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An Analysis of Indirect Tax Reform In Ireland

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Abstract: This paper applies the Ahmad-Stern model of indirect tax reform to the Irish economy for two different years, 1980 and 1987. It introduces a modification to the traditional marginal social cost measure used in these studies, identifies welfare-improving, revenue-neutral tax changes at the margin and examines their sensitivity to such issues as inequality aversion and consumer preferences. It also estimates the implied degree of inequality aversion for Ireland for these two years. Results suggest that the government's social welfare function, as implied by the indirect tax system, has become less inequality averse.

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An Analysis of Indirect Tax Reform in Ireland in the 1980s[1]

1. Introduction

Since the seminal work by Diamond and Mirrlees (1971), a number of attempts have been made to calculate optimal tax rates for economies e.g. Deaton (1977) for the UK and Harris and McKinnon (1979) for Canada. Other exercises along these lines are studies by Ebrahimi and Heady (1988) who examine the sensitivity of optimal tax rates to assumptions regarding separability and the availability of optimal demogrants and those of Hatta (1989) and Fukushima and Hatta (1991) who examine the welfare implications of a move to uniform taxation.

The calculation of optimal tax rates imposes quite severe informational requirements. For example, it is necessary to specify explicit utility functions for agents as well as the distribution of income (or whichever variable households are ranked over). Demand responses also have to be evaluated for individual households at the optimum, a point which may be quite far away from the current position of the economy. In addition, optimal tax calculations require estimates of how demand elasticities change in response to taxes and/or redistributions of income, which depends upon the second derivatives of demand functions and hence the third derivatives of utility functions.

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The informational difficulties outlined above led to the development of the marginal tax reform literature, with the seminal paper in this area by Ahmad and Stern (1984). This approach has the considerable advantage of not requiring the choice of explicit utility functions, nor of distributions of expenditure, but instead merely requiring information on the actual position of the economy at a single point in time, using actual consumptions, actual distributions of expenditure, and actual aggregate rather than individual demand responses for the current situation of the economy.

Ahmad and Stern (henceforth AS, 1984) examined indirect tax reform for India. This model addressed tax reform using a measure which they called the marginal social cost (MSC) of raising revenue via an increase in the tax on a specific good. Optimality requires that the MSC be equal for all goods. If the MSC are not equal then directions of tax reform at the margin can be identified. The tax on the good with a higher MSC is lowered while that on the good with the lower MSC is raised. The actual expression for MSC is the ratio of a welfare effect and a revenue effect and its calculation requires information on household demands for goods, tax rates, welfare weights and price responses. AS then present calculations of MSC for the Indian economy and identify directions of indirect tax reform at the margin. Similar calculations to those of AS have been carried out for Norway (Christiansen and Jansen (1978)), Belgium (Decoster and Schokkaert (1990)), Canada (Craggs (1990)), Germany (Kaiser and Spahn (1989)), Italy (Brugiavini and Weber (1988)) and Pakistan (Ahmad and Stern (1991)).

This paper extends the AS methodology and applies it to a study of the Irish indirect tax system. It builds upon previous work by the author (Madden (1989)), but differs from that work in a number of crucial respects. Firstly, from a methodological point of view this paper addresses a problem which can arise with the MSC measure introduced by AS. It shows that their MSC measure is not a continuos measure and proposes instead that the reciprocal of MSC is a preferable measure. Secondly, this study looks at indirect tax reform for both 1980 and 1987[1] thus permitting analysis of the degree to which the implied tax reforms for 1980 were subsequently implemented. Thirdly, this study incorporates family size and equivalence scales into the distribution of expenditures. It also addresses the issue of the degree of inequality aversion implicit in the indirect tax system. Finally, this study uses a substantially different and more relialable set of demand responses.[2]

The layout of this paper is as follows: Section 2 describes the basic model of marginal indirect tax reform. Section 3 briefly discusses the data, while section 4 gives a short account of developments in indirect taxes in Ireland over the period under discussion. Section 5 presents and discusses the results, while section 6 offers some concluding comments and outlines possibilities for future research.

2. The basic model of tax reform

The marginal tax reform approach lies very much within the traditional optimal tax literature but takes a different starting point. Rather than attempting to derive those tax rates which minimise welfare loss for the collection of a given revenue and which involve the various difficulties outlined above, the approach takes the existing tax system as given and derives conditions of optimality. If the existing system does not satisfy those conditions, directions of tax reform can be identified at the margin. Tax reform is thus potentially of more relevance to the policy-maker than is optimal tax design.

This approach concentrates on consumer welfare and the government revenue constraint. It also concentrates, for the moment, on the indirect tax system only, though, as we shall see, a potentially attractive extension to the model would be the inclusion of labour supply and the direct tax system. Thus the production side of the model is very simple. Producer prices are fixed and there are constant returns to scale, with the result that tax increases are reflected as consumer price increases and there are no pure profits. (See Stern (1987) for a discussion of the case where tax shifting can be different from 100%).[3] We assume factor incomes are fixed and thus household utility is a function of consumer prices, q. There are n goods and t is a vector of specific taxes.

$$q = p + t \qquad (1)$$

where p is the fixed producer price vector. There are H households indexed by h=1,2..H.

