couples and the singles 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. Note that, in case of couples, as there are nine possible alternatives, (one for each combination of the hours of work of the household head and his/her spouse) table 9a 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 9a. Couples' 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	**0.41**	0.00	0.05	0.14	0.01	0.05	0.10	0.01	0.01	0.77
	0_25	0.00	**0.45**	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.47
	0_40	0.00	0.01	**5.79**	0.01	0.01	0.04	0.00	0.00	0.00	5.86
	40_0	0.00	0.02	0.06	**38.95**	0.03	0.08	0.26	0.01	0.06	39.47
	40_25	0.00	0.00	0.01	0.04	**5.78**	0.00	0.00	0.00	0.00	5.84
	40_40	0.00	0.01	0.03	0.19	0.02	**17.89**	0.05	0.00	0.00	18.20

	50_0	0.00	0.02	0.04	0.36	0.03	0.09	**20.03**	0.02	0.03	20.61
	50_25	0.00	0.00	0.00	0.03	0.00	0.01	0.01	**2.35**	0.00	2.40
	50_40	0.00	0.01	0.01	0.08	0.02	0.04	0.02	0.00	**6.21**	6.38
	Total	0.41	0.52	6.00	39.81	5.89	18.20	20.48	2.38	6.31	**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	**0.16**	0.00	0.01	0.07	0.01	0.02	0.06	0.00	0.00	0.33
	0_25	0.00	**0.50**	0.01	0.01	0.00	0.02	0.00	0.00	0.00	0.54
	0_40	0.00	0.01	**5.73**	0.03	0.01	0.04	0.02	0.00	0.01	5.85
	40_0	0.13	0.00	0.09	**39.10**	0.03	0.04	0.47	0.01	0.03	39.90
	40_25	0.01	0.00	0.02	0.13	**5.78**	0.00	0.11	0.01	0.01	6.06
	40_40	0.02	0.00	0.07	0.40	0.06	**18.07**	0.40	0.05	0.08	19.15
	50_0	0.08	0.00	0.05	0.01	0.01	0.01	**19.30**	0.00	0.01	19.46
	50_25	0.00	0.00	0.01	0.01	0.00	0.00	0.03	**2.30**	0.00	2.35
	50_40	0.01	0.00	0.02	0.06	0.01	0.00	0.09	0.01	**6.17**	6.36
	Total	0.41	0.52	6.00	39.81	5.89	18.20	20.48	2.38	6.31	**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	**0.28**	0.00	0.01	0.27	0.01	0.08	0.13	0.01	0.01	0.81
	0_25	0.00	**0.52**	0.01	0.11	0.00	0.05	0.05	0.00	0.01	0.76
	0_40	0.00	0.00	**5.90**	0.59	0.05	0.73	0.18	0.01	0.07	7.54
	40_0	0.08	0.00	0.03	**38.82**	0.05	0.27	0.90	0.05	0.22	40.42
	40_25	0.00	0.00	0.01	0.01	**5.76**	0.05	0.07	0.01	0.05	5.96
	40_40	0.01	0.00	0.02	0.00	0.00	**16.98**	0.11	0.01	0.08	17.22
	50_0	0.04	0.00	0.01	0.00	0.01	0.03	**19.02**	0.01	0.06	19.18
	50_25	0.00	0.00	0.00	0.00	0.00	0.01	0.01	**2.28**	0.01	2.30
	50_40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**5.80**	5.82
	Total	0.41	0.52	6.00	39.81	5.89	18.20	20.48	2.38	6.31	**100.00**

Evidence for couples basically tells us that there is not relevant changes of the households labour supply behaviour. After the Danish reform, we can observe that there agents not working before the reform still remain at home; 0.36% of observations exit from the labour market while 0.78% of them reduce their labour supply after the reform. Under the French scenario, participation increases by 0.08%, while reduction in labour supply affects a 0.22% of the individuals. Under the UK scenario, around 4.05 % of individuals reduce their labour supply. Participation falls by 0.48%.

