Review of Income and Wealth
Series 56, Number 1, March 2010

A MICROSIMULATION EVALUATION OF EFFICIENCY, INEQUALITY, AND POLARIZATION EFFECTS OF IMPLEMENTING THE DANISH, THE FRENCH, AND THE U.K. REDISTRIBUTION SYSTEM IN SPAIN

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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, the U.K., and Denmark (corporatist, liberal, and social-democratic model respectively). The analysis is performed using microsimulation models in which labor 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 cases we observe a tendency toward an increased polarization.

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 (labor) market[1]).

Note: The authors acknowledge the useful comments made by Frank Cowell, Luc Arrondel, participants of the Bar Ilan University workshop on polarization and of the International Microsimulation Association conference in Ottawa, as well as two anonymous referees. They also acknowledge financial support of the Spanish Government (ECO2008-06395-C05-02) and of the French Government (ANR BLAN06-2_139446). Any remaining errors, results produced, interpretations, or views presented are the authors' responsibility.

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[1]This definition of decommodification has been elaborated by Esping-Andersen on the basis of a concept due to Karl Polanyi (1944).

Recent economic and socio-demographic trends in Spain led to a rise in the demand for social protection that the actual Spanish model is unable to fully cover.

The Spanish experience with new social risks typifies many of the issues 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 (see Tables 1 and 2). 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 (see Figures 1 and 2).

These 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 of reform of the Spanish welfare state. The debate is focused 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 U.K. 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 dependents 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 labor 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. Labor 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, p. 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 toward achieving a system of generous universal and highly distributive benefits not dependent on any individual contributions. In contrast to the liberal

TABLE 1

Poverty Rates for People of Working Age and for Households with a Working-Age Head, by Household Characteristics in Some OECD Countries

	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					
	Mid-2000s	Point changes Since 1995	Level, Mid-2000s				Point Changes Since Mid-1990s				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**
Belgium	7	0.5	8	25	8	2	0.0	6.7	0.7	–0.8	29	18	6	22	20	3
Denmark	5	1.2	5	18	8	1	1.0	4.8	1.5	0.3	22	28	1	15	6	0
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
Italy	10	–2.8	11	36	16	1	–3.1	–2.2	–1.3	–3.1	40	50	4	36	33	8
Portugal	11	–0.4	11	37	24	3	0.0	–2.4	3.3	0.2	58	31	16	33	26	8
Sweden	6	1.4	5	23	9	1	1.4	7.6	2.6	0.2	23	16	1	21	[..]	1
U.K.	7	–0.3	8	33	7	1	–1.2	–1.4	–1.9	0.0	38	11	3	28	22	2
U.S.	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

Notes: 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 Belgium, Portugal, and Spain (where 2005 data, based on EU SILC, are not comparable with those for earlier years).

Source: Computations from OECD income distribution questionnaire.

TABLE 2

Poverty Rates for Children and People in Households with Children by Household Characteristics in Some OECD Countries

	Poverty Among Children		Poverty in Households with Children									
			All		Single		Couple			By Number of Children		
					Level, Mid-2000s							
	Mid-2000s	Point Changes Since Mid-1990s	Level, Mid-2000s	Change from 1995	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**
Belgium	10	–0.8	9	0.1	43	10	36	11	3	7	9	11
Denmark	3	0.8	2	0.7	20	4	21	5	0	2	2	4
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
Italy	16	–3.4	14	–3.1	[..]	16	78	24	1	..	..	..
Portugal	17	0.0	14	0.4	[..]	26	53	34	5	10	17	[..]
Sweden	4	1.5	4	1.5	18	6	36	14	1	4	3	3
U.K.	10	–3.6	9	–3.7	39	7	36	9	1	4	6	20
U.S.	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

Notes: 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 Belgium, Portugal, and Spain (where 2005 data, based on EU SILC, are not comparable with those for earlier years).

Source: Computations from OECD income distribution questionnaire.

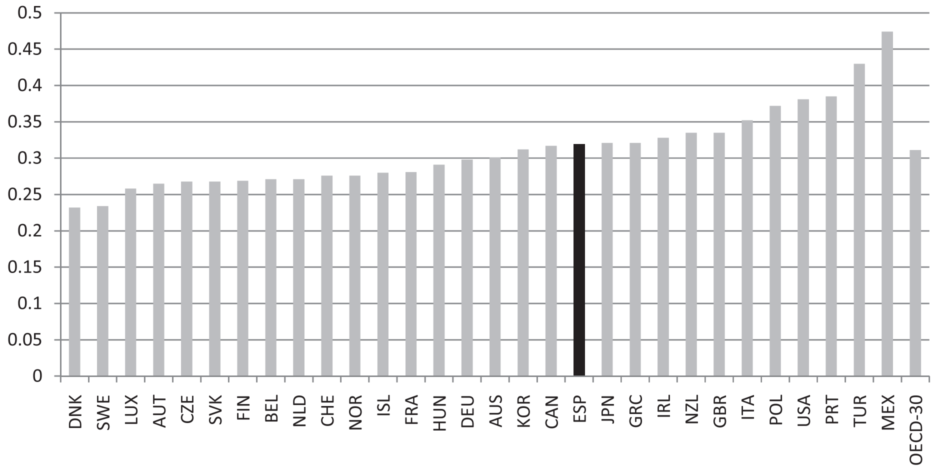

Figure 1. Gini Coefficients of Income Inequality in OECD Countries, Mid-2000s

Notes: 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).

