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Is a Tax Cut on Cultural Goods Consumption Actually Desirable? A Microsimulation Analysis applied to Spain*

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Abstract

Proposals for tax cuts on cultural goods represent an ongoing debate in cultural policy. The main aim of this paper is to shed some light on this debate using microsimulation tools. First, we have estimated an Almost Ideal Demand System for 19 different groups of goods, including cultural goods. Expenditure and price elasticities have been obtained from this model. Using this information, three alternative cuts in the VAT rate on cultural goods have been microsimulated and evaluated in terms of revenue and welfare. These types of fiscal reforms will lead to welfare and efficiency gains that can be described as regressive.

I. Introduction

Traditionally, tax policies that favour cultural goods are justified by their classification as *merit* goods, according to Musgrave's definition (1959).

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Although this is somewhat controversial, the justification for government intervention in the provision and funding of these goods is also based on the potential existence of external economies and information asymmetries. In any case, and despite these normative considerations, government policies for the promotion of culture should be evaluated to ensure that well-informed decisions are taken.

Far from being a purely academic exercise, this is an ongoing issue in debates on cultural policy, as demonstrated by the controversy surrounding the removal of the zero-rate VAT on books in Mexico, the proposal by ministers of the European Union (EU) Audiovisual Policy Unit to harmonise VAT on books and audio-visual media, and the petition, signed by European pop artists, for a cut in the VAT on CDs in order to give music the same tax treatment as books, newspapers and cinema tickets, which are subject to lower tax rates. In this context, the European Commission presented a directive proposal with a new list of goods and services that would benefit from a reduced rate of VAT. This measure would specifically affect theatre and cinema tickets, as well as books, newspapers and magazines. The tax cut will depend on the arrangements to be made by the economics ministers of the EU in the near future.

Tax cut proposals such as those described above are generally made without taking into account all their economic effects. That is to say, they generally lack the support provided by empirical evidence. Nevertheless, they are often approved. Fortunately, economists have a series of different tools at their disposal that allow the effects of such proposals to be determined. One of these tools is microsimulation, which enables the assessment of fiscal reforms even before they are passed by the parliament. These techniques are increasingly used in developed countries, though up to now they have scarcely been used in the economics of culture (see Merz (1991) and O'Donoghue (2001)).

The main aim of this paper is to shed some light on the debate, using microsimulation tools to analyse the expected demand shifts and their effects on consumers' welfare. This type of analysis will show that there are some caveats that must be taken into account when implementing these kinds of fiscal reforms. In order to meet the paper's objective, our first step will be to analyse consumers' revealed preferences. Thus, we will assess the own-price elasticities, cross elasticities and expenditure elasticities of 19 different groups of consumer goods including cultural ones. This will allow us to analyse rarely studied issues in the economics literature, such as how consumers' consumption of cultural goods responds to price or income changes, as well as the complementary or substitute nature of the different cultural goods. This kind of empirical analysis is uncommon. Nevertheless, from an economic perspective, it is crucial to understand the demand

patterns of cultural goods and the effectiveness of public policies that support these goods and services.

With this in mind, three alternatives for reforming the indirect tax on cultural goods will be evaluated. The analysis will be carried out using a microsimulation of these three possible tax reforms and the results will help us identify the most likely effects of a tax cut on cultural goods. Specifically, we will try to quantify the impact on revenue as well as the effects of the suggested reforms on social and individual welfare. Moreover, the microsimulation exercises will allow us to determine how the gains (and eventual losses) from these tax cuts will be distributed and who will benefit from them. In other words, this microsimulation exercise will enable us to ascertain whether a tax cut on cultural goods is actually desirable from an economic point of view, based on an assessment of public sector revenue losses and consumer gains.

The econometric basis for these simulations is the estimation of an Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer (1980a and 1980b), which lets us control for all cross effects generated by price or real income changes. The data-set used to estimate this model is the Spanish Continuous Survey of Household Expenditure (ECPF).[1]

The paper is organised as follows: Section II will describe the indirect taxation of cultural goods in Spain, as well as the simulated reforms; Section III will set out the complete demand model used and Section IV the demand system estimated; the tax reform estimation of the microsimulation results will be presented in Section V; and Section VI will summarise the main conclusions.

II. Taxation of cultural goods in Spain: current situation and simulated reforms

In Spain, as in other EU countries, indirect taxation on consumption generally comprises value added tax (VAT) and the different excise duties imposed on specific consumer goods such as spirits, beer, hydrocarbons, tobacco, electricity and vehicle registration. Of these, VAT is the only one that affects cultural goods and services (i.e. there are no excise duties to be paid on such goods and services). However, the tax rates levied on these goods differ across product categories. VAT on records, films and audio-visual media is currently set at a minimum of 15 per cent throughout Europe, and in some countries it is as high as 25 per cent. On the other hand, other cultural goods, such as books and newspapers, are subject to rates as low as 4 per cent.

[1]This survey has a panel structure and is currently used in international studies (see, for instance, Browning and Collado (2001)).

TABLE 1

Spanish VAT rates on cultural goods and services

	Initial scenario	*Simulated reform A*	*Simulated reform B*	*Simulated reform C*
Cinema, theatre, concert, ballet and museum tickets, botanic gardens, etc.	7%	4%	0%	4%
Books, magazines and newspapers	4%	4%	0%	0%
Records, films and audio-visual media	16%	4%	0%	7%

Table 1 summarises the VAT rates currently imposed on cultural goods and services in Spain within the EU VAT system. As the table shows, VAT is levied at 7 per cent on cinema, theatre, concert, ballet and museum tickets and admission to botanic gardens and sporting events such as football games; at 4 per cent on books, magazines and newspapers (although textbooks are not included in this item, they are taxed at 4 per cent); and at 16 per cent on records, films and audio-visual media. This information provides the initial scenario for this paper. As can be seen, there is a wide range of tax rates and there is no zero-rate tax or exemption. Three reforms of this regime are simulated. The first analyses the application of a uniform tax rate of 4 per cent on all cultural goods and services (reform A); the second proposes a broad zero rate (reform B); and the third simulates reducing the tax imposed on these goods to the rate immediately below the one in the initial regime (reform C). Reform A could be considered as being equivalent to the European pop artists' proposal to establish a unique fiscal treatment for cultural goods.

III. A complete demand system: data and estimation process

The database used is the Spanish Continuous Survey of Household Expenditure. The ECPF is a panel run by the Spanish National Institute of Statistics (INE). This survey provides quarterly and annual information on household incomes and consumption, including own consumption, own supply and payment in kind. It is targeted at 3,200 families chosen by sampling techniques, and one-eighth of the sample is renewed each quarter. The survey also includes exhaustive information on household characteristics such as employment status and demographics.

