An Analysis of Indirect Tax Reform in Ireland in the 1980s

DAVID MADDEN

I. INTRODUCTION

Since the seminal work by Diamond and Mirrlees (1971), various attempts have been made to calculate optimal tax rates for different countries (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 Fukushima (1991) and Fukushima and Hatta (1989), 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 behavioural responses themselves change in response to taxes.

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2 For a recent discussion of optimal taxation and its relevance for policymakers, see Heady (1993).
and/or redistributions of income (i.e. knowledge of the second derivatives of
demand functions and hence the third derivatives of utility functions).

Such informational difficulties can severely compromise the policy relevance
of optimal tax design. A potentially more rewarding approach is that of marginal
tax reform, 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 an explicit model of the distribution of expenditure, but
instead merely requires information on the actual position of the economy at a
single point in time, using actual consumptions, actual distributions of
expenditure, and aggregate rather than individual demand responses for the
current situation of the economy.

Ahmad and Stern (1984, hereinafter referred to as AS) examined indirect tax
reform for India. This model addressed tax reform using a measure that 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 MSCs are not equal, then directions of tax reform at the margin can be
identified. The tax on the good with a higher MSC should be lowered while that
on the good with the lower MSC should be 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 (Cragg, 1991),
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. First, from a
methodological point of view this paper addresses a problem that can arise with
the MSC measure introduced by AS. It shows that their MSC measure is not a
continuous measure and argues that the reciprocal of MSC is a preferable
measure. Second, this study looks at indirect tax reform for both 1980 and 1987,3
thus permitting analysis of the tax reforms that the model suggests would have
been welfare-improving in 1980. Third, 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.

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3 Marginal tax reform analysis requires cross-sectional data on household consumptions. Such data for Ireland
are only available at seven-yearly intervals. The relevant years for the 1980s were 1980 and 1987.
Finally, this study uses a substantially different and, it is believed, more reliable set of demand responses.

The layout of this paper is as follows. Section II describes the basic model of marginal indirect tax reform. Section III briefly discusses the data, while Section IV gives a short account of developments in indirect taxes in Ireland over the period under discussion. Section V presents and discusses the results for derived tax reforms, while Section VI discusses a related issue known as the inverse optimum problem. Section VII offers some concluding comments.

II. 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 that minimise welfare loss for the collection of a given revenue (raising the various difficulties outlined in Section I), the approach takes the existing tax system as given and identifies directions of tax reform at the margin. Tax reform is thus potentially of more relevance to the policymaker than is optimal tax design.

This approach concentrates on consumer welfare and the government revenue constraint. In this paper, we examine the indirect tax system only, although this model can be extended to incorporate direct taxation and labour supply. 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 welfare, $\partial V/\partial t_i$. We also have a change in revenue, $\partial R/\partial t_i$. The ratio of these two measures gives the marginal social cost of raising one unit of revenue from increasing the tax on good $i$. Thus AS define the MSC, $\lambda_i$, as

\[
\lambda_i = \frac{\partial V/\partial t_i}{\partial R/\partial t_i}
\]

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 $\lambda_i$ should be equal, since otherwise we could raise

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4 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. See Madden (1993b).
5 Thus we do not allow for the possibility of either an optimal lump-sum payment or an income tax. For an account of how such features affect optimal tax results, see Atkinson (1977), and for an example of how to incorporate direct taxation into marginal tax reform, see Madden (1995).
6 Note that this measure of social cost does not take account of compliance costs nor does the revenue effect take account of administrative costs. For an approach to incorporate the latter, see Ahmad and Stern (1987).
the tax on a good with low MSC and lower the tax on a good with high MSC, thus increasing welfare for no change in revenue.

As can be seen from equation (1), the expression for $\lambda_i$ is the ratio of a welfare effect, $\partial V / \partial t_i$, and a revenue effect, $\partial R / \partial t_i$. In general, we would expect $\partial R / \partial t_i$ to be positive, but, in principle, it can be greater than, less than or equal to zero. This can have implications for the value of $\lambda_i$, since as $\partial R / \partial t_i$ becomes smaller, $\lambda_i$ becomes larger and approaches infinity in the limit. This introduces a discontinuity into the relationship between $\lambda_i$ and $\partial R / \partial t_i$ and also raises the question of comparison between two $\lambda_i$s when either or both has a negative value. 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 $\rho_i$) 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, $\rho_i$ gives the marginal revenue cost of increasing the tax on a good so as to provide one extra unit in welfare (we can call this the marginal revenue cost, MRC). Note that the existence of negative $\rho_i$ does not complicate our rule. In making a pairwise comparison between any two goods, $i$ and $j$, the principle 'lower $t_i$ if $\rho_i < \rho_j$' is always robust to whatever sign $\rho_i$ and $\rho_j$ take.