Given prices q, the demand of household h, $x^h(q)$, maximises utility, $u^h(x^h)$ subject to the household budget constraint. Then $v^h(q)$, the indirect utility function, gives the maximum utility possible at prices q. We assume a Bergson-Samuelson social welfare function which we can write as a function of prices in the form:

$$V(q) = W(v^1(q), v^2(q), \ldots, v^H(q)) \tag{2}$$

The aggregate demand vector is given by

$$X(q) = \sum_h x^h(q) \tag{3}$$

and government tax revenue is given by

$$R = t \cdot X = \sum_i t_i X_i \tag{4}$$

The crucial parameter of the AS model is what they call the marginal social cost (MSC) of taxation of each good. If we increase the tax on good i, we have a change in utility, $\delta V/\delta t_i$. We also have a change in revenue, $\delta R/\delta t_i$. The ratio of these two measures gives the marginal social cost of raising one unit of revenue from increasing the tax on good i[4]. Thus they define the MSC, λ_i, as

$$\lambda_i = -\frac{\partial V/\partial t_i}{\partial R/\partial t_i} \tag{5}$$

where we insert the minus sign to denote marginal cost. It is intuitively obvious that at the optimum the marginal cost of raising funds from different sources should be the same, i.e. all the λ_i should be equal, since otherwise we could raise the tax on a

good with low MSC and lower the tax on a good with high MSC, thus increasi welfare for no change in revenue.

As can be seen from (5), the expression for λ_i is the ratio of a welfare effe $\delta W/\delta t_i$, and a revenue effect, $\delta R/\delta t_i$. $\delta W/\delta t_i$ will always be negative. In gener we would expect $\delta R/\delta t_i$ to be positive, but, in principle, it can be greater than, le than, or equal to zero (the case of $\delta R/\delta t_i<0$ could be regarded as a commodi specific Laffer effect)[5]. This can have implications for the value of λ_i. As $\delta R/\delta$ becomes smaller, λ_i becomes larger. When $\delta R/\delta t_i=0$, $\lambda_i=\infty$, and when $\delta R/\delta t_i<0$, $\lambda_i<$ This introduces a discontinuity into the relationship between λ_i and $\delta R/\delta t_i$ and als raises the question of how to compare λ_is between two goods when one has positive MSC and the other a negative. From a policy point of view, a negative λ implies that a lowering of the tax on good i will not only increase welfare but wil also increase revenue. Thus, *a fortiori*, we would recommend that the tax on good should be lowered and we can also lower the tax on any other good j whose $\lambda_j>0$ thus giving us an even greater welfare gain with no revenue change. This, of course, implies that the rule whereby the tax on the good with the higher λ_i be reduced does not hold when one of the λ_i is negative. As can be seen from the tables in the appendix, $\delta R/\delta t_i$ is negative for tobacco for certain demand specifications.

To overcome these problems and avoid any question of discontinuity, we propose that goods be ranked according to $1/\lambda_i$ (which for convenience we will refer to as ρ_i) with the general recommendation that if $\rho_i<\rho_j$, then the indirect tax on good i should be lowered and that on good j should be raised. Intuitively, ρ_i gives the

marginal cost in revenue foregone when a tax is lowered so as to provide one extra unit in welfare (we can call this the marginal revenue cost, MRC). Note that the existence of negative ρ_i does not complicate our rule. The principle "lower t_i if $\rho_i<\rho_j$" is always robust to whatever sign $\rho_{i,j}$ takes.

Our next task is to find an expression for ρ_i that is readily calculable. From Roy's identity we know that

$$\frac{\partial V^h}{\partial q_i} = -\alpha^h x_i^h \qquad (6)$$

where α^h is the private marginal utility of income. Then we can say that

$$\frac{\partial V^h}{\partial t_i} = -\sum_h \beta^h x_i^h \qquad (7)$$

where $\beta^h = \delta W/\delta u^h.\alpha^h$ is the social marginal utility of income of household h, i.e., the welfare weight.

From (4) we have

$$\frac{\partial R}{\partial t_i} = X_i + \sum_k t_k \frac{\partial X_k}{\partial t_i} \qquad (8)$$

Thus we now have an expression for ρ_i from (7) and (8)

$$\rho_i = \frac{X_i + \sum_k t_k \frac{\partial X_k}{\partial t_i}}{\sum_h \beta^h x_i^h} \qquad (9)$$

By multiplying the numerator and denominator of (9) by q_i we can rewrite it as

$$\rho_i = \frac{q_i X_i}{\sum_h \beta^h q_i x_i^h} + \frac{\sum_k \tau_k q_k X_k e_{ki}}{\sum_h \beta^h q_i x_i^h} \qquad (10)$$

where τ_k is the tax on good k as a proportion of consumer price and ε_{ki} is the cross-price elasticity of good k with respect to good i. Thus (10) gives an expression for ρ_i which is readily calculable from available data.

The decomposition of ρ_i in (10) gives a more intuitive understanding of the marginal social cost of increasing the tax on a good. ρ_i represents the revenue cost at the margin of generating an extra unit of welfare via a reduction in t_i. It comprises two components, the first involving only household demands and welfare weights, and the second, in addition, taxes and aggregate demand responses. The first term on the right-hand side of (10) is the reciprocal of the "distributional characteristic" of the good (see Feldstein (1972) for a more detailed discussion). If we have a strong aversion to inequality then the β^h will differ significantly and be relatively larger for poorer households. This term could then play an important role in the ranking of ρ_i across goods, as the dominant contribution to it would be the reciprocal of the share in total consumption of good i by the poorest groups. If we are not concerned with distributional issues and give equal welfare weights to each household, say $\beta^h=1$, then

this term will be one for all goods and so will not contribute to the ranking of ρ_i across goods. The second term in (10) involves the effect of demand responses on revenue.

