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Abstract: The distributional characteristic is a measure which can be used in many applications in social cost-benefit analysis. In the application here, the distributional characteristics of a number of broad aggregates of goods are calculated for Ireland. These calculations can aid in assessing the distributional implications of price and tax changes.

Keywords: Distributional Characteristic, welfare weight, tax reform.

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1. Introduction

All other factors held equal, changes in prices can have implications for the distribution of income (or any other measure of household or individual resources). Thus a price increase (say caused by an increase in indirect taxes) in a good which is disproportionately consumed by lower income households will clearly lead to a deterioration in the relative position of such households. Recently the distributional implications of price movements have been examined by amongst others Callan et al (2008) and Jennings et al (2009). The former paper examines the impact of a carbon tax across households, where households are differentiated by income and demographic characteristics. The latter paper analyses recent changes in overall price deflation in Ireland and looks at the incidence of these price changes across the income distribution.

This short note complements this analysis by calculating the *distributional characteristic* of broad aggregates of goods. The distributional characteristic (first introduced by Feldstein, 1972) provides a useful summary of the extent to which the consumption of any good (or aggregate of goods) is distributed across the distribution of income.[1] Essentially the consumption of the good by each household (or group of households) is accorded a specific weight and typically the weights will be directly related to some measure of household resources such as income, such that poorer households have a higher weight. A comparison of this weighted average of consumption of the good with a simple unweighted average then gives a single coefficient which can be used to rank goods in terms of the extent to which their consumption is concentrated amongst poorer households. While distributional characteristics have most commonly been used in analysis of tax reforms, they can be applied to many cases of social cost-benefit analysis where distributional weights are important.

[1] In what follows we will use the term income, but clearly the analysis could be applied to other measures of household resources, such as expenditure.

The calculation of the distributional characteristic for each good then provides very useful information in terms of the analysis of the distributional impact of price changes. It complements the Jennings et al analysis by showing precisely which goods (in terms of price changes) will impact most upon the less well-off. Thus if within a period of general deflation price falls were concentrated amongst goods with a high distributional coefficient, we could infer that such deflation was relatively benefiting the less well-off. The distributional characteristic also provides a very useful summary of the relative distributional impact (at the margin) of any indirect tax change. Calculations of the distributional characteristic for Ireland for 1980 and 1987 were carried out by the author in the context of a more general analysis of marginal tax reform (Madden, 1995).

The remainder of this note proceeds as follows: first we briefly describe how the distributional characteristic is calculated. We then calculate the characteristics for broad aggregates of goods using the last three Household Budget Surveys (1994/95, 1999/2000 and 2004/2005).

2. **Distributional Characteristics**

Suppose there are *H* households and that consumption of a good *i* by household *h* is denoted as x_i^h and we use upper-case letters to denote total consumption of the good with $X_i = \sum_{h=1}^{H} x_i^h$. The distributional characteristic of good *i* is then denoted by

$$D_i = \frac{\sum_{h=1}^{H} \beta^h x_i^h}{\sum_{h=1}^{H} x_i^h} = \frac{\sum_{h=1}^{H} \beta^h x_i^h}{X_i}$$

where β^h reflects the relative weight attached to household *h* and incorporates the extent to which distributional considerations are a concern. Suppose the analyst does not wish to take distributional considerations into account at all. The each household has the same weight (which is easiest to simply set to one) and we have $D_i = 1 \forall i$ and all goods have a distributional characteristic equal to one.

Alternatively, suppose instead that the analyst wishes to take distributional considerations into account and wishes to place a higher weight on less well-off households. In this case less well-off households will make a relatively higher contribution to the numerator in D_i and hence those goods whose consumption is more concentrated amongst less well-off households will have a relatively higher value of D_i.