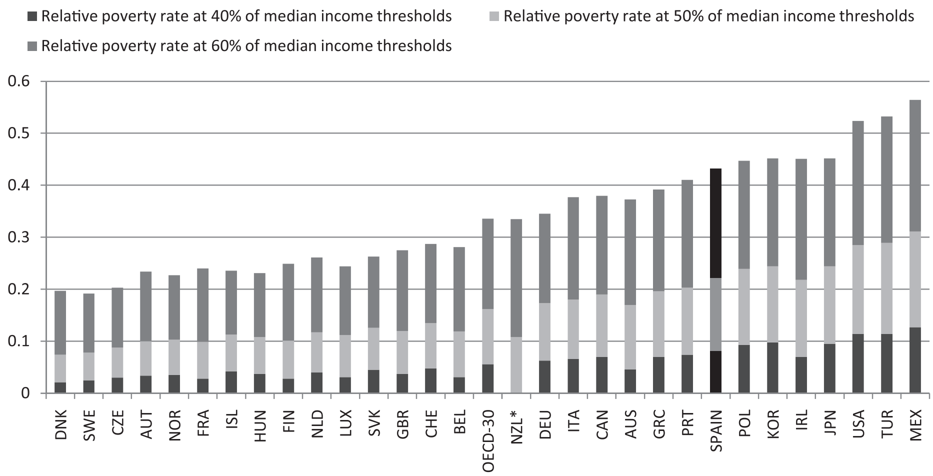

Figure 2. Relative Poverty Rates for Different Income Thresholds, Mid-2000s; Relative Poverty Rates at 40, 50, and 60% of Median Income Thresholds

Notes: Poverty rates are defined as the share of individuals with equivalized 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).

type of welfare states, "this model crowds out the market and, consequently, constructs an essentially universal solidarity in favor of the welfare state" (Esping-Andersen, 1990, p. 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 labor market, especially in the public sector.

Whatever reform is implemented, it is important to have a clear picture of its potential impact on the economy. In what follows, we try to offer some elements of evidence of these effects. We will analyze the impact upon efficiency (in particular labor 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, the U.K., and Denmark (corporatist, liberal, and social-democratic respectively).

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

To analyze 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 polarization 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 the distribution of political opinions, crime rate, drug consumption and so on) 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 could 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—which may not be completely extreme but represent sharply defined political opinions and involve 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—that matters for conflict.

With these considerations in mind, the fundamental contributions of our paper can be summarized in two points. First, we want to offer some elements of clarification on the debate regarding the reforms of the welfare state in Spain by making comparisons with other European welfare regimes, using polarization measures to enlarge the final picture of inequality results. Second, we want to show the potential of behavioral 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. The first point concerns the fact that microsimulation techniques allow the analyst to work in a world in which it is possible to translate large-scale national policies from one country to another: we know that, in practice, things are not so easy. Second, we do not pretend to assess the effects of reforming the whole social protection system and even less 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 the principal characteristics of the redistribution systems which are simulated. Section 3 describes the microeconometric simulation framework. Section 4 presents the simulation results concerning efficiency, inequality, and polarization. Concluding comments are given in Section 5.

2. The Data, the Microsimulation Models, and the Principal Characteristics of the Redistribution Systems

Gladhispania is a microsimulation model that has been developed at the University of Balearic Islands (details on the model, the dataset, and the methodological issues are contained in Oliver and Spadaro, 2004). It is built on the 1999 Spanish wave of the European Community Household Panel (ECHP). It simulates the personal income tax and the social insurance contribution of wages.

Table 3 gives the results of the model's calibration and compares them to the corresponding aggregate figures reported in official statistics. The statistics describing the variables used in the econometric section are given in Table 4, while the four scenarios simulated with Gladhispania are described below.

2.1. *The 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

TABLE 3
Calibration of GLADHISPANIA (in billions of Euros)

	1999		
	Official Statistics (4)	Gladhispania (5)	Difference (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] = (net tax/taxable income)	23.15%	23.87%	3.12%
Employees' Social Security contributions[d]	14.57	14.26	–2.13%

Notes:
[a]INE.
[b]Source: Informe Anual de Recaudación Tributaria, 2001.
[c]Source: Memoria de la Administración Tributaria, 2001.
[d]Source: Anuario de Estadísticas Laborales y de Asuntos Sociales, 2002.