3. Data Requirements.

We wish to obtain estimates of ρ_i for Ireland using expression (10). The data required are the following: data on household expenditure of goods, x^h_i, which are obtained from the Household Budget Survey (HBS); welfare weights, β^h, which will be discussed below; tax rates t_k, which can be obtained from Revenue Commissioners' Reports; and demand responses. Demand responses can be obtained from estimates of aggregate demand systems. Madden (1993a) provides a comprehensive set of demand responses using a variety of models. For the purposes of this paper it was decided to use an AIDS model estimated in first differences.[6] The period of estimation was 1958-88 and ten goods were included: food, alcohol, tobacco, clothing and footwear, fuel and power, petrol, transport and equipment (including travelling within the state), durables, other goods and services. For estimation purposes services were treated as a residual. Three versions of the model were estimated, an unrestricted version, one with homogeneity imposed and one with homogeneity and symmetry imposed.[7]

One point that should be stressed here is that the analysis is strictly marginal. We do not need estimates of demand and utility functions for individual household groups. For a marginal reform the only data needed on individual households are their consumption levels, since these tell us what the utility consequences of marginal changes would be. To estimate the demand and revenue effects, all that is needed are the aggregate demand responses.

We next need to explain the derivation of the welfare weights. These are introduced exogenously, but are generated from a commonly used utility of income function due to Atkinson (1970). He generated welfare weights from the following function:

$$U^h(I) = \frac{kI^{1-e}}{1-e}, e \geq 0, e \neq 1, \; -k \log(I), \; e=1. \qquad (11)$$

where I^h is the total expenditure per equivalent adult of the h^{th} household. In Madden (1989) total expenditure per household was used as the I variable. However, this ignores the fact that higher spending households are typically larger households and so the distribution of expenditure on a "per equivalent adult basis" may be different from that on the basis of purely total expenditure. The equivalence scales used were obtained from the ESRI study by Conniffe and Keogh (1988).[8] As it turns out, the introduction of equivalence scales makes relatively difference to the ranking of goods by MRC, although, as would be expected their introduction does tend to reduce the variance of expenditure.[9]

Given our expression for $U^h(I)$ above, we have $\beta^h=U'(I^h)$ and we choose a normalisation for β^h through choice of k, so that the welfare weight for the poorest household is unity. Then we have $\beta^h = (I^1/I^h)^e$. Thus, β^h can be viewed as representing the marginal social value of a unit of expenditure to group h relative to a unit to group 1. In the case of zero inequality aversion e=0 and $\beta^h=1$ for all h. If e>0 then $\beta^h<1$ so that increments of expenditure to the poor are seen to have a higher marginal social value than those to the rich. The ratio β^h/β^h_1 increases with e for $I^h<I^h_1$ and so e can be regarded as an inequality aversion parameter. We have included four values of e in the results presented in this paper: 0, 1, 2, and 5. A value of e=1 implies that a marginal unit of expenditure to group h is worth half as much as a marginal unit to group 1 if the expenditure of group h is twice that of group 1. A value of e=5 approaches the extreme Rawlsian case of only considering the welfare of the poorest.[10]

4. Developments in Indirect Taxation in Ireland, 1980-87.

Since we are comparing marginal tax reform in 1980 and 1987, it is useful to check on the major changes in tax rates and expenditure patterns over the period. Before analysing this issue, it is worth noting that the 1980-87 period is an unusually interesting period. The decade of the 1980s saw dramatic changes in indirect taxes as successive governments addressed the very high levels of Exchequer borrowing and the escalating debt/GNP ratio. Table 1 shows our calculated indirect tax rates as they stood in 1980 and 1987. A detailed discussion of the changes in tax rates is

presented in the Appendix, but broadly speaking we can identify tax increases in almost all categories of goods, with the exception of transport and equipment.

Table I Indirect Tax Rates 1980 and 1987

Good	1980	1987
Food	-0.012	0.033
Alcohol	0.490	0.476
Tobacco	0.708	0.781
C & F	0.000	0.080
F & P	0.009	0.060
Petrol	0.480	0.677
T & E	0.418	0.288
Durables	0.206	0.220
Other Goods	0.163	0.146
Services	0.108	0.126

The other important change over the period is in spending patterns. Here we have to be careful to distinguish between spending patterns as given in the HBS and those derived from National Accounts data, from which the elasticities are obtained. The correspondence between the two disaggregations has been made as close as possible but is still not exact.[11]

Table 2 gives the change in spending patterns on both a National Accounts and Household Budget Survey basis. It shows that the major shift in spending has been towards services and other goods and away from food, durables, transport and equipment and fuel and power. Given the expressions for elasticities in the AIDS model ($\varepsilon_{ij}=\gamma_{ij}/w_i - \delta_{ij}$, where γ_{ij} is a parameter from the estimating equation, w_i is the budget share of good i and δ_{ij} is the Kronecker delta) this implies that services' and other goods' cross elasticities with respect to the other commodities will fall in absolute value, while the own-price elasticity could rise or fall.[12]

Table II Expenditure Patterns 1980 and 1987

Good	1980 Share		1987 Share	
	NIE	HBS	NIE	HBS
Food	0.279	0.269	0.247	0.246
Alcohol	0.119	0.047	0.123	0.051
Tobacco	0.041	0.030	0.047	0.036
C & F	0.087	0.102	0.082	0.078
F & P	0.060	0.066	0.057	0.069
Petrol	0.043	0.054	0.034	0.044
T & E	0.092	0.106	0.078	0.105
Durables	0.054	0.057	0.039	0.041
Other Goods	0.097	0.054	0.102	0.056
Services	0.127	0.213	0.191	0.274