So how do we arrive at values for the β^h in a coherent and transparent manner? Probably the most frequently used approach is to let β^h for each household equal its marginal utility of income, where the utility of income function is the well-known Atkinson one. Thus $U^h(Y^h) = \frac{k(Y^h)^{1-e}}{1-e}, e \neq 1$ and $U^h(Y^h) = \log Y^h, e = 1$, where U^h represents the utility of household h and Y^h represents its income. In this function, k is a normalisation factor (usually set equal to one for convenience), while e is a parameter which denotes the degree of concern for distributional considerations of the analyst.[2]

Thus we have $\beta^h = \frac{\partial U^h}{\partial Y^h} = (Y^h)^{-e}, e \neq 1$ and $\beta^h = \frac{\partial U^h}{\partial Y^h} = \frac{1}{Y^h}, e = 1$ and we have set *k=1*. Suppose we denote the poorest household as household “1”, then the relative weight for household h, i.e. its weight relative to the poorest household, $\frac{\beta^h}{\beta^1} = \left(\frac{Y^h}{Y^1}\right)^{-e} = \left(\frac{Y^1}{Y^h}\right)^{e}$. When *e=0*, then this clearly collapses to one, and all households have the same weight. Values of e greater than zero then lead to relatively lower weights for richer households. For example, if the poorest household had an

[2] e is essentially fulfilling two roles here. Any value greater than zero will ensure the property of diminishing marginal utility of income. But values of e greater than zero can also incorporate a social planners view as to the welfare weight which can be attached to any given household.

income of say €100, then with e=5, a household with twice the income of the poorest household would have a relative weight of $\frac{\beta^h}{\beta^1} = \left(\frac{200}{100}\right)^{-5} = \left(\frac{100}{200}\right)^{5} = \frac{1}{32}$.

Thus by varying the value of the parameter, *e*, we can vary the relative weight attached to the poorest household's consumption in terms of the calculation of the distributional characteristic. High values of *e* (which would generally be regarded as *e*>5) will lead to a high weighting being attached to the consumption patterns of the very poorest households. Clearly the value of *e* is at the discretion of the analyst and it is typical to include results for a range of values.

Given the choice of *e* and a suitable measure of household resources it is then straightforward to calculate β^h for each household, after which D_i can be calculated for each good. Note that what is most important here is the *ranking* of goods by D_i. The absolute values of the distributional characteristic will depend upon the choice of welfare weights, and as discussed above, this will depend upon the value of *e* chosen by the analyst. Thus comparing values of D_i for different values of *e* is not meaningful. However comparison of D_i for two different goods for the same value of *e* is valid.

The approach outlined in this section involves the calculation of specific household welfare weights (via the specific Atkinson utility of income function). It could be argued that results may be specific to this particular utility of income function and that more general results are desirable. For such an approach, see Makdissi and Wodon (2002) and Duclos et al (2002).

In the next section we calculate values of the distributional characteristic for broad aggregates of goods in Ireland.

3. Calculation of Distributional Characteristics for Ireland and Discussion

In this section we present calculations of distributional characteristics for Ireland for three different periods. These periods correspond to the three most recent Household

Budget Surveys (HBS), 1994/95, 1999/2000 and 2004/2005. The HBS is a nationally representative survey which provides a detailed account of spending on a wide variety of items for a sample of approximately 7000 households. The results from the HBS form the basis of the weights used in constructing the Consumer Price Index (CPI). The HBS collects data on expenditure over a very wide range of goods and in principle the distributional characteristic for each good could be calculated. However, in order to simplify analysis we present results for eleven broad aggregates. Inevitably in carrying out such aggregation we do lose some detailed information. Thus a broad aggregate such as Transport includes such sub-categories as bus fares and air travel and we might reasonably expect that the distributional characteristics for these two sub-categories would differ.

The categories of goods whose distributional characteristics we calculate are: food, alcohol, tobacco, clothing and footwear, fuel and light, housing, non-durable goods, durable goods, miscellaneous goods, transport and services. Their shares of total expenditure for the three periods are given in table 1 showing a shift away from food and towards transport and services.

The welfare weights which form the basis for the distributional characteristic are also derived from the relevant HBS. The HBS provides detailed summaries of expenditure by gross income decile. Thus we can partition the population into ten "households" where each household is the average household for that decile. Given knowledge of the gross income of that household we can then calculate the β^h. An alternative approach is to use the total expenditure for each decile (where once again the decile is with reference to gross income). This will tend to give higher absolute values for the distributional characteristic since for poorer households total expenditure is likely to be a higher fraction of gross income than is the case for richer households but it does not affect the rankings of goods, as can be seen from inspection of tables 2-4.