In accordance with the level of disaggregation permitted by this survey and the availability of consumer price indices, 19 expenditure groups were considered, three of which were cultural goods.[2] The first group of cultural

[2]The goods are grouped as follows: 1. food and non-alcoholic beverages; 2. alcoholic beverages; 3. tobacco; 4. clothing and footwear; 5. housing; 6. furniture and household equipment; 7. gas and fuel; 8. medical and pharmaceutical products and services; 9. fuel; 10. private transport services; 11. public transport; 12. communications; 13. leisure, entertainment and holidays; 14. education; 15. cinema,

goods consists of admission to cinemas, theatres, museums and other cultural events, the second group covers books, magazines and newspapers, and the third group comprises records, films and audio-visual media.

The empirical study is made up of two phases – an estimation phase and a simulation phase. The first phase generates the price elasticity and expenditure elasticity matrix using ECPF data corresponding to the period 1985 (third quarter) to 1995 (fourth quarter). Using these results, the second phase then simulates the effects of a tax reform, taking the 1998 ECPF data as a reference.

The model used in this paper assumes, first, that consumers divide their total income between savings and spending on durable and non-durable goods. Subsequently, income allocated to durable and non-durable goods is divided between different types of goods (see, for example, Blundell (1988)). In practice, the model assumes expenditure on these goods is separable within total expenditure. Changes in consumer behaviour are taken into account by restructuring the composition of the household shopping basket, maintaining real consumer expenditure constant in the scenarios considered. That is, we assume that the allocation between spending and saving of the economic agents remains constant over time.

The model used in the estimation phase is the Almost Ideal Demand System proposed by Deaton and Muellbauer (1980a and 1980b). The main attraction of AIDS is that it allows a first-order approximation to an unknown demand system (Nicol, 1989).

$$(1) \qquad w_{iht} = a_{ih} + \sum_{j=1}^{19} \gamma_{ij} \ln p_{jt} + \beta_i \ln y_{ht} + \varepsilon_{iht} .$$

Subscripts i, h and t refer respectively to the type of goods, household and time. The variable w_{iht} defines the share of total expenditure that good i represents in household h during period t. The variables p and y represent the price and real expenditure respectively, the latter being used as a proxy of real income.

The parameters a, γ and β were estimated by imposing zero-degree homogeneity constraints on prices and income (expressions (2), (3) and (4)) and symmetry constraints on substitution effects (expression (5)):

$$(2) \qquad \sum_{i=1}^{19} a_{ih} = 1 ;$$

$$(3) \qquad \sum_{i=1}^{19} \beta_i = 0 ;$$

theatre, museum and other events; 16. books, magazines and newspapers; 17. film and music on magnetic media; 18. consumer durables; and 19. other goods.

$$(4) \qquad \sum_{i=1}^{19} \gamma_{ij} = 0 \quad (j = 1,...,19);$$

$$(5) \qquad \gamma_{ij} = \gamma_{ji} \quad (i, j = 1,...,19).$$

The sum of the different relative weightings of the expenditure groups, w_i, must satisfy

$$(6) \qquad \sum_{i=1}^{19} w_{iht} = 1.$$

Parameter a is modelled using a series of dummies that allow households to be categorised by home tenure, alcohol and tobacco consumption, education, size of town of residence, employment status (active or inactive) and employment category. The model is estimated under the assumption that individuals will alter their expenditure decisions as a result of the price changes generated by the simulated reforms. Hence, the share that each good has in total expenditure, w_i, has to be predicted and adjusted by the prediction error, ε, where $w_i = y_i\hat{\beta} + \hat{\varepsilon}_i$.

The expenditure on each good depends not only on the price of the good itself but also on the price of other goods, which requires that the complementarity and substitutability relationships between those goods be modelled explicitly. It should be noted that we implicitly assume that producer prices do not change; it is the price to the consumer that is modified by the tax reforms, and variations in the demand quantities do not affect producer prices. Hence, our welfare analysis focuses on the consumer surplus changes assuming that the producer surplus does not vary with the VAT rate modifications. Real expenditure is obtained from expenditure on all goods deflated by the Stone index, which takes a specific value for each household:

$$(7) \qquad \ln p_{ht} = \sum_{j=1}^{19} w_{jht} p_{jt}.$$

Given that the AIDS is made up of a system of dependent linear equations, we have estimated n–1 equations of the system, excluding the equation corresponding to consumer durables. The parameter values of the equation that is omitted in the estimation have been obtained using equations (2) to (6).

Infrequent purchases and seasonal variation are among the main econometric problems with this type of data. To avoid the first problem, the model has been estimated following the procedure proposed by Baker, McKay and Symons (1990), which consists of using instrumental variables

in a three-stage least squares estimation procedure. Seasonal variation, on the other hand, is corrected by including a variable that takes account of the trend of the series and by introducing a dummy variable for each quarter of the series (the variable that corresponds to the fourth quarter is omitted in the estimation).

IV. Demand system estimation

The expenditure and price elasticities of this demand system are obtained from the following expressions:

$$(8) \qquad e_i = \frac{\beta_i}{w_i} + 1$$

$$(9) \qquad \varepsilon_{ij} = \frac{1}{(1+\beta_i \ln p_i)}\left(\frac{\gamma_{ij}}{w_i} - \frac{\beta_i}{w_i}\left(w_j + p_j \sum_{k \neq i}^{n} \ln p_k \frac{\partial w_k}{\partial p_j}\right)\right) - \delta_{ij}$$

where $\delta_{ij} = 1$ if $i = j$ and 0 in all other cases.

The estimated expenditure elasticities and the Marshallian own-price elasticities are presented in Tables 2 and 3. As may be seen, all goods are observed to have a positive expenditure elasticity – that is to say, none of the categories is inferior.[3] This outcome is to be expected, since the items of expenditure considered in the equations are of an aggregated nature and while it may be the case that a specific good is inferior, it is unlikely that this would be the case for an entire category of goods. However, several expenditure groups are defined as necessities since their expenditure elasticities are less than 1 (including food, as might be expected). Conversely, the three groups of cultural goods considered here conform to the profile of luxuries since their expenditure elasticities are greater than 1, particularly in the case of cinema, theatre and other shows. This means that the consumption of cultural goods is very sensitive to an income increase and, by extension, to the economic cycle. For instance, in the case of expenditure on cinema, theatre and other entertainment, the estimated average value of price elasticities shows that a 1 per cent increase (decrease) in household expenditure will generate a 1.75 per cent increase (decrease) in expenditure on these goods. This result is consistent with other empirical studies in this area. For instance, Frey and Pommerehne (1989, page 9)

[3]It can be proved that the income elasticity is the expenditure elasticity of any particular good multiplied by the income elasticity of the expenditure. Since the latter could be greater or less than 1, it is not clear whether the income elasticity will be higher or lower than the expenditure elasticity. In our data-set, the average income elasticity of expenditure is greater than 1, at 1.16; hence, the income elasticities of the goods are expected to be greater than the expenditure elasticities reported in this paper.