We need to find an expression for $\rho_i$ that is readily calculable. As can be seen from Appendix A, it can be shown that

$$\rho_i = \frac{q_i X_i}{\sum_h \beta^h q_i x_i^h} + \frac{\sum_h \tau_k q_i X_i e_{ki}}{\sum_h \beta^h q_i x_i^h}$$

(2)

where $q_i$ is the consumer (i.e., tax-inclusive) price of good $i$, $x_i^h$ is the consumption of good $i$ by household $h$, $X_i = \sum_h x_i^h$ is the total consumption of good $i$, $\beta^h$ is the welfare weight for household $h$, $\tau_k$ is the tax on good $k$ as a proportion of consumer price and $e_{ki}$ is the uncompensated cross-price elasticity of good $k$ with respect to good $i$. Thus equation (2) gives an expression for $\rho_i$ which is readily calculable from available data.

The decomposition of $\rho_i$ in equation (2) also gives an intuitive understanding of the marginal social cost of reducing the tax on a good. $\rho_i$ 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

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7 While such an effect may be intuitively unlikely in practice we found $\partial R / \partial t_i < 0$ for tobacco for some demand specifications. See Fitzgerald, Quinn, Whelan and Williams (1988) for a discussion of how such an effect may arise in the context of cross-border trade.

8 When we observe a negative $\rho_i$, we can lower the tax on good $i$ and at the same time lower the tax on any other good with positive $\rho_j$, thus generating an even greater welfare gain with no revenue loss.
and welfare weights, and the second involving, in addition, taxes and aggregate demand responses. The first term on the right-hand side of equation (2) 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 welfare weights, \( \beta^h \), will differ significantly and be relatively larger for poorer households. This term could then play an important role in the ranking of \( p_i \) 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 unity for all goods and so will not contribute to the ranking of \( p_i \) across goods. The second term in equation (2) involves the effect of demand responses on revenue.

III. DATA REQUIREMENTS

We wish to obtain estimates of \( p_i \) for Ireland using expression (2). The data required are the following: data on household expenditure of goods, \( x_i^h \), which are obtained from the Irish Household Budget Survey (HBS); welfare weights, \( \beta^h \), which will be discussed below; tax rates, \( t_s \), which can be obtained from Revenue Commissioners’ Reports; and demand responses, which 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 Almost Ideal Demand System (AIDS) model estimated in first differences. The period of estimation was 1958–88 and 10 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.

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 are needed are the aggregate demand responses.

9 The demand estimates obtained, and hence the calculated values of the \( p_i \), will obviously depend upon the demand model used and the restrictions imposed upon that model. The \( p_i \) presented in this paper are calculated from demand estimates with the restrictions of homogeneity and symmetry imposed. For a discussion of the sensitivity of the calculated \( p_i \) to such issues as choice of demand model, see Madden (1993b).

10 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 aggregate demand responses 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 data are not available for Ireland. Thus the
For the purposes of discussion of our results, we 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):

\[ U^h(I^h) = \frac{k(I^h)^{1-e}}{1-e} \quad \text{if } e \geq 0, \ e \neq 1; \]

\[ U^h(I^h) = k \log(I^h) \quad \text{if } e = 1 \]

where \( I^h \) is the total expenditure per equivalent adult of the \( h \)th household, \( e \) is a parameter reflecting inequality aversion and \( k \) is chosen for purposes of normalisation. 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. Expenditure per equivalent adult is used here, and the equivalence scales used were obtained from Conniffe and Keogh (1988). As it turns out, the introduction of equivalence scales makes relatively little difference to the ranking of goods by MRC, although, as would be expected, their introduction tends to reduce the variance of expenditure. We disaggregate household expenditure by decile.