Evidence for singles is a little bit different (see Table 9b). The UK and the French scenarios produce very similar impact on participation and labour supply. In the first case participation is reduced by 2.2% and the total labour supply is reduced by 4.2%. In the second case participation is reduced by 3.6% and the total labour supply is reduced by 4.3%. The Danish scenario is the system that produces the strongest effects on the efficiency of the system: single aggregate labour supply is reduced by 13.2% meanwhile participation decrease by 14.3%. This is basically due to the large "decommodification" effects obtained with the minimum income subsidy.

Table 9b. Singles' Labour Supply Transition Matrices

			Spanish system			
Working hours		0	30	40	50	total
Danish System	0	**18.90**	2.73	8.84	3.13	33.60
	30	0.05	**9.17**	0.32	0.44	9.99
	40	0.26	0.79	**39.15**	0.51	40.71
	50	0.09	0.44	1.10	**14.06**	15.70
	total	19.31	13.13	49.42	18.15	100.00

			Spanish system			
Working hours		0	30	40	50	total
French System	0	**18.90**	0.61	2.35	1.06	22.92
	30	0.04	**12.33**	0.35	0.19	12.91
	40	0.22	0.14	**46.69**	0.31	47.36
	50	0.15	0.05	0.03	**16.59**	16.81
	total	19.31	13.13	49.42	18.15	100.00

			Spanish system			
Working hours		0	30	40	50	total
UK System	0	**18.99**	0.24	1.36	0.87	21.46
	30	0.08	**12.78**	0.78	0.56	14.20
	40	0.14	0.07	**47.28**	0.76	48.24
	50	0.10	0.03	0.00	**15.96**	16.09
	total	19.31	13.13	49.42	18.15	100.00

With such evidence, two points should be stressed: first, the majority of households are on the diagonal, which implies that they do not alter their labour supply behaviour; second, 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.

4.2 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 Appendix 2.

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.

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. 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.

We first calculate the DER (from Duclos, Esteban and Ray, 2004) indices on disposable households' income taking into account four values of parameter α, i.e. {.25, .5, .75, 1} (this parameter can be interpreted as the relative weight given to polarization with respect to inequality: the higher is the higher is the importance of polarization[8]). We then conclude our polarization analysis 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

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

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).[9].

Figure 5 show the Kernel density distribution of the disposable income under the four simulated systems.