TABLE 2

Expenditure elasticities by group of goods

	Average value	*90th percentile*	*99th percentile*
1. Food and non-alcoholic beverages	0.63	0.78	0.85
2. Alcoholic beverages	0.66	0.86	0.95
3. Tobacco	0.81	0.91	0.95
4. Clothing and footwear	1.14	1.07	1.04
5. Housing	0.79	0.88	0.92
6. Furniture and household equipment	0.94	0.97	0.98
7. Gas and fuel	0.69	0.85	0.93
8. Medical and pharmaceutical products and services	1.06	1.03	1.01
9. Fuel	1.25	1.13	1.07
10. Private transport services	1.20	1.09	1.05
11. Public transport	1.01	1.01	1.00
12. Communications	0.86	0.92	0.96
13. Leisure, entertainment and holidays	1.40	1.20	1.13
14. Education	1.30	1.11	1.05
15. Cinema, theatre, museum, etc.	1.75	1.31	1.11
16. Books, periodicals and newspapers	1.37	1.17	1.08
17. Music and film on magnetic media	1.24	1.09	1.03
18. Consumer durables	1.48	1.17	1.06
19. Other goods not listed above	1.27	1.14	1.04

Note: Evaluated at population values.

found that 'an increase in per capita income of 1 per cent raises the number of visits to performing arts institutions per adult by roughly 3 per cent'. Withers (1980) also found that performing arts are luxuries. Moreover, Levy-Garboua and Montmarquette (2003) pointed out that 'it is likely that the demand for the arts is price-elastic and art is a luxury good'.

The own-price elasticities have the expected sign for cinema, theatre and other entertainment (group 15) and for books, newspapers and magazines (group 16). The results show that demand for these goods is very sensitive to price changes, particularly in the case of group 16. In both cases, a 1 per cent price decrease will generate an increase of more than 1 per cent in the consumption of such goods. Similar results have been found by SGAE (2002), Fernández-Blanco et al. (2002) for the Spanish case and Corning and Levy (2002) for theatre attendance using US data. These studies show that price increases discourage attendance at cinemas, theatres and other entertainments by non-regular spectators, whereas regular spectators maintain a similar level of expenditure and thus continue to attend these events, although less frequently.

The furniture and household equipment group and the record and film group are the only two with positive estimated price elasticities. However, it

can be seen in Table 3 that these elasticities are negative for at least the last 10 percentiles. Since the value zero is included in any two-tailed confidence interval for the standard confidence levels, it can be argued that the elasticity of such goods is not significantly different from zero. Finally, the goods analysed all had inelastic demands with the following exceptions: private transport; cinema, theatre and other events; and books and newspapers. Consequently, we can expect more than proportional changes in the consumption of these cultural goods as a reaction to reductions in VAT rates.

Table 4 lists the cross elasticities between the 19 groups of goods and the cultural goods considered here. For substitute goods, the cross elasticity has to be positive. Complementary goods, on the other hand, have a negative cross elasticity. Apart from the residual category 19, the main complementarity and substitutability relations arise among the cultural goods themselves. In particular, going to the cinema and other shows is complementary to the purchase of books, newspapers and magazines and substitutable for the acquisition of records and films. These relationships, estimated from cross elasticities, indicate the direction of the expected changes for other non-cultural goods after the reforms analysed here took place.

TABLE 3

Own-price elasticities by group of goods

	Average value	*90th percentile*	*99th percentile*
1. Food and non-alcoholic beverages	–0.24	–0.51	–0.65
2. Alcoholic beverages	–0.19	–0.66	–0.87
3. Tobacco	–0.91	–0.95	–0.97
4. Clothing and footwear	–0.69	–0.85	–0.92
5. Housing	–0.83	–0.88	–0.90
6. Furniture and household equipment	0.45	–0.13	–0.57
7. Gas and fuel	–0.52	–0.76	–0.89
8. Medical and pharmaceutical products and services	–0.78	–0.91	–0.96
9. Fuel	–0.81	–0.91	–0.95
10. Private transport services	–2.05	–1.49	–1.24
11. Public transport	–0.83	–0.93	–0.97
12. Communications	–0.95	–0.97	–0.98
13. Leisure, entertainment and holidays	–0.56	–0.80	–0.89
14. Education	–0.04	–0.64	–0.85
15. Cinema, theatre, museum, etc.	–1.23	–1.10	–1.04
16. Books, magazines and newspapers	–1.65	–1.30	–1.14
17. Music and film on magnetic media	0.65	–0.36	–0.77
18. Consumer durables	–1.43	–1.18	–1.09
19. Other goods not listed above	6.20	2.58	0.05

Note: Evaluated at population values.

TABLE 4

Ordinary cross elasticities

	15. Movies, theatre and shows	*16. Books, newspapers and magazines*	*17. Records and films*
1. Food and beverages	–0.003	–0.002	–0.001
2. Alcoholic beverages	0.093	0.631	0.374
3. Tobacco	0.034	–0.006	–0.023
4. Clothing and footwear	–0.098	–0.191	–0.051
5. Housing	–0.004	–0.036	0.017
6. Furniture and household equipment	–0.144	–0.048	–0.148
7. Gas and fuel	–0.012	–0.259	0.133
8. Medical and pharmaceutical products and services	–0.131	0.053	–0.056
9. Fuel	0.078	0.062	–0.048
10. Private transport services	0.260	0.242	–0.040
11. Public transport	–0.168	–0.186	–0.142
12. Communications	–0.136	0.163	–0.018
13. Leisure, entertainment and holidays	–0.053	0.041	–0.055
14. Education	–0.058	0.380	0.155
15. Cinema, theatre and shows	–1.228	–0.718	0.711
16. Books, newspapers and magazines	–0.524	–1.648	–0.331
17. Records and films	1.329	–0.840	0.650
18. Consumer durables	0.329	0.076	–0.171
19. Other goods not listed above	–0.038	0.133	1.180

After the estimation phase had been completed, the proposed tax reforms were simulated. When p_j varies, it can be proved that variations in the shares are approximately equal to

$$\Delta w_i = w_i \left(\varepsilon_{ij} + \delta_{ij} \right) \frac{\Delta p_j}{p_j} \qquad (10)$$

where $\Delta p_j / p_j$ is approximately the VAT rate change and $\delta_{ij} = 1$ if $i = j$ and 0 otherwise. It can be observed from equation (10) that an inelastic good will find its share reduced – although its demand will increase – if its price decreases. On the other hand, if its own-price elasticity is greater than 1 (in absolute value), both the share and quantity demanded will increase when there is a price reduction. Furthermore, the shares of total expenditure of complementary goods will increase when prices decrease because of tax cuts, but the shares of substitutes will be reduced.