Given our expression for \( U^h(I^h) \) above, we have \( \beta^h = U^h(I^h) \) where ‘ denotes the first derivative, and we choose a normalisation for \( \beta^h \) through choice of \( k \), so that the welfare weight for the poorest household is unity. Then we have \( \beta^h = (I^1/I^h)^e \), where \( I^1 \) is expenditure per equivalent adult for the poorest household. Thus \( \beta^h \) 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 \( \beta^1/\beta^h \) increases with \( e \) for \( I^1 < I^h \), and so \( e \) can be regarded as an inequality aversion parameter. We have included a number of values for \( e \) in the results presented in this paper. A value of \( e = 1 \) implies that a marginal unit of expenditure to group \( h \) is worth half as much as a marginal unit

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11 Note that the distributional issue being discussed here is distribution of expenditure rather than distribution of welfare. Ideally, we would like to have some measure of welfare to take account of the fact that higher-spending households may also work longer hours and so the difference in household welfare may be less than that in household expenditure. Such household welfare information is very difficult to obtain. Note also that our welfare weights are independent of prices. This is a local approximation which is suitable for marginal analysis. For conditions under which this assumption would hold for non-marginal analysis, see Roberts (1980).
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.12

IV. 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 in recent Irish economic history. The decade of the 1980s saw dramatic changes in indirect taxes as successive governments addressed very high levels of exchequer borrowing and an 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 Appendix C, but broadly speaking we can identify tax increases in almost all categories of goods, with the exception of transport and equipment.

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.

<table>
<thead>
<tr>
<th>Good</th>
<th>1980</th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>-0.012</td>
<td>0.033</td>
</tr>
<tr>
<td>Alcohol</td>
<td>0.490</td>
<td>0.476</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0.708</td>
<td>0.781</td>
</tr>
<tr>
<td>Clothing and footwear</td>
<td>0.000</td>
<td>0.080</td>
</tr>
<tr>
<td>Fuel and power</td>
<td>0.009</td>
<td>0.060</td>
</tr>
<tr>
<td>Petrol</td>
<td>0.480</td>
<td>0.677</td>
</tr>
<tr>
<td>Transport and equipment</td>
<td>0.418</td>
<td>0.288</td>
</tr>
<tr>
<td>Durables</td>
<td>0.206</td>
<td>0.220</td>
</tr>
<tr>
<td>Other goods</td>
<td>0.163</td>
<td>0.146</td>
</tr>
<tr>
<td>Services</td>
<td>0.108</td>
<td>0.126</td>
</tr>
</tbody>
</table>

12 For a discussion of appropriate values of $e$, see Stern (1977). Prior to his becoming UK Chancellor of the Exchequer, Dalton suggested that $e$ was greater than 1 and possibly around 2 (Dalton, 1939).
Table 2 gives the change in spending patterns on both a National Accounts and a 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 \( (ij) = \frac{\partial \gamma}{\partial \omega_i} - \frac{\partial \delta}{\partial \omega_j} \), where \( \gamma \) is a parameter from the estimating equation, \( \omega_i \) is the budget share of good \( i \) and \( \delta \) 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 their own-price elasticities could rise or fall.\(^{14}\)

**V. CALCULATED MRCS FOR 1980 AND 1987**

We will now discuss the results obtained from calculating values of \( \rho_i \) for 1980 and 1987. As we have seen above, the values of \( \rho_i \) calculated will depend upon both distributional and efficiency factors. Before presenting the values of \( \rho_i \), 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 shown in Tables 3 and 4, and are the values of the reciprocal of \( \rho_i \) obtained when we impose the condition that all uncompensated own- and cross-price elasticities are zero, i.e. \( \varepsilon_{ij} = 0 \) for all values of \( i \) and \( j \). Thus they are equal to \( 1/\rho_i = \)

<table>
<thead>
<tr>
<th>Good</th>
<th>1980 share</th>
<th>1987 share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>0.279</td>
<td>0.269</td>
</tr>
<tr>
<td>Alcohol</td>
<td>0.119</td>
<td>0.047</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0.041</td>
<td>0.030</td>
</tr>
<tr>
<td>Clothing and footwear</td>
<td>0.087</td>
<td>0.102</td>
</tr>
<tr>
<td>Fuel and power</td>
<td>0.060</td>
<td>0.066</td>
</tr>
<tr>
<td>Petrol</td>
<td>0.043</td>
<td>0.054</td>
</tr>
<tr>
<td>Transport and equipment</td>
<td>0.092</td>
<td>0.106</td>
</tr>
<tr>
<td>Durables</td>
<td>0.054</td>
<td>0.057</td>
</tr>
<tr>
<td>Other goods</td>
<td>0.097</td>
<td>0.054</td>
</tr>
<tr>
<td>Services</td>
<td>0.127</td>
<td>0.213</td>
</tr>
</tbody>
</table>

\(^{13}\) The good with the greatest discrepancy is alcohol. This presumably reflects the under-reporting of alcohol consumption typical in survey-based data.