Figure 5. Kernel densities of disposable income under the 4 systems simulated

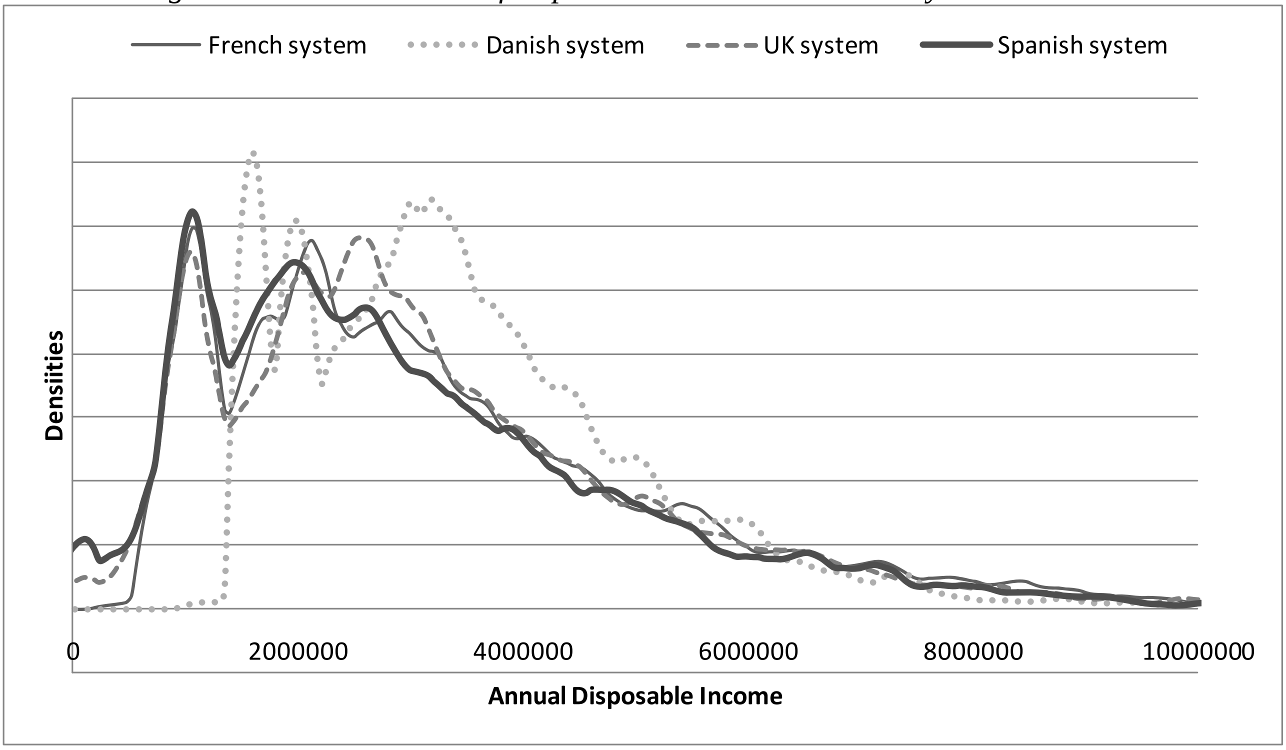


Table 10 reports the Gini inequality index and four DER indices of polarization, one for each value of the parameter α, that as explained before, we interpret as the relative weight given to polarization with respect to inequality.

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 rather strong, bringing the Gini index from .35 to 0.24.

The same conclusion cannot be stated for the DER indices. In fact the result changes in relation to the chosen value of α, with a completely different ranking in the case of $\alpha = 1$. In this case the French system shows the highest polarization index, even if the difference from the Spanish system is not large.

The intuition behind this results is that the French redistribution system penalizes the middle class in favour of the poorest decile of the income distribution (the effective average tax rate for the decile

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[9] The choice of these variables is purely illustrative of how the polarization analysis can be enriched when heterogeneous datasets are available. An exhaustive population groups' polarization analysis is out of the scope of the present paper.

from 3 to 6 increase by 6% on average) leaving more or less unchanged the situation of the richest deciles. The result is an increase in the distance among the two first modes of the income distribution (see Figure 4) and, as a consequence, an increase in polarization.

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

Table 10. Inequality and Polarization indexes - Disposable Income (in brackets standard errors obtained by bootstrap)

	Gini	alpha = 0.25	alpha = 0.5	alpha = 0.75	alpha = 1
Spanish system	0.35 (0.0041)	0.26 (0.0024)	0.21 (0.0016)	0.18 (0.0014)	0.15 (0.0013)
UK system	0.31 (0.0031)	0.24 (0.0019)	0.20 (0.0013)	0.17 (0.0010)	0.15 (0.0009)
French system	0.32 (0.0036)	0.25 (0.0022)	0.21 (0.0016)	0.18 (0.0014)	0.16 (0.0014)
Danish system	0.24 (0.0030)	0.20 (0.0019)	0.18 (0.0014)	0.16 (0.0012)	0.15 (0.0012)

The only reform that would reduce both the Gini and all the DER indices is the UK system. The reduction is always significant, but for high levels of α it is rather small. On the other side, the Danish system shows a stronger reduction on the Gini index, but the reduction of polarization is not so strong, and not significant when $\alpha = 1$.

The fact that the UK system is more redistributive than the French one (the Gini is 0.31 against 0.32) should not be a 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 the income distribution of Spain.

To deepen the inequality and polarization analysis we now focus on some population subgroups. We do not pretend to be exhaustive on this side, but rather to report some interesting examples as evidence of the meaningfulness of this analysis.