TABLE 5

Breakdown of total expenditure by expenditure group

	Initial scenario	*Reform A*	*Reform B*	*Reform C*
1. Food and non-alcoholic beverages	0.2016	0.2018	0.2017	0.2017
2. Alcoholic beverages	0.0076	0.0069	0.0071	0.0072
3. Tobacco	0.0197	0.0197	0.0197	0.0197
4. Clothing and footwear	0.0738	0.0755	0.0749	0.0744
5. Housing	0.2347	0.2346	0.2348	0.2343
6. Furniture and household equipment	0.0900	0.0930	0.0916	0.0918
7. Gas and fuel	0.0147	0.0146	0.0147	0.0145
8. Medical and pharmaceutical products and services	0.0279	0.0284	0.0281	0.0282
9. Fuel	0.0359	0.0359	0.0359	0.0360
10. Private transport services	0.0262	0.0256	0.0258	0.0261
11. Public transport	0.0088	0.0094	0.0092	0.0091
12. Communications	0.0211	0.0212	0.0211	0.0212
13. Leisure, entertainment and holidays	0.1266	0.1279	0.1271	0.1275
14. Education	0.0162	0.0157	0.0158	0.0160
15. Cinema, theatre, museum, etc.	0.0030	0.0029	0.0030	0.0028
16. Books, magazines and newspapers	0.0064	0.0075	0.0071	0.0069
17. Music and film on magnetic media	0.0018	0.0014	0.0016	0.0015
18. Consumer durables	0.0652	0.0651	0.0652	0.0659
19. Other goods not listed above	0.0190	0.0158	0.0171	0.0166

Table 5 shows the changes in the shopping basket induced by the simulated reforms, using the consumption behaviour implicit in the AIDS model. Such changes in the shares of each group of goods within total expenditure are a direct consequence of the own and cross effects on expenditure induced by these reforms.

Since books and newspapers have an elastic demand and are complementary with respect to cinema tickets and music and film recordings, the proposed reforms must lead unambiguously to an increment in their share, as shown in Table 5. Furthermore, given our estimates, we may expect reductions in the shares of cinema, theatre and museum tickets and of music and film on magnetic media since their demands are less elastic and they present two cross effects with different signs.

V. Microsimulated distributive and welfare results

Having microsimulated the proposed reforms, in this section we analyse the distributive and welfare outcomes.[4] First, it should be pointed out that the

[4]An appendix describing the metrics used is included.

TABLE 6

Percentage change in tax revenue with respect to the initial scenario

	Reform A	*Reform B*	*Reform C*
VAT	–0.154	–0.770	–0.592
Excise duties	0.258	–0.074	–0.040
Total	–0.020	–0.544	–0.413

Note: Evaluated at population values.

overall decline in tax revenue implied by these reforms is not very large: 0.02 per cent for reform A, 0.54 per cent for reform B and 0.41 per cent for reform C. Obviously, B is the most radical reform since it implies abolishing VAT for cultural goods. A and C, however, are partial reforms, with C being more important as the books and newspapers group has the highest budget share among cultural goods and this reform involves a reduction in its VAT rate whereas under A it remains unchanged. The small revenue impact is closely linked to the low weighting of cultural goods in household budgets (1.12 per cent) and the cross effects that will shift the demand for other goods. As shown in Table 6, even though the consumption of cultural goods is not subject to any excise duty, excise revenue is altered slightly as a result of the reassignments in the household shopping basket induced by the reforms.

Given that the revenue effects of the three reforms are very small, at first sight this would appear to be an argument in favour of their application. However, the tax reforms studied here cannot be justified on the sole basis of this condition.

In addition to revenue aspects, a thorough assessment of such reforms requires consideration of three other crucial issues. First, it is necessary to calculate to what extent the reforms affect the distribution of expenditure. Second, the effect on individual well-being and social welfare must be assessed. Finally, it is appropriate to identify the characteristics of the households benefiting most from these measures. This set of results enables a cost–benefit analysis of the reforms to be made.

As regards the first issue mentioned above, the decrease in indirect tax revenue is not equally distributed. In fact, the reforms considered here slightly increase inequality, as shown in the Gini indices in Table 7. This increase in the Gini index, though small, is greatest when all cultural goods are zero-rated (reform B).

In addition, the reforms considered here impair the redistributive capacity of indirect taxation, as evidenced by the Reynolds–Smolensky index in Table 7. This is due to the loss of revenue arising from such measures and the loss of progressiveness of indirect taxation (computed via the Kakwani index). The low revenue impact observed in Table 6 is

TABLE 7

Distribution, redistribution and progressiveness indices

	Pre-reform	*Reform A*	*Reform B*	*Reform C*
		Gini index		
Gross expenditure	0.3178291	–	–	–
Net expenditure	0.3135603	0.3136195	0.3136896	0.3136451
		Reynolds–Smolensky redistribution index		
Net expenditure	0.0042689	0.0042096	0.0041395	0.0041840
		Kakwani progressiveness index		
Net expenditure	0.0375026	0.0370591	0.0367393	0.0370179
		Average rate		
Average rate	11.52936%	11.52705%	11.46715%	11.48386%

Note: Evaluated at population values.

corroborated by the narrow changes in the average rates shown in Table 7. Nevertheless, the reforms considered here barely change the distribution of effective average rates, as shown in Figure 1. The positive slope of the graph is related to the fact that luxury goods usually have higher VAT rates, and therefore the higher the income the higher the effective average tax rate.

In short, the simulated reforms scarcely have any distributive impact, although they do produce a very slight increase in the inequality of the expenditure distribution and they reduce the redistributive capacity and progressiveness of indirect taxes. Overall, a reduction in taxation on the