\(^{14}\) More formally, \( \partial \varepsilon_{ij} / \partial \omega_i = \gamma_\omega / \omega_j^2 = (-\varepsilon_{ij} + 1) / \omega_i. \)
\(\Sigma_0 \beta^i x_i / X_i\). 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 \(\beta^i\) as weights. These weights depend on the value of \(e\), the inequality aversion parameter. When \(e = 0\) (i.e. there is no inequality aversion), they are all equal to one, i.e. \(1/\rho_i = X_i / X\). As \(e\) increases, necessities get a relatively higher and luxuries a relatively lower value for the distributional characteristic, since 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 \(e = 1\) and \(e = 2\). This suggests that tobacco consumption became relatively more concentrated amongst lower-expenditure households over the 1980s.

<table>
<thead>
<tr>
<th>Good</th>
<th>(e = 0)</th>
<th>(e = 1)</th>
<th>(e = 2)</th>
<th>(e = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>1.000</td>
<td>0.603</td>
<td>0.391</td>
<td>0.159</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.000</td>
<td>0.564</td>
<td>0.339</td>
<td>0.113</td>
</tr>
<tr>
<td>Tobacco</td>
<td>1.000</td>
<td>0.607</td>
<td>0.396</td>
<td>0.162</td>
</tr>
<tr>
<td>Clothing and footwear</td>
<td>1.000</td>
<td>0.559</td>
<td>0.334</td>
<td>0.110</td>
</tr>
<tr>
<td>Fuel and power</td>
<td>1.000</td>
<td>0.612</td>
<td>0.404</td>
<td>0.171</td>
</tr>
<tr>
<td>Petrol</td>
<td>1.000</td>
<td>0.565</td>
<td>0.339</td>
<td>0.109</td>
</tr>
<tr>
<td>Transport and equipment</td>
<td>1.000</td>
<td>0.546</td>
<td>0.317</td>
<td>0.094</td>
</tr>
<tr>
<td>Durables</td>
<td>1.000</td>
<td>0.550</td>
<td>0.324</td>
<td>0.105</td>
</tr>
<tr>
<td>Other goods</td>
<td>1.000</td>
<td>0.567</td>
<td>0.334</td>
<td>0.117</td>
</tr>
<tr>
<td>Services</td>
<td>1.000</td>
<td>0.542</td>
<td>0.312</td>
<td>0.092</td>
</tr>
</tbody>
</table>

We now present the calculated values of the individual \(\rho_i\) for the two years. These values indicate the scope for welfare-enhancing tax reform with the tax reform rule being to raise the tax on the good with the highest \(\rho_i\) and lower the tax on the good with the lowest \(\rho_i\), thus effectively adopting a concertina-type reform in the \(\rho_i\)'s. Note that this is not necessarily the same as a concertina-type
reform in tax rates.\footnote{In fact, it can be shown that when \( e = 0 \) and thus \( \beta_i^k = 1 \) for all \( h, \), then \( \partial p_i / \partial c = \iota_i e \). If \( \iota_i < 0 \), then this implies that a concertina-type reform in \( t_i \) is sufficient for a concertina-type reform in \( p_i \). Note, however, that the \( \iota_i \) are uncompensated elasticities and thus even if we impose concavity on the underlying consumer cost function, we cannot guarantee that \( \iota_i < 0 \).}

Tables 5 and 6 give the rankings of goods by MRC for 1980 and 1987.

The tables are presented for different levels of \( e \), the inequality aversion parameter, and according to the year in question. To analyse the sensitivity of the rankings of goods to these different features, we examine rank correlations in Table 7.

We can briefly summarise the results as follows:

(a) Although we can see the effect of increasing the degree of inequality aversion through changes in the ranking of goods such as food and fuel and power, the rank correlations in Table 7 suggest that the rankings, and thus the tax reform recommendations, show relatively little sensitivity to the value of \( e \), especially in 1980.