TABLE 4
Descriptive Statistics of the Variables Used in the Econometric Section

Singles			Couples		
Variable	Mean	SD	Variable	Mean	SD
Yearly disposable income	14,692	9,559	Yearly disposable income	24,030	15,756
Weekly hours of leisure	135.22	17			
			Children (in %):		
Age	41.8	11.3	No children	24.3	
Education (in %):			One child	30.4	
University graduate	37.1		Two children	38.3	
Secondary school	21.2		Three or more children	7.0	
Less than secondary school	41.7				
			Head of the household		
Children (in %):			Weekly hours of leisure	127.7	11.6
No children	83.4		Age	38.9	8.3
One child	10.4		Education (in %):		
Two children	5.02		University graduate	30.8	
Three or more children	1.16		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	259		Number of observations	1,015	

family-based. They reduce taxable income as follows: the minimum personal allowance is 3305.57 Euros (6611.13 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 threshold; and (b) 1202.02 Euros per child for the first two children and 1803.04 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 3 to 16 (for expenses regarding educational material), and 300.50 Euros per child under 3. Finally, an increase of 2103.54 or 2704.55 Euros is applied to 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 six tax brackets (see Table 5).[2]

2.2. *The U.K. System*

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

[2]Some Spanish regions actually have their own social assistance schemes. From an aggregate point of view they are not representative, given their reduced amounts and the small number of recipients.

TABLE 5
Tax Rates Schedule (in Euros)

Spanish System (1999)		U.K. 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	Mean tax rate: 31.75%
over 66,111	48.0%			44,404	48.0%		
				over 44,404	54.0%		

The U.K. 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 still higher 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 percent, a wide "standard rate" band of 22 percent, and a higher rate of 40 percent, affecting only high income taxpayers. Income from financial capital is taxed at 20 percent 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 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 look for a job. If family income is less than the threshold (7100 Euros for a couple without children), IS makes up the shortfall.

Finally, a working family tax credit (WFTC) is given to those households with low income not covered by the IS. It is a benefit for families with dependent children where at least one parent is employed or self-employed for at least 16 hours per week. The benefit is tapered away when 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 4000 Euros), nevertheless it is paid at the same rate for couples and lone parents; and 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.

2.3. *The 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 1248 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 4494 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 on the origin (windfall gains, dividends, rents, etc), but as we have no details for each household on these various sources of capital income, we simply apply a flat tax rate of 15 percent. Earned incomes (including unemployment benefits and pensions) get a 10 percent deduction with a minimum and a maximum amount. Moreover, a deduction of 20 percent is applied afterwards with a maximum of 2165 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 by 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.

2.4. *The 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 1342 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 percent. 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 3860 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 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 percent, but we have chosen a tax of 31.75 percent in order to respect a taxation ceiling which establishes that no part of the income can be taxed at a rate higher than 59 percent (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: $(100{,}000 - 4481) * 0.0625 + (100{,}000 - 23{,}867) * 0.06 + (100{,}000 - 37{,}148) * 0.15 + (100{,}000 - 4481) * 0.3175 = 50{,}293$ Euros.

Danish 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 shows nuances across systems.

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

There is a clear contrast between the Danish, French, and U.K. 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 performs better in terms of decommodification.

3. The Microeconometric Simulation Framework[4]

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:

$$U = U(y, h; Z) \tag{1}$$

where Z represents individual characteristics. Consumers maximize utility, subject to the usual budget constraint, which is defined in terms of gross real wages, w,

[3]The difference in their size and importance as a redistributive device in France, Denmark, and the U.K. makes their inclusion in our analysis difficult to treat and discuss properly.
[4]The econometric exercise draws on Labeaga *et al.* (2008).

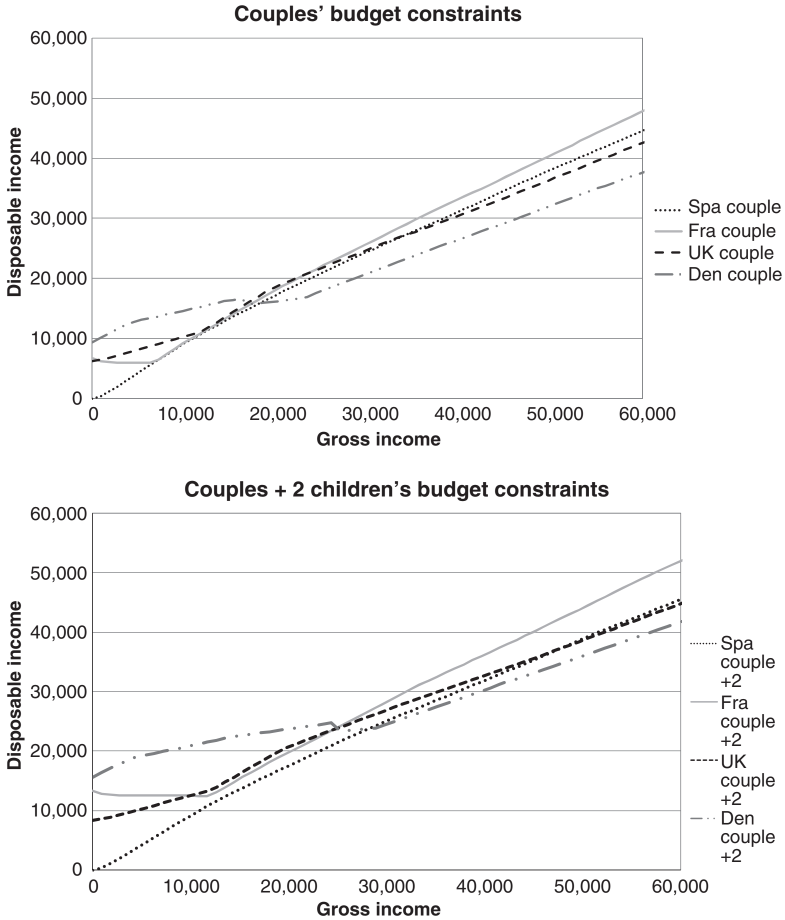

Figure 3. Budget Constraints

total household non-labor 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:

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

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

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

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 labor supply function). The discrete choice approach, instead of estimating the Marshallian labor supply parameters, starts by specifying utility

$U(.)$ and estimating its parameters. As usual, we perform separate estimations on singles and couples. For singles, we adopt the flexible quadratic utility function (as in Keane and Moffit, 1998; Blundell *et al.*, 2000):

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

For couples, the specification is the following:

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

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:

$$\begin{aligned} \beta_y &= \beta_{y0} + \beta_y' Z \\ \beta_{h_h} &= \beta_{h_h0} + \beta_{h_h}' Z_h. \\ \beta_{h_c} &= \beta_{h_c0} + \beta_{h_c}' Z_c \end{aligned} \tag{6}$$

These functional forms are easily tractable and allow for a wide range of potential behavioral 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.

In general, the results of the econometric exercise are similar to those provided by the existing literature (see Blundell *et al.*, 2000) (Appendix 1 offers a thorough description of the econometric methodology and of the results obtained). The coefficients in the regression corresponding to couples show that the marginal utility of income is positive for 94 percent of the sample (see Tables A2 and A3 in Appendix 1), 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 labor 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 labor force or to work only part-time, then to return when their

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

TABLE 6
Elasticity of Unconditional Expectation of Hours of Work

Pre-Reform Gross Household Income Deciles	Couples (Spouse)	Couples (Head of the Household)	Singles (With or Without Children)
1	0.854	0.034	2.115
2	0.860	0.070	0.486
3	0.571	0.038	0.083
4	1.313	0.000	–0.015
5	0.348	0.000	0.000
6	0.325	0.004	–0.030
7	0.325	0.004	0.000
8	0.059	0.008	–0.047
9	0.131	0.007	–0.031
10	0.069	0.007	–0.114
Total	0.300	0.021	0.033

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.

Table 6 shows the wage elasticity of unconditional[6] expectations of hours of work (computed by increasing the gross wage rate by 1 percent).[7] The first column gives the spouse elasticity: the overall elasticity is around 0.3. Interestingly, the elasticity is decreasing with income. In the first four deciles the elasticity is significantly larger than the average and it is lower in the richest deciles. Columns 2 and 3 show the elasticity of the head of the household (for couples) and the elasticity of singles, respectively. In both cases the overall elasticity is very close to zero. As before, the elasticity is slightly higher for the poorer deciles and lower for richer households. In the case of singles there are deciles with small but negative elasticities, which can be justified because the sub-sample of the singles is relatively small and a few observations with an atypical behavior can condition the results.

These results are in line with the empirical literature on the econometrics of labor 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, for Germany), very low levels are observed. Our results reflect the specific nature of the Spanish labor market, which is inflexible with regard to the supply of hours (due partly to the rigidity of labor demand). Moreover, although the rate of labor

[6]Following Aaberge and Flood (2008), we refer to unconditional elasticity when the effects on participation as well as hours supplied are accounted for.

[7]To generate a simulation we proceed as follows. First, we record the discrete hours level for each individual which is closest to their observed hours level. Second, we take random draws from an extreme value distribution for the stochastic part of the utility at each choice. These draws are accepted if they result in an optimal hours level which matches the discretized value observed in the reference scenario. If this is not the case, the draw is rejected and another one is sought, until a perfect match between observed and predicted hours is obtained. This procedure is repeated 100 times. Then, we get that the household is going to shift to each choice with a certain probability (that in some cases is zero).

market activity of women in Spain has notably increased in the last decades, it is still low relative to similar countries; the majority of the spouses in the couples subsample are women.

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 the 1999 Spanish system. Tables 7a and 7b present, respectively, the couples' and the singles' labor 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

TABLE 7a
Couples' Labor Supply Transition Matrices

Combination of Working Hours (Household Head_Spouse)		Spanish System									
		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**
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**
U.K. 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**

TABLE 7b
Singles' Labor Supply Transition Matrices

	Working Hours	Spanish System 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
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
U.K. 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

matrix displays the percentage of individuals (households) changing from the observed alternative *j* to the predicted alternative *i*. The diagonal elements refer to the percentage of observations whose labor supply is unchanged following the reform. Note that for couples there are nine possible alternatives, one for each combination of the hours of work of the household head and his/her spouse. Table 7a 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 the spouses' working hours.