FIGURE 1

Distribution of effective average tax rates

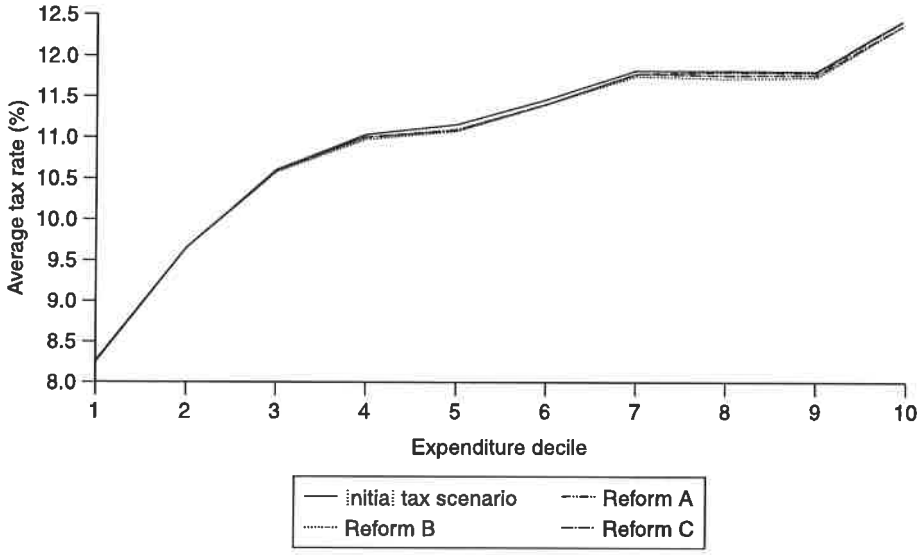
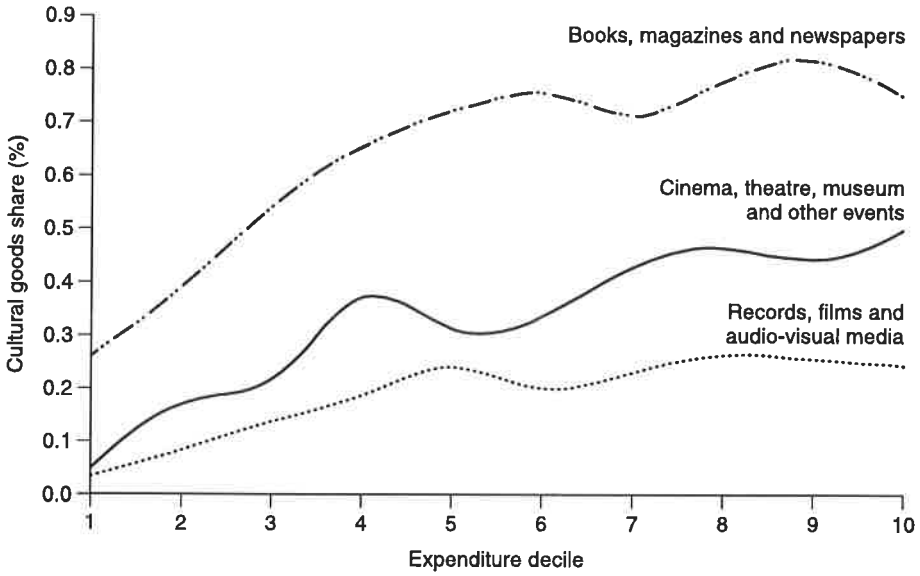


FIGURE 2

Distribution of private expenditure on cultural goods



consumption of cultural goods and services benefits the population that spends most on these goods. This result is closely linked to the high concentration of consumption of this type of good in the uppermost deciles of expenditure (see Figure 2).

The effects of the reforms on individual well-being may be studied using two approaches. The first of these is to assess the reform just after its introduction (static monetary variation). Here it is assumed that, in the short term, households do not modify their behaviour in response to fiscal parameter changes. In the second approach, individual well-being is assessed using Hicks's equivalent variation (1939) and King's equivalent expenditure (1983), which assume that households reallocate expenditure when relative prices change. Obviously, all these measures reflect pure private effects of the simulated reforms. Since positive externalities are expected from a tax cut on cultural goods, private effects represent the lower bound of the total effects.[5]

The results in Table 8 show that, on average, the reforms considered produce welfare gains in the short and the long term. Three aspects must be stressed. On the one hand, welfare gains are substantially greater if we take household behaviour into account. On the other hand, and as may be

[5]However, externalities are not easily assessed and there is not a unique methodology to measure them. Therefore, we consider that including externalities could be an extension to our private welfare analysis.

TABLE 8

Mean variation in household welfare

Euros per year

Expenditure = 17,639.83	*Reform A*	*Reform B*	*Reform C*
Initial equivalent expenditure	17,603.1	17,565.0	17,591.5
Final equivalent expenditure	17,676.6	17,715.0	17,688.2
Static monetary variation	6.2	14.7	9.9
Equivalent variation	36.8	75.2	48.4

Note: Evaluated at population values.

expected, the highest gains arise when the cultural goods are zero-rated (reform B), whereas the reform that generates the least gain in welfare is the reduction to a uniform 4 per cent VAT rate (reform A). Finally, average welfare gains are not significant in absolute terms, and represent a small percentage of the average household's spending. In relative terms, the gains are limited but not insignificant, particularly in the long term. For instance, the price of a cinema ticket was about 5 euros in Spain in 1998, so in comparative terms reform A would generate a welfare gain equivalent to attendance at eight additional films a year or to the purchase of two or three CDs. If VAT were eliminated on cultural goods (reform B), welfare gains would be as high as the purchase of 15 extra cinema tickets or four additional CDs. However, these gains would be distributed among all goods categories, as shown in Table 5, and the demand for cultural goods would barely change.

Nevertheless, these results show that, on average, the reforms would increase households' well-being. The differences observed in Figure 2 in the

TABLE 9

Distributive analysis of welfare: average equivalent variation

Euros per year

Expenditure decile	*Reform A*	*Reform B*	*Reform C*
1	9.9	19.3	12.7
2	16.8	33.5	21.9
3	22.2	44.5	29.0
4	27.4	55.2	35.9
5	32.6	66.0	42.7
6	38.4	78.0	50.4
7	45.2	92.2	59.5
8	54.5	116.0	71.8
9	69.1	142.3	91.2
10	110.0	228.9	145.9
Mean	36.8	75.2	48.4

Note: Evaluated at population values.

TABLE 10

Breakdown of equivalent variation by socio-economic variables

Average, euros per year

	Households	*Reform A*	*Reform B*	*Reform C*
Household head's educational level				
Tertiary education	16.3%	57.5	118.6	76.0
Secondary education	12.8%	45.4	93.0	59.8
Primary education	70.9%	30.5	61.9	40.0
Household head's labour status				
In work	59.6%	43.7	89.6	57.6
Unemployed	3.8%	27.9	56.5	36.6
Retired	29.4%	27.6	56.0	36.2
Unfit for work / Not working	7.1%	21.6	43.6	28.3
Student / On military service	0.0%	17.6	35.2	23.0
Household composition				
Couple with three or more children under 16	11.3%	41.3	84.5	54.4
Father/mother or couple with at least a son/daughter 16 or over	2.2%	40.4	82.8	53.3
Couple with two children under 16	8.9%	38.0	77.5	49.9
Couple with one child under 16	7.0%	34.0	69.3	44.7
Couple without children, with a member over 65	1.7%	27.9	56.5	36.5
Couple without children, with a member under 65	9.9%	22.6	45.6	29.6
Individual aged 30–64	3.7%	21.6	43.6	28.3
Individual aged under 30	0.3%	21.6	43.5	28.2
Individual aged 65 or over	6.2%	13.7	27.3	17.8
Other households with all members related to the family	35.2%	44.3	90.9	58.4
Other households with one or more members not related to the family	13.3%	40.1	82.0	52.8
Other households	0.3%	36.2	73.8	47.6
Size of town of residence				
Capital of a province	35.3%	42.3	86.7	55.7
Town, not a capital, with over 100,000 inhabitants	8.6%	36.9	75.3	48.5
Town, not a capital, with 50,000–100,000 inhabitants	7.3%	37.4	76.4	49.2
Town, not a capital, with 20,000–50,000 inhabitants	12.3%	36.4	74.3	47.9
Town, not a capital, with 10,000–20,000 inhabitants	10.4%	33.7	68.7	44.3
Town with under 10,000 inhabitants	26.0%	30.5	62.2	40.1

consumption of cultural goods make it appropriate to study how gains are distributed in terms of economic and socio-economic variables. As a starting point, Table 9 contains the distribution of such gains by expenditure deciles using equivalent variation. The results clearly indicate that welfare gains rise with expenditure – that is, whatever tax reform is implemented, a decrease in VAT on cultural goods benefits high-income households more. Specifically, the average welfare gains of households from the uppermost decile are more than 10 times greater than those of households from the first decile.