(b) Controlling for the degree of inequality aversion, the rank correlation between rankings for 1980 and 1987 is in the range 0.7–0.8, suggesting that tax reform recommendations for both years would have been similar.

The result in (a) is perhaps surprising since it suggests that distributional considerations matter little in the ranking of goods. This might be explained in two ways. First, with only 10 household groups differentiated by expenditure per equivalent adult, there is a relatively tight expenditure distribution and so we do

<table>
<thead>
<tr>
<th>Good</th>
<th>( e = 0 )</th>
<th>( e = 1 )</th>
<th>( e = 2 )</th>
<th>( e = 5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>1.000</td>
<td>0.709</td>
<td>0.536</td>
<td>0.312</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.000</td>
<td>0.656</td>
<td>0.461</td>
<td>0.229</td>
</tr>
<tr>
<td>Tobacco</td>
<td>1.000</td>
<td>0.734</td>
<td>0.571</td>
<td>0.351</td>
</tr>
<tr>
<td>Clothing and footwear</td>
<td>1.000</td>
<td>0.646</td>
<td>0.446</td>
<td>0.212</td>
</tr>
<tr>
<td>Fuel and power</td>
<td>1.000</td>
<td>0.729</td>
<td>0.566</td>
<td>0.352</td>
</tr>
<tr>
<td>Petrol</td>
<td>1.000</td>
<td>0.656</td>
<td>0.457</td>
<td>0.217</td>
</tr>
<tr>
<td>Transport and equipment</td>
<td>1.000</td>
<td>0.644</td>
<td>0.441</td>
<td>0.202</td>
</tr>
<tr>
<td>Durables</td>
<td>1.000</td>
<td>0.653</td>
<td>0.456</td>
<td>0.224</td>
</tr>
<tr>
<td>Other goods</td>
<td>1.000</td>
<td>0.680</td>
<td>0.494</td>
<td>0.263</td>
</tr>
<tr>
<td>Services</td>
<td>1.000</td>
<td>0.631</td>
<td>0.425</td>
<td>0.189</td>
</tr>
</tbody>
</table>
not pick up very ‘poor’ or very ‘rich’ households, owing to the relatively low level of disaggregation. There may well be two households in the same group 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 that indirect taxes may be a relatively inefficient means of addressing distributional issues and reducing inequality (Sah (1983) provides a more theoretical exposition of this), especially for countries with well-developed direct tax systems and/or lump-sum grants. For example, were we to calculate the value of \( \rho_r \), the MRC

\begin{table}
\centering
\caption{Marginal Revenue Costs for 1980}
\begin{tabular}{|c|c|c|c|}
\hline
 & \( e = 0 \) & \( e = 2 \) & \( e = 5 \) \\
\hline
1. Other goods & 1.043 & Services & 3.206 & Services & 10.874 \\
2. Services & 1.000 & Other goods & 3.031 & Other goods & 8.910 \\
3. Food & 0.968 & Food & 2.475 & Clothing/footwear & 7.376 \\
4. Clothing/footwear & 0.815 & Clothing/footwear & 2.436 & Petrol & 7.244 \\
5. Petrol & 0.788 & Petrol & 2.327 & Durables & 6.418 \\
6. Fuel/power & 0.742 & Durables & 2.086 & Transport/equipment & 6.234 \\
7. Durables & 0.676 & Transport/equipment & 1.843 & Food & 6.099 \\
8. Transport/equipment & 0.584 & Fuel/power & 1.837 & Alcohol & 4.755 \\
9. Alcohol & 0.537 & Alcohol & 1.583 & Fuel/power & 4.326 \\
10. Tobacco & 0.363 & Tobacco & 0.918 & Tobacco & 2.250 \\
\hline
\end{tabular}
\end{table}