The evidence for couples basically tells us that there are no significant changes in the households' labor supply behavior. For the Danish reform, we can observe that there are agents who did not work before the reform and still remain at home; 0.36 percent of observations exit from the labor market while 0.78 percent of them reduce their labor supply after the reform. Under the French scenario, participation increases by 0.08 percent, while reduction in labor supply affects 0.22 percent of the individuals. Under the U.K. scenario, around 4.05 percent of individuals reduce their labor supply. Participation falls by 0.48 percent.

Evidence for singles is a little bit different (see Table 7b). The U.K. and the French scenarios have a very similar impact on participation and labor supply. In the first case participation is reduced by 2.2 percent and the total labor supply is reduced by 4.2 percent. In the second case participation is reduced by 3.6 percent and the total labor supply is reduced by 4.3 percent. The Danish scenario is the system that produces the strongest effects on the efficiency of the system: single aggregate labor supply is reduced by 13.2 percent while participation decreases by 14.3 percent. This is basically due to the large "decommodification" effects obtained with the minimum income subsidy.

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 labor supply behavior; second, the higher the marginal tax rate, the greater are the labor supply effects. The Danish system is the one with the highest marginal tax rates and hence the highest labor 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. In order to do so 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. The idea was to explicitly model the possibility that a population could be grouped into clusters of significant size where individuals tend to identify with other members of their group but feel alienated with respect to individuals in other groups. This behavioral/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 possible social tensions between population groups (e.g. organized strikes, demonstrations, revolts). 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 members of such groups feels that their position is unfair with respect to other individuals or groups.

Before entering into the details of the results of our simulations, 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 for the households' disposable income, taking into account four values of parameter α, i.e. $\{0.25, 0.5, 0.75, 1\}$ (this parameter can be interpreted as the relative weight given to polarization with respect to inequality: the higher is α 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 of 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

[8]See Appendix 2 for a detailed definition of the meaning of α. 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 *et al.* (2004).

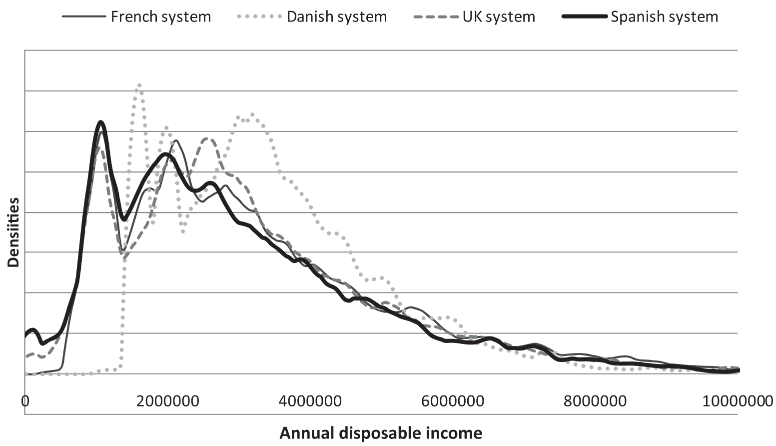

Figure 4. Kernel Densities of Disposable Income Under the Four Systems Simulated

TABLE 8

Inequality and Polarization Indexes: Disposable Income (Standard Errors Obtained by Bootstrap in Brackets*)

	Gini	$\alpha = 0.25$	$\alpha = 0.5$	$\alpha = 0.75$	$\alpha = 1$
Spanish system	0.351 (0.0041)	0.268 (0.0024)	0.216 (0.0016)	0.181 (0.0014)	0.155 (0.0013)
U.K. system	0.313 (0.0031)	0.246 (0.0019)	0.203 (0.0013)	0.173 (0.0010)	0.151 (0.0009)
French system	0.328 (0.0036)	0.256 (0.0022)	0.212 (0.0016)	0.183 (0.0014)	0.161 (0.0014)
Danish system	0.237 (0.0030)	0.202 (0.0019)	0.180 (0.0014)	0.166 (0.0012)	0.155 (0.0012)

Note: *We have drawn 1000 independent bootstrap samples.

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), the educational level of the household head (graduate studies or more, secondary education, primary education), and his/her working status (employee, self employed, and others—including inactive people).[9] Figure 4 shows the Kernel density distribution of the disposable income under the four simulated systems. Table 8 reports the Gini inequality index and four DER indices of polarization, one for each value of the parameter α. 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 0.35 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 though the difference with the Spanish system is not large.

[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.

The intuition behind these results is that the French redistribution system penalizes the middle class in favor of the poorest decile of the income distribution (the effective average tax rate for the decile from 3 to 6 increases by 6 percent 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 A1 in Appendix 2) 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 0.25 and 0.5, and a rather uncertain ranking when $\alpha = 0.75$, where the difference with the Spanish system is not significant, except for the Danish one.

The only reform that would reduce both the Gini and all the DER indices is the U.K. 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 in polarization is not so strong, and not significant when $\alpha = 1$.