An analysis of the distribution of equivalent variation has also been carried out taking different socio-economic variables into account. The results are shown in Table 10. First, it can be seen that welfare gains are closely associated with the level of education and labour status of the head of the family. In particular, where university studies have been undertaken, welfare gains are twice as high as those where studies are at primary-school level. This result corroborates those reported in the CIMEC (1999) study, where there is a very high correlation between attendance at theatres, cinemas and other stage arts and people's educational level and standard of living. Second, welfare gains depend, as expected, on the economic situation of households. Households where the principal earner is working benefit more from a tax reduction on cultural goods than those where the principal earner is unemployed or retired. Third, reforms are more favourable to households made up of couples rather than one individual, especially when the individual in question is 65 or over. This result will partly depend on scale economies in two-earner couples. Thus, the ability to pay again plays a central role in the distribution of welfare gains. Finally, the results show that the greatest welfare gains arise where individuals live in big cities where cultural availability (supply) is concentrated.

TABLE 11

Atkinson index and King's proportional increase in initial equivalent income (λ)

Inequality aversion	*Pre-reform*	*Reform A*		*Reform B*		*Reform C*	
	Atkinson index	Atkinson index	King's λ	Atkinson index	King's λ	Atkinson index	King's λ
0	0.000	0.000	1.009	0.000	1.012	0.000	1.006
0.5	0.081	0.081	1.009	0.081	1.011	0.081	1.006
1	0.159	0.159	1.008	0.160	1.011	0.160	1.005
1.5	0.235	0.235	1.008	0.235	1.011	0.235	1.005
2	0.308	0.308	1.008	0.307	1.011	0.308	1.005
2.5	0.378	0.378	1.008	0.377	1.011	0.378	1.005
3	0.444	0.444	1.008	0.444	1.011	0.444	1.005

Note: Evaluated at population values.

TABLE 12

Efficiency analysis

Decile	*Equivalent deadweight loss* (Ed_E)			*Relative change in efficiency* (Ed_E/R_1)		
	Reform A	Reform B	Reform C	Reform A	Reform B	Reform C
1	–10.32	–17.74	–11.45	–0.019	–0.034	–0.022
2	–16.49	–28.53	–18.25	–0.015	–0.027	–0.017
3	–20.67	–35.75	–22.61	–0.013	–0.023	–0.015
4	–24.17	–41.54	–26.27	–0.012	–0.021	–0.013
5	–28.04	–48.69	–30.52	–0.012	–0.021	–0.013
6	–33.35	–57.87	–36.01	–0.012	–0.021	–0.013
7	–38.00	–66.65	–41.73	–0.011	–0.019	–0.012
8	–44.76	–78.79	–49.16	–0.011	–0.019	–0.012
9	–57.01	–101.28	–62.61	–0.011	–0.020	–0.012
10	–90.86	–165.65	–102.51	–0.011	–0.020	–0.012
Mean	–30.53	–52.71	–32.96	–0.0127	–0.0225	–0.0141

Notes: Evaluated at population values. R_1 represents post-reform tax revenue.

Supplementary to the analysis of individual well-being, we also studied the effects of these three reforms on *social* welfare. Table 11 shows the results for the Atkinson index and King's proportional increase in initial equivalent income (λ) for different values of the inequality aversion parameter. These results show gains – albeit small – in social welfare. The reform that produces the greatest gains (though modest) is the one that applies a zero rate of tax to the consumption of cultural goods.

Finally, Table 12 shows that the tax reforms simulated here produce gains in efficiency, measured as decreases in the equivalent deadweight loss. On average, reform B is the one that results in the greatest efficiency gains, with an improvement of 0.0225 euros per euro of additional revenue.

VI. Final conclusions

This paper has used the Spanish Continuous Survey of Household Expenditure to estimate an AIDS model with a total of 19 expenditure groups. These groups include three types of cultural goods: (i) cinemas, theatres, museums, etc.; (ii) books, magazines and newspapers; and (iii) film and music on magnetic media. The relevance of this exercise lies in the fact that it is one of the first attempts to estimate a complete demand system explicitly taking into account the demand for cultural goods.

From this demand model, the effects of three tax reforms were simulated, where each reform involved a reduction in the indirect taxation on cultural goods. Reform A consisted of applying a low VAT rate (4 per cent) to the

consumption of all cultural goods and services. Reform B consisted of zero-rating cultural goods, i.e. the total elimination of indirect taxation on culture. Reform C reduced the tax to the rate immediately below the one originally in force.

Econometric estimation of the AIDS model provided the price and expenditure elasticities of the various categories of goods. It is noteworthy that cultural goods and services are all luxury goods since their expenditure elasticities are greater than 1 in all cases. Moreover, the demand for cinemas, theatres and other events has the largest average expenditure elasticity: 1.75. Cinemas, theatres and other events and books and newspapers also respond more than proportionally to price changes, since their own-price elasticities are greater than 1, in absolute terms. Moreover, the most important complementarity and substitutability relations are observed among cultural goods. In particular, admissions to the cinema and other shows are complements of purchases of books, newspapers and magazines and substitutes for purchases of records and films.

With regard to the revenue effects, the proposed reforms produce small declines in tax revenue: 0.02 per cent for reform A, 0.54 per cent for reform B and 0.41 per cent for reform C. The simulated changes affect all expenditure groups because of the cross effects.

As for the distributive effects, the reforms considered here slightly increase inequality in the expenditure distribution. Moreover, they also reduce the redistributive capacity and the progressiveness of indirect taxes (although the difference is practically negligible) because consumption of this type of good is directly related to the household's purchasing power.

Since all the reforms studied involve tax cuts, they bring about welfare gains. However, these welfare gains are positively related to the ability to pay, the economic situation and the educational level of a household. This result allows us to qualify the distributive aspects of this type of reform in that people with a lower cultural level, who should thus be the primary target of cultural policies, are the group that least benefits when such policies are exclusively of a fiscal type. Finally, and as expected, these reforms bring social welfare and efficiency gains, which increase with the magnitude of the tax cut.

Summing up, this research shows that tax cuts on cultural goods and services will lead to welfare and efficiency increases but that these gains are not equally distributed. Moreover, the policy can be described as regressive, since these goods have income elasticities greater than 1. Consequently, the richer a household is, the larger the welfare gains are. In conclusion, policymakers should take this trade-off into account when debating whether to introduce such tax cuts.