\begin{table}
\centering
\caption{Marginal Revenue Costs for 1987}
\begin{tabular}{|c|c|c|c|}
\hline
 & \( e = 0 \) & \( e = 2 \) & \( e = 5 \) \\
\hline
1. Other goods & 1.145 & Other goods & 2.316 & Services & 5.064 \\
2. Services & 0.960 & Services & 2.258 & Other goods & 4.349 \\
3. Food & 0.875 & Petrol & 1.785 & Petrol & 3.763 \\
4. Petrol & 0.816 & Food & 1.633 & Transport/equipment & 3.291 \\
5. Fuel/power & 0.781 & Alcohol & 1.566 & Alcohol & 3.153 \\
6. Alcohol & 0.722 & Transport/equipment & 1.509 & Clothing/footwear & 2.837 \\
7. Transport/equipment & 0.666 & Fuel/power & 1.379 & Food & 2.806 \\
8. Clothing/footwear & 0.598 & Clothing/footwear & 1.341 & Durables & 2.514 \\
9. Durables & 0.563 & Durables & 1.234 & Fuel/power & 2.221 \\
10. Tobacco & 0.240 & Tobacco & 0.420 & Tobacco & 0.683 \\
\hline
\end{tabular}
\end{table}
for a uniform lump-sum grant, we may find that it has quite a low value relative to the calculated $i$, suggesting that, rather than lower the tax on a good with a low $i$, we could simply increase the value of the grant. 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, stressing the relatively undeveloped direct tax systems which operate in many less-developed economies.

A further point to remember in examining the rankings in Tables 5 and 6 is that we have not allowed for external effects associated with the consumption of various goods. For example, the consumption of goods such as alcohol, tobacco and petrol may give rise to social costs, which can be reduced by the imposition of corrective taxes. Since we do not incorporate such effects in this model, it is possible that the relatively low rankings of goods such as alcohol and tobacco is explained by this factor.

The result in (b) could be interpreted as implying that there was little indirect tax reform over the 1980–87 period. To check this, we can examine Table 5, 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 $e = 2$. Table 5 recommended tax increases on such general categories of goods as other goods, services, food and possibly clothing and footwear, while tax cuts were recommended for tobacco, fuel and power, transport and equipment, durables 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 because of 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

---

16 For an example of one approach to calculating the external effects implicit in the indirect tax system, see Madden (1992).
cuts were not put into effect; on the contrary, taxes were increased on most of those goods. This may reflect the fact that the 1980–87 period was one in which the overall level of taxation in Ireland increased significantly, in response to the rising public sector indebtedness. At a time when macroeconomic magnitudes were reaching unsustainable levels, marginal tax reform may have been low on the government’s list of priorities.17

VI. DISTRIBUTIONAL CONSIDERATIONS AND THE INVERSE OPTIMUM

As mentioned above, the deterioration in the Irish public finances during the 1980–87 period may explain why the implied tax reforms of 1980 were not implemented, for the most part. Another possible consequence of this concentration upon macroeconomic concerns may have been a neglect of distributional considerations. An exercise which may throw some light on this is what is known as the inverse optimum problem. This exercise estimates the degree of inequality aversion implicit in the tax system under the assumption that the government is optimising. Thus we calculate the value of \( e \), the coefficient of inequality aversion, that is consistent with optimality of the existing tax system, where by optimality we mean that the marginal revenue costs are the same for all goods, i.e. \( \rho_i = \rho \) for all values of \( i \). Thus we will have 10 expressions for equation (2), one for each good, with two unknowns, \( e \) and \( \rho \), which can be estimated via non-linear regression. The results of this exercise are presented in Table 8, with t-statistics in parentheses.18

<table>
<thead>
<tr>
<th></th>
<th>( e )</th>
<th>( \rho )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>0.360</td>
<td>1.126</td>
</tr>
<tr>
<td></td>
<td>(0.38)</td>
<td>(1.85)</td>
</tr>
<tr>
<td>1987</td>
<td>−0.135</td>
<td>0.845</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(2.82)</td>
</tr>
</tbody>
</table>

Note: t-statistics are given in parentheses.

17 In January 1982, Garret Fitzgerald’s first 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 at a time of fiscal imbalance, rather than as a marginal tax reform.

18 Note that in our estimation of \( e \) and \( \rho \) from equation (2), we are treating the \( e_ki \) as observations when in fact they are estimates which themselves will have standard errors. Thus the t-statistics in Table 8 are overestimates of the ‘true’ t-statistics.
The results are somewhat surprising. Recall that $e$ represents a coefficient of inequality aversion. Its estimated value of 0.360 for 1980 suggests that the government was mildly inequality-averse. However, the estimated value of $-0.135$ for 1987 suggests that the government’s attitude towards inequality as revealed in the indirect tax system was quite the opposite and that over certain ranges the social welfare function was ‘regressive’. The other result of interest concerns the estimated values of $\rho$. Recall that $\rho$ 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 $\rho$ 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 striking results from Table 8 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 second, that the overall marginal social cost of taxation rose over the 1980–87 period (presuming, of course, that the government was optimising during this period).