Tables 2-4 show the values of the distributional characteristic for the three most recent versions of the HBS. There is very strong uniformity of ranking across years, across different values of e and between the use of income or expenditure. Calculations of the Spearman rank correlation coefficient (available upon request) show values in excess of 0.85 for every possible correlation, indicating that the rankings are extremely similar and in many cases identical. The three goods with the highest ranking (and whose expenditure is most concentrated amongst poorer households) are fuel and light, tobacco and food. At the other end of the distribution the goods whose expenditure is most concentrated amongst richer households are services, transport and clothing and footwear. It can be noted from tables 2-4 that in some instances the distributional characteristics for some goods are very close in value (e.g. durable goods and miscellaneous goods in 1999/2000) and the difference between them is unlikely to be statistically significant.

Thus falls in the prices of fuel and light, tobacco and food will be most beneficial to poorer households while falls in the prices of transport and services and clothing and footwear will most benefit richer households. Correspondingly if we were implementing revenue-neutral marginal tax reforms and were willing to ignore issues of deadweight loss and efficiency and had a moderate degree of inequality aversion (as embodied in a value of *e* of 1) then we would recommend reductions in indirect taxes on fuel/light and tobacco and increases in taxes on transport and services.

4. Concluding Remarks

This short note has calculated the distributional characteristic for broad aggregates of goods for Ireland for three different periods, corresponding to the three most recent Household Budget Surveys. The results are quite consistent with the results from previous analysis of the 1980 and 1987 HBS suggesting that broad spending patterns across the income distribution have been quite stable. Note that this does not imply that overall budget shares are constant (or near constant) but just that changes in budget shares have been reasonably uniform across the income distribution.

There are some caveats which should be borne in mind regarding this analysis. Inevitably, given the thousands of different goods purchased by Irish households it is only practical to calculate distributional characteristics for broad aggregates. In that regard, caution should be applied in terms of tax recommendations which might follow this analysis. As pointed out above, while one broad aggregate of goods might have, say, a high distributional characteristic, that may not be the case for all goods in this aggregate. Thus in the case of say transport, while a tax increase on luxury cars might appear to be progressive, if that tax increase also includes bus-fares the impact on progressivity will be diminished. Similarly if we observe price decreases in a broad aggregate good such as food the impact upon poorer households may be minimal if the price decreases are concentrated in such food items as fillet steak and caviar. In such instances it may be useful to calculate the distributional characteristic for the specific good in question.

It should also be borne in mind that when recommending tax reforms distributional considerations may have to be accompanied by other concerns. Thus optimal tax theory advises that tax reforms should also take account of efficiency effects i.e. generally have higher taxes on goods with low price elasticities (which are typically also goods with low income elasticities and hence high distributional characteristics). In the case of goods such as tobacco and alcohol the issue of external effects must also be borne in mind when making tax changes. However, even bearing this caveat in mind, it seems reasonable to suggest that the distributional characteristic is a measure which may be useful for policy analysis in a number of areas and one which should be calculated with the publication of each Household Budget Survey.

Table 1: Shares of Total Expenditure

Good	1994/95	1999/2000	2004/2005
Food	0.24	0.22	0.18
Alcohol	0.05	0.06	0.04
Tobacco	0.03	0.02	0.02
Clothing and Footwear	0.02	0.07	0.05
Fuel and Light	0.05	0.04	0.04
Housing	0.10	0.10	0.12
Non-Durable Goods	0.02	0.03	0.02
Durable Goods	0.04	0.05	0.05
Miscellaneous Goods	0.04	0.04	0.03
Transport	0.15	0.18	0.16
Services	0.25	0.26	0.29
Total	1.00	1.00	1.00