Appendix. Measurement of the distributive and welfare impact: metrics

Below we review a set of metrics and concepts for computing the impact of the three reform scenarios analysed. The degree of inequality in the distribution of private spending is measured with the well-known Gini and Atkinson indices. The Hicksian equivalent and compensated variation are used to measure the impact on consumers' individual welfare. Other relevant items in welfare economics are used, such as equivalent expenditure, equally distributed equivalent expenditure and the coefficient of proportional gain in social welfare, λ, defined by King (1983).

Commencing with the measurement of inequality in the distribution of household expenditure, the *Gini index* was calculated. Given an expenditure distribution, $F(X)$, the related Gini index is defined as[6]

$$\text{(A1)} \qquad F(X) \to G_X = 1 - 2\int_0^1 L_X(p)dp, \quad p \in (0,1).$$

Another popular index of inequality is that of Atkinson, which requires the specification of an explicit social welfare function (presented later).

The Hicksian *equivalent variation* and the *compensating variation* are computed from the notion of equivalent expenditure, defined formally from the system of demand estimated in Section III. As King (1983) showed, given a reference price vector, P_r, the equivalent expenditure is defined as that level of expenditure that makes it possible for the taxpayer to reach a reference level of utility, $v_R(P,G)$, where P is the price vector and G is the effective expenditure. Accordingly, once the indirect utility function representing taxpayers' preference is known, the explicit function of *equivalent expenditure*, G_e, can be obtained by solving the following general equation:

$$\text{(A2)} \qquad v\left(P_r, G_e\right) = v_R\left(P, G\right)$$

[6]To effectively calculate this index, the most widely used expression was applied using discrete variables and weightings to raise the calculations of the index to the overall population.

$$G = 1 + \frac{1}{\sum \omega_h} - \frac{2\sum \omega_h x_h \left(\rho_h + \frac{\omega_h - 1}{2}\right)}{\frac{\sum \omega_h x_h}{N}\left(\sum \omega_h\right)^2}$$

where
$\rho_h = 1$ if $h = 1$;
$\rho_h = \omega_h - 1$ if $h > 1$;
x_h = total expenditure of household h;
ω_h = populational weighting of household h;
N = population size.

which, in terms of the expenditure function, $e(P,U)$, can be expressed more usefully as

(A3) $G_e = e\left(P_r, v_R\left(P,G\right)\right)$.

Depending on the level of utility taken as a reference, expression (A3) can lead to an *initial equivalent expenditure*, G_e^0, if the level of utility obtained is the initial one, v^0, or a *final equivalent expenditure*, G_e^1, if the target utility is the final one, v^1:

(A4) $G_e^0 = e\left(P_1, v^0\left(P,G\right)\right)$;

(A5) $G_e^1 = e\left(P_0, v^1\left(P,G\right)\right)$.

A welfare-enhancing reform will conform to the following order of the values of equivalent expenditure: $G_e^0 < G < G_e^1$. Conversely, when the reform triggers losses, the order is reversed: $G_e^0 > G > G_e^1$. As a result, the following is one way to measure the general welfare induced by any tax reform:

(A6) $GEB_i = G_{e_i}^1 - G_{e_i}^0$.

The compensating variation (CV) and the equivalent variation (EV), contained in expressions (A7) and (A8), are also metrics that represent monetary equivalents of changes in welfare. These metrics 'cardinalise' the ordinal changes in utility induced by modifications in the price vector. CV is defined as the monetary amount by which the impaired households should be compensated, or which should be demanded from the gainers due to the price change induced by the reform. This compensation allows households to remain on the initial indifference curve. Therefore, implementing the reform is equivalent to the households receiving compensation for the impairment or making a payment for the benefits they received. EV is identified with the amount of money that the households that lost (gained) in the reform would be willing to pay to prevent (ensure) the actual occurrence of the change in the price vector.

(A7) $CV = e\left(P^0, v^0\right) - e\left(P^1, v^0\right) = G - G_e^0$;

(A8) $EV = e\left(P^0, v^1\right) - e\left(P^1, v^1\right) = G_e^1 - G$.

CV and EV thus defined will both take positive values when there is a gain in welfare and negative values when there is a loss.

The standard approach for quantifying efficiency is to estimate the deadweight loss. This metric is determined to be the difference between the Hicksian metrics (CV and EV) and the variation in tax revenue generated by populational households h:

$$\text{(A9)} \quad E_{GC} = \sum_h CV_h - \left(R_h^1 - R_h^0\right);$$

$$\text{(A10)} \quad E_{GE} = \sum_h EV_h - \left(R_h^1 - R_h^0\right)$$

where R_h^0 and R_h^1 identify initial and final levels of tax revenue for the h households. In addition, it may be interesting to quantify the *social value* of the reform. The social value of government intervention should be understood as any metric that permits assessment of the actions of the public sector and whose computation requires an explicit social welfare function. *Social welfare* may be defined in terms of the equivalent expenditure, G_e, as follows:

$$\text{(A11)} \quad W = W\left(G_{e_1}, G_{e_2}, \ldots, G_{e_N}\right).$$

From (A11), we can derive a measure of social value called the *proportional increment in original equivalent expenditure*, denoted λ. This metric is defined as the *proportional* increase in initial equivalent expenditure that would make it possible to match the social welfare created by the reform. Formally,

$$\text{(A12)} \quad W\left(\lambda G_{e_1}^0, \lambda G_{e_2}^0, \ldots, \lambda G_{e_N}^0\right) = W\left(G_{e_1}^1, G_{e_2}^1, \ldots, G_{e_N}^1\right).$$

Additionally, the equivalent expenditure function can also be used to construct inequality indices defined on the distribution of equivalent expenditure. In this way, following Atkinson (1970) and Sen (1973), we can define the *equally distributed equivalent expenditure*, $\hat{g}_e$, as the equivalent expenditure level that, distributed equally among all households, would provide the same level of social welfare as the actual distribution of equivalent expenditure. We can identify two values of $\hat{g}_e$: one refers to the pre-reform equilibrium situation, $\hat{g}_e^0$, and the other to the post-reform equilibrium, $\hat{g}_e^1$. Formally, $\hat{g}_e^0$ and $\hat{g}_e^1$ are determined by solving the following equations:

$$\text{(A13)} \quad W\left(\hat{g}_{e_1}^0, \hat{g}_{e_2}^0, \ldots, \hat{g}_{e_N}^0\right) = W\left(G_{e_1}^0, G_{e_2}^0, \ldots, G_{e_N}^0\right);$$

$$\text{(A14)} \quad W\left(\hat{g}_{e_1}^1, \hat{g}_{e_2}^1, \ldots, \hat{g}_{e_N}^1\right) = W\left(G_{e_1}^1, G_{e_2}^1, \ldots, G_{e_N}^1\right).$$