5. Results for 1980 and 1987.

We will now discuss the results obtained from calculating values of ρ_i for 1980 and 1987. As we have seen above, the values of ρ_i calculated will depend upon both distributional and efficiency factors. Before presenting the values of ρ_i, it may be useful to try to isolate the distributional factors by calculating the "distributional characteristic" of the different goods for 1980 and 1987. These are the values of $1/\rho_i$ obtained when we impose the condition that $\varepsilon_{ij}=0$, $\forall i,j$. Thus $1/\rho_i=\Sigma_h\beta^h x_i^h/X_i$. This measure summarises the variation of consumption patterns across income classes by weighting the market shares of the different households in the consumption of commodity i, using the β^hs as weights. These values depend on the value of e, the inequality aversion parameter. When e=0,i.e. no inequality aversion, the values are all equal to one i.e $1/\rho_i=X_i/X_i$. As e increases, necessities get a relatively higher and luxuries a relatively lower value for the distributional characteristic, since

Table 3 Distributional Characteristics 1980

Good	e=0	e=1	e=2	e=5
Food	1.000	0.603	0.391	0.159
Alcohol	1.000	0.564	0.339	0.113
Tobacco	1.000	0.607	0.396	0.162
C & F	1.000	0.559	0.334	0.110
F & P	1.000	0.612	0.404	0.171
Petrol	1.000	0.565	0.339	0.109
T & E	1.000	0.546	0.317	0.094
Durables	1.000	0.550	0.324	0.105
Oth.Goods	1.000	0.567	0.334	0.117
Services	1.000	0.542	0.312	0.092

Table 4 Distributional Characteristics 1987

Good	e=0	e=1	e=2	e=5
Food	1.000	0.709	0.536	0.312
Alcohol	1.000	0.656	0.461	0.229
Tobacco	1.000	0.734	0.571	0.351
C & F	1.000	0.646	0.446	0.212
F & P	1.000	0.729	0.566	0.352
Petrol	1.000	0.656	0.457	0.217
T & E	1.000	0.644	0.441	0.202
Durables	1.000	0.653	0.456	0.224
Oth Goods	1.000	0.680	0.494	0.263
Services	1.000	0.631	0.425	0.189

consumption by less well-off households is receiving a relatively higher weight in the expression for the numerator of $1/\rho_i$. Thus, taking 1980, for example, if we were willing to neglect efficiency considerations and had a value of e=2, our policy prescriptions would be to lower the taxes on fuel and power, tobacco and food, and to raise the taxes on services, transport and equipment and durables. Note also that in 1980 fuel and power consistently had the highest distributional characteristic, while in 1987, tobacco's was the highest for values of e=1, 2. This suggests that tobacco consumption became relatively more concentrated amongst lower expenditure households over the 1980s.[13]

A further exercise which can be carried out and which gives a useful insight into distributional issues over the period is to examine what is known as the "inverse optimium" problem and infer the degree of inequality aversion implicit in the indirect tax system.[14] In other words, we calculate the value of e, the coefficient of inequality aversion which is consistent with optimality of the existing tax system. Thus we assume that $\rho_i=\rho$, $\forall i,j$. Then we can rewrite (10), using the full expression for β^h, as equation (12).

$$\sum_h \left(\frac{I^1}{I^h}\right)^e q_i x_i^h = (1/\rho)\,(q_i X_i + \sum_k \tau_k e_{ki} q_k X_k) \qquad (12)$$

We have ten observations on this equation (one for each good) for both 1980 and 1987 and we can estimate e via non-linear estimation. The non-linear estimation procedure in the SHAZAM package was used. In all cases, the estimated values appeared to be robust to starting values and convergence was reached after around fifteen iterations. Because the estimated values of e and ρ will be sensitive to the demand responses used, we have presented estimates for the three versions of the AIDS model in first differences used (viz. unrestricted (DAIDS1), with homogeneity imposed (DAIDS2) and with homogeneity and symmetry imposed (DAIDS3)). The results are presented in table 5, with standard errors of coefficients in brackets.

The results are surprising. Recall that e represents a coefficient of inequality aversion. The estimates for 1980 suggest that the government was mildly inequality averse. However, the figures for 1987 suggest that the government's attitude towards inequality as revealed in the indirect tax system was quite the opposite and that the indirect tax system was regressive.[15] The other result of

Table 5 Estimated e and ρ, 1980 and 1987.

1980	DAIDS1	DAIDS2	DAIDS3
e	0.4533	0.4452	0.3598
	(1.45)	(1.45)	(0.96)
ρ	1.1871	1.1825	1.1260
	(0.96)	(0.96)	(0.61)
1987			
e	-0.532	-0.588	-0.135
	(1.18)	(1.18)	(0.79)
ρ	0.6940	0.6790	0.8449
	(0.39)	(0.39)	(0.30)

interest concerns the estimated values of ρ. Recall that ρ is the inverse of the overall marginal social cost of taxation (i.e. it is the inverse of the Lagrange multiplier of the government's constrained optimisation problem). Thus a higher value of ρ indicates a lower marginal social cost of taxation. The results here indicate that this marginal social cost of taxation was lower in 1980 than in 1987. Thus there are two remarkable features of Table 5 that need explaining: first, that the government's attitude towards inequality, as implied by the indirect tax system, altered quite significantly over the 1980-87 period and secondly, that the overall marginal social cost of taxation rose over the 1989-87 period (presuming, of course, that the government was optimising during this period).