The fact that the U.K. 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 sets 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 U.K. one, while for high incomes the situation is reverted. Moreover, it should be stressed that Spain, especially in 1999, has significantly lower values of per capita income than the U.K. 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 9 reports the Gini index and the DER indices for α equal to 0.5 and 1 for the subgroups of the population based on the age of the household head. Three age classes were generated corresponding to household heads less than 35 years old, between 35 and 60, and above 60. 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 an

TABLE 9

Polarization by Age Class

		Spanish System	Danish System	French System	U.K. System
Gini	Less than 35	0.330 (0.0121)	0.186 (0.0078)	0.277 (0.0077)	0.262 (0.0086)
	Between 35 and 60	0.338 (0.0055)	0.223 (0.0040)	0.310 (0.0048)	0.295 (0.0041)
	More than 60	0.357 (0.0067)	0.262 (0.0050)	0.352 (0.0061)	0.352 (0.0056)
$\alpha = 0.5$	Less than 35	0.212 (0.0058)	0.157 (0.0046)	0.198 (0.0042)	0.185 (0.0040)
	Between 35 and 60	0.210 (0.0022)	0.172 (0.0019)	0.205 (0.0022)	0.196 (0.0017)
	More than 60	0.231 (0.0033)	0.216 (0.0033)	0.236 (0.0033)	0.231 (0.0029)
$\alpha = 1$	Less than 35	0.153 (0.0042)	0.150 (0.0042)	0.161 (0.0039)	0.150 (0.0032)
	Between 35 and 60	0.151 (0.0016)	0.153 (0.0018)	0.160 (0.0019)	0.151 (0.0015)
	More than 60	0.180 (0.0037)	0.210 (0.0048)	0.187 (0.0037)	0.178 (0.0033)

TABLE 10

Polarization by Gender for Singles (No Children)

		Spanish System	Danish System	French System	U.K. System
Gini	Couples	0.339 (0.0044)	0.225 (0.0032)	0.314 (0.0039)	0.299 (0.0033)
	Males	0.390 (0.0149)	0.260 (0.0122)	0.374 (0.0151)	0.359 (0.0132)
	Females	0.429 (0.0205)	0.261 (0.0182)	0.414 (0.0212)	0.428 (0.0201)
$\alpha = 0.5$	Couples	0.211 (0.0018)	0.175 (0.0015)	0.208 (0.0017)	0.198 (0.0014)
	Males	0.241 (0.0085)	0.211 (0.0090)	0.239 (0.0093)	0.230 (0.0077)
	Females	0.295 (0.0171)	0.327 (0.0243)	0.316 (0.0191)	0.302 (0.0171)
$\alpha = 1$	Couples	0.153 (0.0014)	0.155 (0.0014)	0.162 (0.0015)	0.151 (0.0010)
	Males	0.175 (0.0069)	0.201 (0.0097)	0.182 (0.0077)	0.171 (0.0062)
	Females	0.293 (0.0240)	0.657 (0.0542)	0.347 (0.0280)	0.310 (0.0247)

TABLE 11

Polarization by Education

		Spanish System	Danish System	French System	U.K. System
Gini	Graduate	0.300 (0.0102)	0.245 (0.0081)	0.301 (0.0086)	0.267 (0.0070)
	Secondary	0.297 (0.0100)	0.209 (0.0074)	0.283 (0.0085)	0.265 (0.0082)
	Primary	0.328 (0.0045)	0.219 (0.0029)	0.295 (0.0038)	0.297 (0.0036)
$\alpha = 0.5$	Graduate	0.198 (0.0047)	0.180 (0.0041)	0.201 (0.0040)	0.186 (0.0031)
	Secondary	0.198 (0.0045)	0.168 (0.0041)	0.198 (0.0044)	0.189 (0.0039)
	Primary	0.209 (0.0018)	0.177 (0.0016)	0.201 (0.0017)	0.197 (0.0015)
$\alpha = 1$	Graduate	0.150 (0.0033)	0.151 (0.0030)	0.153 (0.0029)	0.145 (0.0017)
	Secondary	0.147 (0.0025)	0.150 (0.0033)	0.153 (0.0032)	0.150 (0.0029)
	Primary	0.151 (0.0014)	0.157 (0.0014)	0.155 (0.0014)	0.149 (0.0010)

intensity similar to that observed in the general case described previously. 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 favorable to elderly classes.

Things change when we look at polarization indices. Polarization indices are not always reduced, with some sharp increase, as in the case of the Danish reform for the subgroup “above 60 years old” and $\alpha = 1$.

In Table 10 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 the case of single women is similar to that of single men.

For these groups, polarization is clearly higher for single women in all the scenarios, with a rather surprising 0.65 value for the Danish system (which increases polarization of the other groups as well when $\alpha = 1$).

Table 11 shows the inequality and polarization indices when we classify the population by educational level of the household head. The Spanish system reveals a higher inequality for low-educated and highly educated households. All the proposed reforms reduce inequality. For the Danish system the reduction is more evident, followed by the U.K. and French systems.

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 U.K. system reduces polarization for graduate and primary school groups and increases it for secondary school groups (for $\alpha = 1$).

5. Conclusions

This paper analyses the impact on 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, the U.K., and Denmark (corporatist, liberal, and social-democratic model, respectively).