Table 11. Polarization by age class

		Spanish system	Danish system	French system	UK system
Gini	Less than 35	0.33 (0.0121)	0.18 (0.0078)	0.27 (0.0077)	0.26 (0.0086)
	Between 35 and 60	0.33 (0.0055)	0.22 (0.0040)	0.31 (0.0048)	0.29 (0.0041)
	More than 60	0.35 (0.0067)	0.26 (0.0050)	0.35 (0.0061)	0.35 (0.0056)
alpha=.5	Less than 35	0.21 (0.0058)	0.15 (0.0046)	0.19 (0.0042)	0.18 (0.0040)
	Between 35 and 60	0.21 (0.0022)	0.17 (0.0019)	0.20 (0.0022)	0.19 (0.0017)
	More than 60	0.23 (0.0033)	0.21 (0.0033)	0.23 (0.0033)	0.23 (0.0029)
alp	Less than 35	0.15 (0.0042)	0.15 (0.0042)	0.16 (0.0039)	0.15 (0.0032)

	Between 35 and 60	0.15 (0.0016)	0.15 (0.0018)	0.16 (0.0019)	0.15 (0.0015)
	More than 60	0.18 (0.0037)	0.21 (0.0048)	0.18 (0.0037)	0.17 (0.0033)

Table 11 reports the Gini index and the DER indices for α 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 higher inequality for the middle-aged and elderly classes, with a similar result in the polarization indices. 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 in all of these systems. This result is driven by the fact that the minimum income schemes simulated are, in practice, less favourable to elderly classes.

Things change when we look at polarization indices. Polarization is not reduced for all indices and for all subgroups, varying from time to time, and showing some sharp increase, as the Danish system for elderly household head and $\alpha = 1$.

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

		Spanish system	Danish system	French system	UK system
Gini	Couples	0.33 (0.0044)	0.22 (0.0032)	0.31 (0.0039)	0.29 (0.0033)
	Males	0.39 (0.0149)	0.26 (0.0122)	0.37 (0.0151)	0.35 (0.0132)
	Females	0.42 (0.0205)	0.26 (0.0182)	0.41 (0.0212)	0.42 (0.0201)
alpha=.5	Couples	0.21 (0.0018)	0.17 (0.0015)	0.20 (0.0017)	0.19 (0.0014)
	Males	0.24 (0.0085)	0.21 (0.0090)	0.23 (0.0093)	0.23 (0.0077)
	Females	0.29 (0.0171)	0.32 (0.0243)	0.31 (0.0191)	0.30 (0.0171)
alpha=1	Couples	0.15 (0.0014)	0.15 (0.0014)	0.16 (0.0015)	0.15 (0.0010)
	Males	0.17 (0.0069)	0.20 (0.0097)	0.18 (0.0077)	0.17 (0.0062)
	Females	0.29 (0.0240)	0.65 (0.0542)	0.34 (0.0280)	0.31 (0.0247)

In Table 12 we divide the population into single men, single women (both without dependent children) and the rest of the sample (which in the table we call "couples" for simplicity). What appears first is that, singles, especially women, have a higher inequality index, especially under the Spanish system. Under the Danish system, we observe that single women are paired with single men. For these groups, polarization in clearly higher for single women in all the scenarios, with a rather surprising .65 value for the Danish system (which increases polarization of the other groups as well when $\alpha = 1$).

Table 13. Polarization by education

		Spanish system	Danish system	French system	UK system
Gini	Graduate	0.30 (0.0102)	0.24 (0.0081)	0.30 (0.0086)	0.26 (0.0070)
	Secondary	0.29 (0.0100)	0.20 (0.0074)	0.28 (0.0085)	0.26 (0.0082)
	Primary	0.32 (0.0045)	0.21 (0.0029)	0.29 (0.0038)	0.29 (0.0036)

alpha=.5	Graduate	0.19 (0.0047)	0.18 (0.0041)	0.20 (0.0040)	0.18 (0.0031)
	Secondary	0.19 (0.0045)	0.16 (0.0041)	0.19 (0.0044)	0.18 (0.0039)
	Primary	0.20 (0.0018)	0.17 (0.0016)	0.20 (0.0017)	0.19 (0.0015)
alpha=1	Graduate	0.15 (0.0033)	0.15 (0.0030)	0.15 (0.0029)	0.14 (0.0017)
	Secondary	0.14 (0.0025)	0.15 (0.0033)	0.15 (0.0032)	0.15 (0.0029)
	Primary	0.15 (0.0014)	0.15 (0.0014)	0.15 (0.0014)	0.14 (0.0010)

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, followed by the UK and French systems.