Before examining individual tax changes between 1980 and 1987, there are a number of qualifying remarks which have to be made concerning these results. The first of these concerns the possibility of external effects. We do not incorporate external effects in our social welfare function and thus do not allow for the possibility

that some of the high taxes we observe, in particular those on tobacco, petrol and alcohol, may in fact be corrective taxes. The incorporation of such effects in our social welfare function would then lower the implied welfare cost of these taxes and, given the high distributional characteristic of tobacco, would also increase the implied inequality aversion. Previous work by the author (Madden, 1992) suggests that such external effects may be important, although the implied inequality aversion is still quite low (less than 0.5).

Secondly, we cannot make inferences about the implied inequality aversion of the government purely by reference to the indirect tax system. It is necessary to take into account also the direct tax system and other fiscal instruments, such as welfare payments. Sah (1983) shows how the indirect tax system is a limited policy instrument for addressing issues of inequality.

Thirdly, the comparison of estimated values of e and ρ for two different points of time, in the context of a tax reform exercise, is difficult. We are comparing the properties of two different equilibria, without directly specifying our welfare function and thus without being able to say which situation represents the higher level of welfare. The finding that the overall marginal social cost of taxation was higher in 1987 than in 1980 does not necessarily imply that global welfare was lower.

The final point to be noted regarding these estimates concerns the relatively high standard errors for the estimates of e. The standard errors are greater in

magnitude than the value of the coefficient and so the reliability of inferences based on these estimates is questionable.

Bearing all these caveats in mind, however, we can still ask whether it is possible to identify any tax changes over the period which might have caused these changes in the estimated values of e and ρ. The change in the estimate of e would presumably be explained by an increase in the tax rate on a good with a high distributional characteristic. Examination of tables 2 and 3 shows that the tax on the three goods with the highest distributional characteristics, fuel and power, tobacco and food, were raised over the period 1980-87. Meanwhile, the tax on the good with the second lowest distributional characteristic, transport and equipment, was lowered (although see the appendix concerning the calculation of the tax on this good).

Before discussing the change in the estimated value of ρ over the period, we examine the calculated values of individual ρ_i for the two years. It should be noted however that this is a distinct exercise. The value of ρ calculated above in the inverse optimum exercise is calculated on the assumption that the government is optimising. The values for the individual ρ_i are not calculated under this assumption. In fact different values of the ρ_i indicate that the government is <u>not</u> optimising. They also indicate the scope for tax reform. Tables A1 and A2 give the rankings of goods by MRC for 1980 and 1987. The tax reform rule to be adopted from these tables is that where $\rho_i > \rho_j$, then raise t_i and lower t_j. Thus, *a fortiori*, we should raise the tax on the good with the highest ρ_i and lower the tax on the good with the lowest ρ_j. Thus we adopt a concertina type reform in the ρ_is. Note that this is not necessarily the same

as a concertina type reform in tax rates.[16] Note also that where $\rho_i<0$, we can lower t_i and also lower the tax on any other good with a positive ρ_j and revenue at the margin should be constant, while welfare will have increased.

The tables are presented for different levels of e, the inequality aversion parameter. The tables can also be differentiated along the lines of the restrictions placed on the underlying demand system, and the year in question. To analyse the sensitivity of the rankings of goods to these different features, we can examine rank correlations, where in each case we control for two of the features and differentiate between the third.

We can briefly summarise the results as follows:

(a) The results are not sensitive to the imposition of homogeneity. However, the additional imposition of symmetry causes rank correlation coefficients to fall to around 0.5.[17] This sensitivity appears to increase marginally when e increases from 0 to 5.

(b) The results show little sensitivity to the value of e. The model with homogeneity and symmetry imposed appears to show slightly more sensitivity, as do the results for 1987.

(c) For all models the rank correlation between 1980 and 1987 is in the range 0.9-0.95 suggesting that tax reform recommendations for both years would have been very similar.

The result in (b) shows that distributional considerations matter little in the ranking of goods.[18] This might be explained in two ways. Firstly, with only ten household groups differentiated by expenditure per equivalent adult, there is a relatively tight expenditure distribution and so we do not pick up very "poor" or very "rich" households, owing to the relatively low level of disaggregation. There may well be two households whose relative rankings of goods by MSC might differ quite significantly for a relatively low value of e. The second "explanation" we can offer is the point referred to above, namely that indirect taxes are a relatively inefficient means of addressing distributional issues and reducing inequality (Sah (1983) provides a more theoretical exposition of this). Thus for countries that do have relatively well developed income tax/social welfare schemes, distributional issues might be best tackled using these instruments. Stern (1990) provides an interesting discussion of this area, bearing in mind the relatively undeveloped direct tax systems operating in many less developed economies.

The result in (c) above suggests that there was little indirect tax reform over the 1980-87 period and, indeed, this observation is consistent with the results from table 5, where the estimated overall ρ (under the assumption that the existing tax system was optimal) was lower for 1987 (thus implying a higher overall marginal

social cost). As we discussed above, however, these comparisons of marginal social costs between two different points in time are not straightforward.