The analysis has been performed using a microsimulation model in which labor supply has been explicitly taken into account. Instead of following the traditional continuous approach (Hausman, 1981, 1985a, 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 analyze 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 polarization effects of each redistributive scenario.

The results show that the scenarios simulated have little impact on the efficiency of the economy (as measured by labor 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 U.K. 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 particularly affected. The other scenarios produce unclear polarization impacts even though, with respect to the baseline system, there is, in some cases, a tendency toward a slightly increased polarization (the case of the Danish system).

Our analysis about the impact of the reforms on polarization shows how important it is to consider complementary measures to redistribution indices. 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 regarding the reform to be implemented appears to be not as easy as in the case where we consider only income inequality.

When moving from a positive to a normative analysis, these results raise questions about the weight that should be given to this additional polarization information. We still need a general framework of analysis for this type of social welfare analysis and this certainly calls for future research.

Appendix 1: Econometric Methodology and Results

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 labor 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 $h_i \in \{h^1, h^2, \ldots, h^{Ki}\}$, $i = h, c$, according to which individuals choose their hours. The observability rule in a typical multinomial model is:

$$\begin{aligned} h_i &= h^1 \text{ if } h \le h_1^B \\ &= h^2 \text{ if } h_1^B < h \le h_2^B \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ &= h^{K-1} \text{ if } h_{K-1}^B < h \le h_{K-1}^B \\ &= h^K \text{ if } h > h_{K-1}^B \end{aligned}$$

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 determined 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):

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

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

for all possible combinations of $h_{h(.)} \in \{h_{h(.)}^1, h_{h(.)}^2, \ldots, h_{h(.)}^{Kh}\}$, and $h_{c(.)} \in \{h_{c(.)}^1, h_{c(.)}^2, \ldots, h_{c(.)}^{Kc}\}$. 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 $h_i \in \{h^1, h^2, \ldots, h^{Ki}\}$. 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

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

[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 A1(c)). 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 a selectivity 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.

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:

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

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:

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

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

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

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

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.

Results

The estimation of the model initially requires the set of labor 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 A1(a) presents the distribution of hours of work for singles; Figures A1(b) and A1(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 percent for singles and 6 percent for household heads (as part of a couple), a figure which rises to 59 percent 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