Table 2: Distributional Characteristics – 1994/95

Good	Inc e=1	Exp e=1	Inc e=2	Exp e=2	Inc e=5	Exp e=5
Food	0.245 (3)	0.313 (3)	0.105 (3)	0.139 (3)	0.046 (3)	0.053 (3)
Alcohol	0.209 (6)	0.278 (6)	0.078 (6)	0.109 (6)	0.031 (6)	0.036 (6)
Tobacco	0.287 (2)	0.355 (2)	0.132 (2)	0.170 (2)	0.057 (2)	0.066 (2)
C & F	0.197 (9)	0.266 (9)	0.069 (9)	0.099 (9)	0.024 (9)	0.029 (9)
F & L	0.291 (1)	0.358 (1)	0.145 (1)	0.182 (1)	0.074 (1)	0.083 (1)
Housing	0.210 (5)	0.279 (5)	0.079 (5)	0.110 (5)	0.031 (5)	0.036 (5)
Non-Dur	0.231 (4)	0.300 (4)	0.092 (4)	0.125 (4)	0.036 (4)	0.042 (4)
Durables	0.203 (8)	0.271 (8)	0.073 (8)	0.103 (8)	0.027 (8)	0.031 (8)
Misc.Goods	0.206 (7)	0.275 (7)	0.076 (7)	0.106 (7)	0.029 (7)	0.034 (7)
Transport	0.192 (10)	0.261 (10)	0.065 (10)	0.094 (10)	0.022 (11)	0.026 (11)
Services	0.181 (11)	0.250 (11)	0.062 (11)	0.089 (11)	0.024 (10)	0.027 (10)

Table 3: Distributional Characteristics – 1999/2000

Good	Inc e=1	Exp e=1	Inc e=2	Exp e=2	Inc e=5	Exp e=5
Food	0.219 (3)	0.290 (3)	0.090 (3)	0.120 (3)	0.041 (3)	0.046 (3)
Alcohol	0.174 (8)	0.249 (9)	0.057 (8)	0.085 (8)	0.021 (9)	0.026 (8)
Tobacco	0.245 (2)	0.316 (2)	0.104 (2)	0.137 (2)	0.045 (2)	0.050 (2)
C & F	0.168 (10)	0.244 (10)	0.052 (11)	0.080 (10)	0.019 (10)	0.021 (10)
F & L	0.270 (1)	0.338 (1)	0.135 (1)	0.168 (1)	0.076 (1)	0.082 (1)
Housing	0.190 (5)	0.264 (5)	0.067 (5)	0.097 (5)	0.027 (7)	0.030 (7)
Non-Dur	0.207 (4)	0.280 (4)	0.080 (4)	0.110 (4)	0.034 (4)	0.038 (4)
Durables	0.185 (7)	0.260 (7)	0.066 (7)	0.095 (7)	0.030 (5)	0.032 (5)
Misc.Goods	0.185 (8)	0.260 (6)	0.067 (6)	0.095 (6)	0.029 (6)	0.032 (6)
Transport	0.170 (9)	0.250 (8)	0.053 (10)	0.081 (9)	0.019 (11)	0.021 (11)
Services	0.167 (11)	0.229 (11)	0.055 (9)	0.077 (11)	0.022 (8)	0.024 (9)

Table 4: Distributional Characteristics – 2004/2005

Good	Inc e=1	Exp e=1	Inc e=2	Exp e=2	Inc e=5	Exp e=5
Food	0.222 (3)	0.302 (3)	0.095 (3)	0.131 (3)	0.045 (3)	0.052 (3)
Alcohol	0.193 (8)	0.273 (8)	0.073 (7)	0.107 (7)	0.033 (7)	0.038 (7)
Tobacco	0.279 (1)	0.357 (1)	0.138 (2)	0.180 (2)	0.075 (2)	0.083 (2)
C & F	0.188 (9)	0.269 (9)	0.068 (9)	0.102 (9)	0.028 (8)	0.033 (9)
F & L	0.275 (2)	0.352 (2)	0.140 (1)	0.180 (1)	0.078 (1)	0.087 (1)
Housing	0.199 (6)	0.279 (6)	0.077 (6)	0.112 (6)	0.033 (6)	0.039 (6)
Non-Dur	0.212 (4)	0.292 (4)	0.085 (4)	0.121 (4)	0.037 (4)	0.043 (4)
Durables	0.193 (7)	0.274 (7)	0.070 (8)	0.105 (8)	0.028 (9)	0.033 (8)
Misc.Goods	0.208 (5)	0.288 (5)	0.083 (5)	0.118 (5)	0.036 (5)	0.042 (5)
Transport	0.177 (10)	0.258 (10)	0.058 (11)	0.091 (10)	0.020 (11)	0.024 (11)
Services	0.173 (11)	0.253 (11)	0.059 (10)	0.091 (11)	0.025 (10)	0.029 (10)

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