A further exercise we can carry out is to examine table A1, see what the implied tax reforms were and then check back to table 1 to see whether the tax reforms were implemented. For the sake of this comparison, we will take a typical value of e=2 (see endnote 12). Table A1 recommended tax increases on such general categories of goods as other goods, services, food and possibly fuel and power, while tax cuts were recommended for tobacco, durables, clothing and footwear and possibly petrol (we will neglect the case of alcohol, since it is the good showing the greatest sensitivity to changes in the underlying demand system. This is possibly due to greater difficulty in obtaining reliable elasticity estimates for alcohol due to problems associated with cross-border trade. See Madden (1993a)). With the exception of other goods the recommended tax increases were put into effect. However, the recommended tax cuts were not put into effect; on the contrary, taxes were increased on those goods. This may reflect the fact that the 1980-87 period was one where the overall level of taxation in Ireland increased significantly, in response to the rising Exchequer indebtedness. At a time whem macroeconomic magnitudes were reaching unsustainable levels marginal tax reform may have been low on the government's list of priorities.[19]

6. Conclusions.

This paper has applied the Ahmad-Stern model of marginal indirect tax reform to the Irish indirect tax sytem for the years 1980 and 1987 and has suggested an amended measure for MSC. It finds that there appears to be considerable scope for indirect tax reforms at the margin. It also finds that the derived tax reform recommendations are quite sensitive to the imposition of symmetry on the underlying demand system describing consumer preferences, but that the degree of inequality aversion appears to matter little. The paper also finds that the estimated degree of inequality aversion consistent with the existing tax system being optimal was low but positive in 1980 and negative in 1987.

There are a number of possible extensions to this model. Firstly, in this model we have analysed indirect taxes independently of decisions regarding labour supply and the direct tax system. Thus we are implicitly assuming separability between goods and leisure. Optimal indirect tax recommendations are extremely sensitive to assumptions regarding separability and the availability of direct taxes (see Deaton (1981)). Thus ideally we would like to incorporate leisure and the direct tax system into our model and test for sensitivity to the imposition of separability. This constitutes a significant part of our current research agenda (see Madden (1993c)). We also hope to incorporate the stylised observation that some consumers may be rationed in some markets, particularly the labour market. In the absence of goods/leisure separability, this could have quite complex effects on tax reforms.

Secondly, this analysis has concentrated on marginal reforms and so has not been able to address issues of global comparisons, either across time, or between situations which involve major changes in the tax regime. This would involve extensions of this work along the lines of Honohan and Irvine (1987) and King (1983).

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APPENDIX

Commodity Classification

The analysis was carried out for ten goods. NIE data for ten goods was provided (on the "old " NIE basis as this was the longest continual series with both value and volume data) and then as close a correspondence as possible with the HBS was obtained. The table below gives the ten goods by their NIE classification and the corresponding items from the HBS used.

Food: Items 75-193.
Alcohol: Items 196-202.
Tobacco: Items 203-205.
Clothing: Items 206-258, items 330-332.
Fuel and Power: Items 259-270.
Petrol: Item 359.
Transport and Equipment and Travelling within the State: Items 351-374 minus item 359.
Durables: Items 295-329 minus items 306, 315.
Other Goods: Items 283-294, items 333-350.
Services: Residual.

Principal Changes in Indirect Taxes: 1980-87.

Over the 1980-87 period the following major VAT changes took place:

1 May 1980:	20% rate raised to 25%.
1 Sept 1980:	10% rate raised to 15%.
1 May 1982:	15% and 25% rates raised to 18% and 30% respectively. VAT on books removed.
1 March 1983:	18% and 30% rates raised to 23% and 35% respectively.
1 May 1983:	5% rate imposed on zero-rated fuel, excluding electricity.
1 May 1984:	Clothing for persons aged 11 years or over liable to VAT at 8%.

1 March 1985:	Fundamental restructuring with three general rates coming into operation (zero, 10% and 23%). 10% VAT on adult footwear.
1 March 1986:	23% rate increased to 25%.
1 July 1986:	Rate of tax on certain services (meals, catering, cinema,repair and maintenance, laundry and cleaning) reduced from 25% to 10%. Rate on hot take-aways increased from zero to 10%.
1 July 1987:	VAT rate on certain small number of services reduced from 25% to 10%.

The major changes in taxation over the period can be briefly summarised as follows: the increase in tax on food reflects the abolition of food subsidies in 1983. The tax on alcohol actually fell reflecting excise duty increases which did not keep pace with inflation. This offset the overall increase in the rate of value-added tax (VAT). Tobacco taxes rose reflecting excise duty increases greater than inflation and also higher VAT rates. The tax on clothing and footwear went from zero to eight per cent largely reflecting the fact that this category of goods became eligible for VAT in 1984. The rise in tax on fuel and power is due to the five per cent VAT introduced on electricity (plus various excise duties on home heating oils etc.). Petrol shows one of the largest increases in tax rates. This is owing to a number of factors. There were increases in excise duties as well as the increase in VAT rates. However what probably contributed most to the rise in the tax as a proportion of the consumer price was the fall in petrol prices in 1986, and the relative non-indexation of excise duties after this price fall. The fall in the tax on transport and equipment and travelling within the state largely reflects both an aggregation issue and a problem arising from calculating the tax on a durable good. The bulk of the tax on this category of aggregated goods arises from the high excise duty on motor vehicles. Consumption of motor vehicles, as measured by purchases of new motor vehicles, fell significantly over the period, thus lowering the ex post tax. The marginal tax changes in the other categories largely reflects changes in various VAT rates.