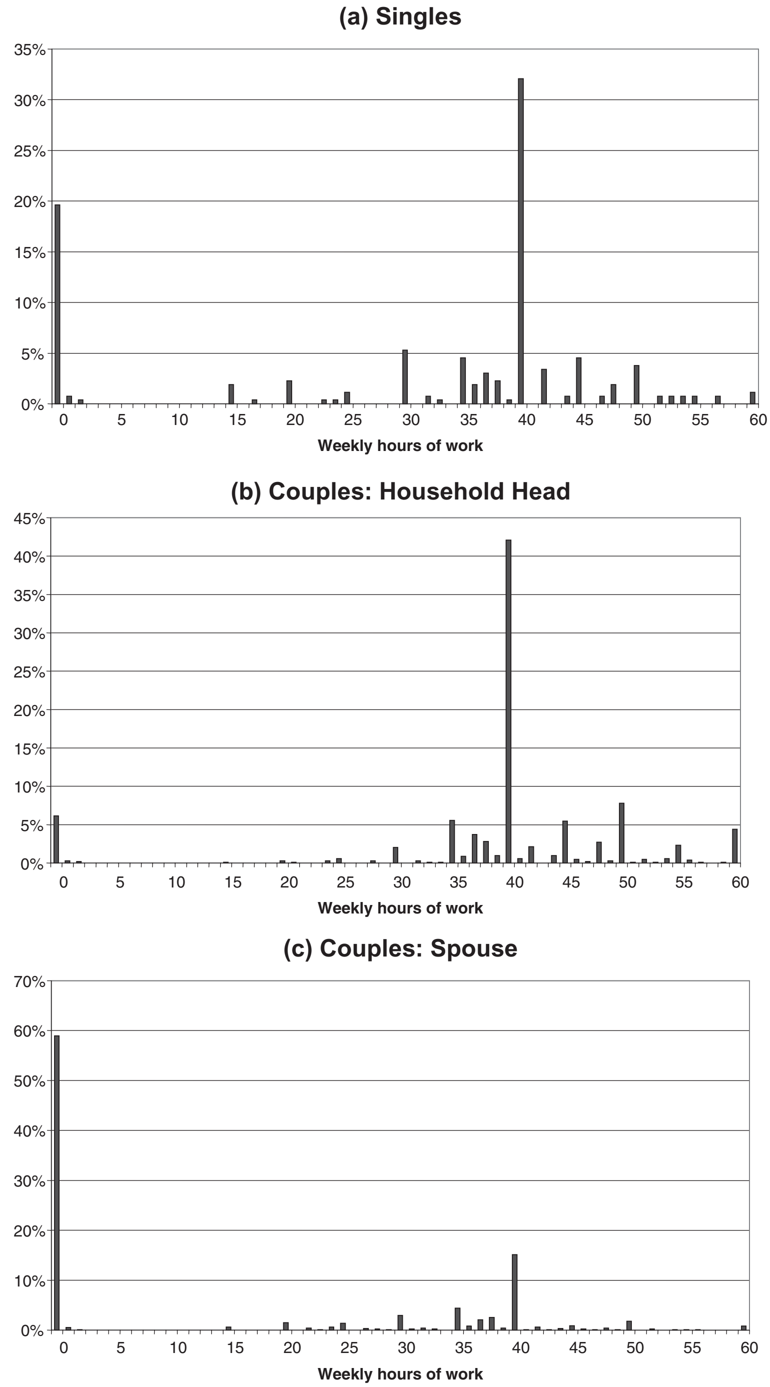

Figure A1. Weekly Hours of Work of Singles and Couples (Household Head and Spouse)

TABLE A1
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

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 (equation (4)) by optimizing (11) and for couples (equation (5)) by optimizing (12). The subsample of singles corresponds to households with only one adult, with or without children (16.6 percent with one or more children and 83.4 percent without children), whereas the subsample of couples corresponds to couples with or without children (75.7 percent with one or more children and 24.3 percent 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 labor status for each month.[12] The typology of households used both for simulation and estimation is reported in Table A1.

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 A2 and A3 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.

[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.

TABLE A2

Estimation for Singles

Variable	Coefficient	t-values
Income^2	–0.413	–0.81
Hours of leisure^2	–236.955***	–7.31
Income × hours of leisure	29.061***	5.00
Income	–25.546***	–3.77
×Age	0.506**	1.96
×Education	0.045	0.05
×Children	0.199	1.19
Hours of leisure	458.942***	7.04
×Age	–0.490	–0.32
×Educ1	–4.197	–1.07
×Educ2	0.398	0.14
Fixed costs	2.401***	4.75
Number of observations	259	
Log likelihood	–273.84	

Notes: The variables have been rescaled as follows: Income = disposable income in Euros/30,000; Hours of leisure = (24 × 7 – 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%.

TABLE A3

Estimation for Couples

Variable	Coefficient	t-values
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 × Hours of leisure of the household head	–0.155	–0.14
Income × Hours of leisure of the spouse	–0.309	–0.35
Hours of leisure of the household head × Hours of leisure of the spouse	–31.879***	–3.47
Income	2.097	1.12
×Age of the household head	–0.419	–0.79
×Age of the household head^2	–0.025	–0.09
×Age of the spouse	1.443**	2.44
×Age of the spouse ^{2}	–0.391	–1.30
Hours of leisure of the household head	204.505***	10.23
×1 (male)	–13.553***	–8.74
×Education of the household head	–8.330***	–3.89
×Age of the household head	3.644***	4.63
Hours of leisure of the spouse	–122.422***	–6.77
×1 (male)	–11.268***	–5.28
×Education of the spouse	–13.036***	–10.15
×Age of the spouse	1.923***	2.86
×Age of the spouse^2	0.573	1.08
×1(one dependent child)	2.929**	2.42
×1(two or more dependent children)	5.570***	3.89
Fixed costs	–1.6302	–1.82
×1(one dependent child)	0.6132	0.62
×1(two or more dependent children)	1.2990*	1.50
Number of observations	1,024	
Log likelihood	–1,456.2512	

Notes: The variables have been rescaled as follows: Income = disposable income in Euros/30,000; Hours of leisure = (24 × 7 – 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%.

The coefficients in the regression corresponding to couples show that the marginal utility of income is positive for 94 percent 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 labor 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 labor 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.

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 A2. 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.

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 $P(f)$.

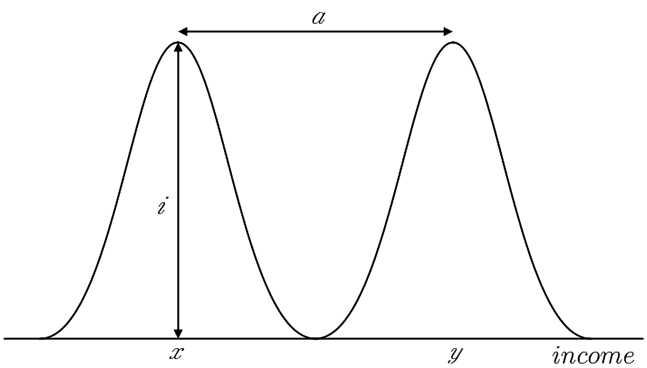

Figure A2. Polarization

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 arbitrarily chosen such that $\alpha \in [0.25,1]$. Finally, considering any distribution function F with associated density f and mean μ, the polarization index can be written as

$$P_\alpha(f) = \int_y f(y)^\alpha a(y) dF(y),$$
$$\text{with } a(y) = \mu + y(2F(y) - 1) - 2\int_{-\infty}^{y} xdF(x).$$

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 the fact that within-group identification and alienation may also depend upon other characteristics, such 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 of 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 $0.5\mu^{\alpha-1}$, such that homogeneity of degree zero is achieved and that the polarization index calculated for $\alpha = 0$ is the Gini coefficient.

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