The polarization is not much different between these groups for the Spanish system and the situation is preserved (with small changes) for the proposed reforms. The Danish and French systems increase slightly polarization for all the groups, while the UK system reduces polarization for graduate and primary school groups and increases it for secondary school group (for $\alpha = 1$).

5 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 al. (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 equivalent 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 evaluated systems 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, the French system has the higher probability of generating a 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, in some case, a tendency toward a slightly increased polarization (it is the case of the Danish system).

The results of our analysis in term of polarization show how important it is to consider not only redistribution effects. When polarization measures are seen as active instruments for policy design instead of merely descriptive tools things becomes much more complex. In particular, the decision of which reform should be implemented appears not so easy as if we were considering only income inequality.

Considering polarization when moving from a positive to a normative analysis implies assessing how much a policy maker should weight this additional polarization information. We still need a general framework for this type of social welfare analysis[10]. This is an important argument for future research.

[10] The only attempt we are aware is Gajdos 2000. Unfortunately the proposed setting is not useful for ex ante social welfare analysis.

Appendix 1. 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.[11] 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:

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

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):

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

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

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.[12] 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:

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

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:

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

[12] 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 4c). 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.

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

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

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

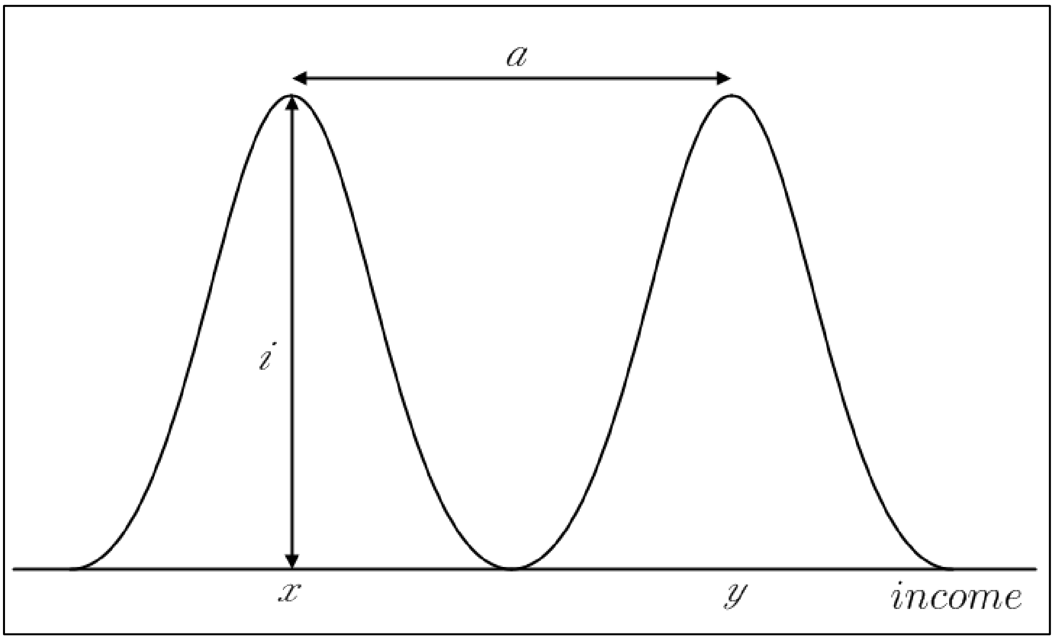
$$\ln \Phi_c = \sum_{i=1}^{N} \sum_{k=1}^{K} d_{jk} \left[\ln \Pr(h_{h(\cdot)} = h^j_{h(\cdot)}, h_{c(\cdot)} = h^k_{c(\cdot)}; Z_h, Z_c, Z\right] \quad (12)$$

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.

Appendix 2. Polarization indices

In terms of income distribution, supposing that two modes are present, identification with the two groups, say x and y, is represented by the probability density function at x and y, while alienation is represented by the distance between x and y. This situation is described in Figure 6. 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.

Figure 6: 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 α is arbitrary chosen such that $\alpha \in [.25,1]$. 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 $a(y) = \mu + y(2F(y)-1) - 2\int_{-\infty}^{y} xdF(x).$

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

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

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 α equal zero is the Gini coefficient.

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