Table A1: Marginal Revenue Costs for DAIDS1 - 1980

e=0	e=1	e=2	e=5
1. Oth G 1.48	1. Oth G 2.61	1. Oth G 4.31	1. Oth G 12.7
2. Alc 1.09	2. Alc 1.93	2. Serv 3.31	2. Serv 11.2
3. Serv 1.03	3. Serv 1.90	3. Alc 3.20	3. Alc 9.61
4. Food 0.97	4. Food 1.61	4. Food 2.48	4. T & E 6.59
5. F & P 0.93	5. F & P 1.52	5. F & P 2.31	5. Food 6.10
6. T & E 0.62	6. T & E 1.13	6. T & E 1.95	6. F & P 5.44
7. Pet 0.58	7. Pet 1.03	7. Pet 1.72	7. Pet 5.36
8. C & F 0.51	8. C & F 0.90	8. C & F 1.51	8. C & F 4.58
9. Dur 0.34	9. Dur 0.62	9. Dur 1.06	9. Dur 3.26
10. Tob -0.03	10. Tob -0.05	10. Tob -0.08	10. Tob -0.19

Table A1 (con): Marginal Revenue Cost for DAIDS2 - 1980

e=0	e=1	e=2	e=5
1. Oth G 1.49	1. Oth G 2.62	1. Oth G 4.32	1. Oth G 12.7
2. Alc 1.09	2. Alc 1.93	2. Serv 3.31	2. Serv 11.2
3. Serv 1.03	3. Serv 1.91	3. Alc 3.21	3. Alc 9.63
4. Food 0.97	4. Food 1.61	4. Food 2.48	4. T & E 6.59
5. F & P 0.93	5. F & P 1.52	5. F & P 2.31	5. Food 6.10
6. T & E 0.62	6. T & E 1.13	6. T & E 1.95	6. F & P 5.43
7. Pet 0.58	7. Pet 1.03	7. Pet 1.72	7. Pet 5.34
8. C & F 0.51	8. C & F 0.91	8. C & F 1.52	8. C & F 4.59
9. Dur 0.34	9. Dur 0.63	9. Dur 1.06	9. Dur 3.26
10. Tob -0.02	10. Tob -0.04	10. Tob -0.06	10. Tob -0.15

Table A1 (con): Marginal Revenue Costs for Daids3 - 1980

e=0	e=1	e=2	e=5
1. Oth G 1.04	1. Serv 1.85	1. Serv 3.21	1. Serv 10.9
2. Serv 1.00	2. Oth G 1.84	2. Oth G 3.03	2. Oth G 8.91
3. Food 0.97	3. Food 1.60	3. Food 2.47	3. C & F 7.37
4. C & F 0.81	4. C & F 1.46	4. C & F 2.44	4. Pet 7.24
5. Pet 0.79	5. Pet 1.40	5. Pet 2.33	5. Dur 6.42
6. F & P 0.74	6. Dur 1.23	6. Dur 2.09	6. T & E 6.23
7. Dur 0.68	7. F & P 1.21	7. T & E 1.84	7. Food 6.10
8. T & E 0.58	8. T & E 1.07	8. F & P 1.84	8. Alc 4.76
9. Alc 0.54	9. Alc 0.95	9. Alc 1.58	9. F & P 4.33
10. Tob 0.36	10. Tob 0.60	10. Tob 0.92	10. Tob 2.25

Table A2: Marginal Revenue Costs for DAIDS1 - 1987

e=0	e=1	e=2	e=5
1. Oth G 1.20	1. Alc 1.78	1. Alc 2.53	1. Alc 5.10
2. Alc 1.17	2. Oth G 1.77	2. Oth G 2.43	2. Serv 5.04
3. F & P 1.03	3. Serv 1.52	3. Serv 2.25	3. Oth G 4.56
4. Serv 0.96	4. F & P 1.41	4. F & P 1.82	4. T & E 3.58
5. Food 0.87	5. Food 1.23	5. T & E 1.64	5. F & P 2.93
6. T & E 0.73	6. T & E 1.13	6. Food 1.63	6. Food 2.80
7. Pet 0.51	7. Pet 0.77	7. Pet 1.11	7. Pet 2.34
8. C & F 0.43	8. C & F 0.66	8. C & F 0.96	8. C & F 2.03
9. Dur 0.15	9. Dur 0.23	9. Dur 0.33	9. Dur 0.67
10. Tob 0.01	10. Tob 0.02	10. Tob 0.03	10. Tob 0.04

Table A2: Marginal Revenue Costs for DAIDS2 - 1987

e=0	e=1	e=2	e=5
1. Oth G 1.22	1. Alc 1.80	1. Alc 2.56	1. Alc 5.16
2. Alc 1.18	2. Oth G 1.80	2. Oth G 2.48	2. Serv 5.08
3. F & P 1.01	3. Serv 1.52	3. Serv 2.26	3. Oth G 4.65
4. Serv 0.96	4. F & P 1.39	4. F & P 1.79	4. T & E 3.58
5. Food 0.88	5. Food 1.23	5. T & E 1.64	5. F & P 2.88
6. T & E 0.72	6. T & E 1.13	6. Food 1.63	6. Food 2.81
7. Pet 0.49	7. Pet 0.75	7. Pet 1.07	7. Pet 2.26
8. C & F 0.44	8. C & F 0.68	8. C & F 0.99	8. C & F 2.09
9. Dur 0.15	9. Dur 0.23	9. Dur 0.33	9. Dur 0.68
10. Tob 0.04	10. Tob 0.06	10. Tob 0.08	10. Tob 0.12