In order to switch from social welfare metrics to inequality metrics, it is necessary for social welfare to be measured in the same units as individual welfare, so that the proportional changes in all equivalent expenditures, G_e, have the same proportional effect on aggregate social welfare. This will be the case when the social welfare function, W, is first-degree homogeneous. In this context, (A11) can be rewritten as

$$\text{(A15)} \quad W = \bar{G}_e W\left(\frac{G_{e_1}}{\bar{G}_e}, \frac{G_{e_2}}{\bar{G}_e}, \ldots, \frac{G_{e_N}}{\bar{G}_e}\right)$$

where $\bar{G}_e$ is the mean of the distribution of equivalent expenses. The main operational advantage of equation (A15) is that it makes it possible to separate the effect on social welfare into its two components: that associated with the distribution of equivalent expenditure and that arising from the average value of the equivalent expenditure, $\bar{G}_e$. This separation of factors allows social welfare changes to be broken down into changes in the average value of the equivalent expenditure, $\bar{G}_e$, and changes in some appropriate index of inequality. If $G_{e_i}/\bar{G}_e = 1$, then $W = \bar{G}_e$, which indicates that there is perfect equality since all households would attain the mean level of welfare. Therefore, if $G_e = \bar{G}_e$ holds, then, by the principle of transfers, the social welfare associated with any unequal assignment may not, in any event, exceed $\bar{G}_e$. Consequently, equation (A15) can be expressed as

$$\text{(A16)} \quad W = \bar{G}_e(1 - I)$$

where I expresses the cost of the inequality in social welfare terms. Therefore, it is a metric of inequality that is zero if the equivalent expenditure is distributed evenly and that rises if there are transfers that favour inequality. Also, since the inequality metric, I, is a scale version of W with the opposite sign (the scale is $\bar{G}_e$), this index satisfies the inverse transfer principle. In short, any distributive change that involves transfers from the rich to the poor will decrease the value of I. Assuming that W is symmetrical and quasi-concave, and considering (A13), (A14) and (A16), an index of inequality can be defined as

$$\text{(A17)} \quad I = 1 - \frac{\hat{g}_e}{\bar{G}_e}.$$

Assuming also that W is homothetical (i.e. that the inequality index is independent of the mean of the distribution), then there is a simple relationship between λ and metrics of inequality before and after the reform. Specifically, when W is homothetical, we have

$$\text{(A18)} \quad W\left(\lambda\hat{g}^0_{e_1}, \lambda\hat{g}^0_{e_2}, \ldots, \lambda\hat{g}^0_{e_N}\right) = W\left(\lambda G^0_{e_1}, \lambda G^0_{e_2}, \ldots, \lambda G^0_{e_N}\right).$$

Suitably combining equations (A12), (A15) and (A18) gives

$$\text{(A19)} \quad W\left(\hat{g}^1_{e_1}, \hat{g}^1_{e_2}, \ldots, \hat{g}^1_{e_N}\right) = W\left(\lambda\hat{g}^0_{e_1}, \lambda\hat{g}^0_{e_2}, \ldots, \lambda\hat{g}^0_{e_N}\right),$$

meaning that $\hat{g}^1_e = \lambda\hat{g}^0_e$ and therefore, from the definition of the inequality index contained in (A12), the value of λ is given by the following expression:

$$\text{(A20)} \quad \lambda = \frac{\bar{G}^1_e(1-I^1)}{\bar{G}^0_e(1-I^0)}.$$

That is to say, the proportional social gain is determined by the increase in equivalent expenditure adjusted by the change in the inequality indices. When λ is greater than 1, the reform generates a gain in social welfare. Conversely, if it is less than 1, there is a loss of welfare.

In order to compute the foregoing measures, it is necessary to specify an explicit *social welfare function* (SWF) and to have the function of the estimated demand equations. For this purpose, we use the SWF proposed by Atkinson (1970), where ε is the measure of inequality aversion. Formally,

$$\text{(A21)} \quad W = \frac{1}{N}\sum_{h=1}^{N}\frac{G^{(1-\varepsilon)}_{e,i}}{1-\varepsilon} \quad \text{if } \varepsilon \neq 1;$$

$$\text{(A22)} \quad W = \frac{1}{N}\sum_{h=1}^{N}\ln G_{e,i} \quad \text{if } \varepsilon = 1.$$

Using this welfare function and the definition of equally distributed equivalent expenditure from (A13) and (A14), we get

$$\text{(A23)} \quad \hat{g}_e = \left[\hat{W}(1-\varepsilon)\right]^{\frac{1}{1-\varepsilon}} \quad \text{if } \varepsilon \neq 1;$$

$$\text{(A24)} \quad \hat{g}_e = e^{\hat{W}} \quad \text{if } \varepsilon = 1.$$

Moreover, from $\widehat{g}_e$ it is possible to obtain the *Atkinson inequality function*, $A(\varepsilon)$:

$$(A25) \quad A(\varepsilon)=1-\frac{\widehat{g}_e}{\overline{G}_e}$$

where $\overline{G}_e$ is the relevant average equivalent expenditure in the population. The Atkinson index is bounded between 0 (total equality) and 1 (total inequality), depending on the inequality aversion parameter, ε. Expression (A25) reflects the trade-off between efficiency (measured via the mean equivalent expenditure) and equity (expressed via the notion of equally distributed equivalent expenditure). In this way, the equal proportional increment in the equivalent expenditure, defined in (A20), is

$$(A26) \quad \lambda=\frac{\overline{G}_e^1\left(1-A(\varepsilon)^1\right)}{\overline{G}_e^0\left(1-A(\varepsilon)^0\right)}.$$

The equivalent expenditure expression will depend on the form of the indirect function of consumer utility. In the particular case of an Almost Ideal Demand System (AIDS), that function, in log form, is as follows (see Baker, Blundell and Micklewright (1989)):

$$(A27) \quad \ln v=\frac{\ln y-\ln a(p)}{b(p)}.$$

Accordingly, taking account of the definition of equivalent expenditure, the following should hold:

$$(A28) \quad \frac{\ln G-\ln a(p)}{b(p)}=\frac{\ln G_e-\ln a(p_R)}{b(p_R)}$$

and therefore the explicit function of equivalent expenditure that we will use in applied work is as follows:

$$(A29) \quad \ln G_e=\frac{b(p_R)}{b(p)}\left[\ln G-\ln a(p)\right]+\ln a(p_R)$$

where the functions $b(p)$ and $\ln a(p)$ are represented by the following functions:

$$\text{(A30)} \quad b(p) = \beta_0 \prod_{i=1}^{19} p_i^{\beta_i};$$

$$\text{(A31)} \quad \ln a(p) = a_0 + \sum_{i=1}^{19} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{19} \sum_{j=1}^{19} \gamma_{ij} \ln p_i \ln p_j.$$

Accordingly, the initial and final equivalent expenditures that we will define in the microsimulation of the tax reforms considered in this paper are defined as

$$\text{(A32)} \quad \ln G_e^o = \frac{b(p_1)}{b(p_0)} \left[\ln y - \ln a(p_0) \right] + \ln a(p_1);$$

$$\text{(A33)} \quad \ln G_e^1 = \frac{b(p_0)}{b(p_1)} \left[\ln y - \ln a(p_1) \right] + \ln a(p_0).$$

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