Table A2 (con): Marginal Revenue Cost for DAIDS3 -1987

e=0	e=1	e=2	e=5
1. Oth G 1.02	1. Oth G 1.50	1. Serv 2.23	1. Serv 5.00
2. Serv 0.95	2. Serv 1.50	2. Oth G 2.07	2. Oth G 3.89
3. Food 0.94	3. Food 1.32	3. Food 1.75	3. Pet 3.62
4. Pet 0.78	4. Pet 1.20	4. Pet 1.71	4. T & E 3.28
5. F & P 0.75	5. C & F 1.06	5. C & F 1.54	5. C & F 3.26
6. C & F 0.69	6. F & P 1.02	6. T & E 1.50	6. Food 3.00
7. T & E 0.66	7. T & E 1.03	7. Dur 1.39	7. Dur 2.82
8. Dur 0.63	8. Dur 0.97	8. F & P 1.32	8. F & P 2.12
9. Alc 0.43	9. Alc 0.65	9. Alc 0.93	9. Alc 1.87
10. Tob 0.38	10. Tob 0.52	10. Tob 0.66	10. Tob 1.08

1. Marginal tax reform analysis requires cross-sectional data on household consumptions. Such data for Ireland is only available at seven yearly intervals. thus the relevant years for the 1980s are 1980 and 1987.

2.Marginal tax reform recommendations can also exhibit sensitivity to specifications regarding preferences and demand systems, although not as much as do derived optimal tax rates. For an examination of this issue, see Madden (1993b).

3. The assumption of perfectly elastic supply is reasonable for a small open economy such as Ireland, for the tradables sector at least.

4. Note that this measure of social costs does not take account of compliance costs, nor does the revenue effect take account of administrative costs. For a methodology to incorporate the latter, see Ahmad and Stern (1987).

5. While such an effect appears intuitively unlikely, in practice we find $\delta R/\delta t_i<0$ for tobacco. See Fitzgerald et al.(1988) for a discussion of how such an effect might arise in the context of cross-border shopping.

6. In Madden (1989) an AIDS model in levels estimated by Rodney Thom (1988) was used. However, there were a number of problems with the data set employed in that study, in particular with the rent variable and so a different set of estimates was chosen, with rent excluded. Note that calculations of ρ_i will be sensitive to the particular model chosen. This is discussed in Madden (1993b).

7. One particular difficulty with the data used is that the data for x_i^h are cross-sectional data obtained from the Household Budget Survey, while the data used to obtain estimates of the demand derivatives come from aggregate time-series data from the Irish National Accounts, National Income and Expenditure (NIE). Ideally, we would like to have pooled time-series and cross-sectional data, but such are not available for Ireland. Thus the correspondence between the commodity classification in the HBS and NIE is not exact. Details of the commodity classification is given in the Appendix.

8. One problem with the equivalence scales of Conniffe and Keogh is that they were explicitly addressing the issue of the cost of children and so do not provide an equivalence scale for an additional adult. We thus assume that there are no economies of scale for an additional adult.

9.Note that the distributional issue being addressed here is distribution of <u>expenditure</u> rather than distribution of <u>income</u>. Ideally we would like to have a measure of lifetime income as it is possible that, for the period under observation, relatively low expenditure may reflect an intertemporal consumption decision rather than a low-expenditure household. Unfortunately, such information cannot be inferred from the HBS, and so total

household expenditure per equivalent adult was chosen as the I variable. However, we would not expect that relative welfare weights would be very sensitive to the choice of either income or expenditure.

10.For a discussion of appropriate values of e see Stern (1977). It is of interest to note that prior to his becoming UK Chancellor of the Exchequer, Dalton suggested that e was greater than 1 and possibly around 2 (Dalton (1939)).

11. The good with the largest discrepancy is alcohol. This presumably reflects the under-reporting of alcohol consumption typical in survey based data.

12.More formally, $\delta\varepsilon_{ii}/\delta w_i=-\gamma_{ii}/w_i^2=-1/w_i(\varepsilon_{ii}+1)$.

13. Unfortunately we cannot compare the average value of the distributional characteristic between 1980 and 1987. This is due to differences in the nature of the data available between 1980 and 1987. In 1987 household consumption data was presented on a decile basis. In 1980 however, the household groups are not broken down on a decile basis but rather over certain ranges of expenditure. Thus the weighting by population for each household group differs. This affects the distribution of overall expenditure per equivalent adult, and hence the average value of the distributional characteristic. It does not affect the relative rankings of goods by distributional characteristic.

14. This has been carried out for Ireland for 1987 in the context of an analysis of corrective taxationby Madden (1992). However, a diffrent set of demand responses was used in that paper.

15. Technically, a negative value of e means that the government's social welfare function violates "S-concavity" (see Sen (1973), p.56).

16. In fact it can be shown that when e=0 and thus $\beta^h=1\forall h$, $\delta\rho_i/\delta\tau_i=\varepsilon_{ii}$. If $\varepsilon_{ii}<0$, then this implies that a concertina reform in τ_i is sufficient for a concertina reform in ρ_i. Note however, that these are uncompensated elasticities and thus we cannot guarantee that $\varepsilon_{ii}<0$, although we would expect this to be the case.

17. This is consistent with other work on the sensitivity of tax reform rankings to demand systems. For a comprehensive review, see Madden (1993).

18. Note that this finding is distinct from the finding that the estimated value of e was low or negative. The results in table A2 show that even if we impose a high degree of inequality aversion on the social welfare function the ranking of goods shows little change.

19. In fact, in January 1982 Garret Fitzgerald's coalition government fell over proposed indirect tax increases. However, it seems fair to suggest that such tax increases were introduced

with the objective of raising revenue rather than as a micro-based reform.