Before attempting to explain these results, there are a number of qualifying remarks which have to be made. The first of these concerns the possibility, discussed above, of external effects in consumption for certain goods. 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 presumably also increase the implied inequality aversion. Previous work by the author (Madden, 1994) suggests that such external effects may be important, although the implied inequality aversion is still quite low (less than 0.5).

Second, as outlined above, 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.

Third, the comparison of estimated values of $e$ and $\rho$ for two different points in 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 low t-statistics for the estimates of $e$. They imply that the standard errors of the estimates are greater in magnitude than the value of the coefficient, and so the reliability of inferences based on these estimates is questionable.

19 Technically, a negative value of $e$ means that the social welfare function violates ‘S-concavity’; see Sen (1973).
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 $\rho$. 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 1 and 3 shows that the taxes 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 Appendix C concerning the calculation of the tax on this good).

Thus the results from the inverse optimum exercise are consistent with the view that concentration on macroeconomic issues over the 1980–87 period led to an overall higher marginal social cost of taxation and lower implied inequality aversion by the government.

VII. CONCLUSIONS

This paper has applied the Ahmad–Stern model of marginal indirect tax reform to the Irish indirect tax system for the years 1980 and 1987, and has amended their approach to rank commodities by the marginal revenue cost rather than the marginal social cost of taxation. It finds that there was considerable scope for indirect tax reforms at the margin for both 1980 and 1987. The publication of the 1994 Household Budget Survey will allow for further analysis of indirect tax reform, this time during a period when macroeconomic fiscal issues were much less pressing. This 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. First, 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)). As noted above, such effects are incorporated into models of this sort in Madden (1994) and sensitivity to separability can be examined. It is also possible to incorporate the stylised fact 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 (see Madden (1995)).

Second, 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 that 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).
APPENDIX A: DERIVATION OF EXPRESSION FOR MARGINAL
REVENUE COST

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 per cent.)20
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.

\[(A1) \quad q = p + t\]

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

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

\[(A2) \quad V(q) = W(v^1(q), v^2(q), \ldots, v^H(q))\]

The aggregate demand vector is given by

\[(A3) \quad X(q) = \sum_h x^h(q)\]

and government tax revenue is given by

\[(A4) \quad R = t'X = \sum_i t_i X_i\]

From Roy’s identity we know that

\[(A5) \quad \frac{\partial V^h}{\partial q_i} = -\alpha^h x^h_i\]

where \(\alpha^h\) is the private marginal utility of income. Then we can say that

\[(A6) \quad \frac{\partial V^h}{\partial t_i} = -\sum_h \beta^h x^h_i\]

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20 The assumption of perfectly elastic supply is reasonable for a small open economy such as Ireland, for the
tradables sector at least.
where \( \beta^h = \alpha^h \frac{\partial W}{\partial u^h} \) is the social marginal utility of income of household \( h \), i.e. the welfare weight.

From equation (A4) we have

\[
\frac{\partial R}{\partial t_i} = X_i + \sum_k t_k \frac{\partial X_k}{\partial t_i}.
\]  

(A7)

Thus, after some rearranging to express in elasticity terms, we have

\[
\rho_i = \frac{q_i X_i}{\sum_h \beta^h q_i x^h_i} + \frac{\sum_h \tau_k q_k X_k e_{ki}}{\sum_h \beta^h q_i x^h_i}
\]

(A8)

which is equation (2) in the text.
APPENDIX B: COMMODITY CLASSIFICATION

The analysis was carried out for 10 goods. NIE data for 10 goods were 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 following list gives the 10 goods by their NIE classification and the corresponding items used from the HBS:

- Food Items 75-193
- Alcohol Items 196-202
- Tobacco Items 203-205
- Clothing Items 206-258, 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, 333-350
- Services Residual

APPENDIX C: 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 September 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-rates fuel, excluding electricity.
- 1 March 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 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 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 8 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 5 per cent VAT introduced on previously zero-rated fuels with the exception of electricity (plus various excise duties on home heating oils etc.). Petrol shows one of the largest increases in tax rates, 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 an aggregation issue. 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 \textit{ex post} tax. The marginal tax changes in the other categories largely reflect changes in various VAT rates.

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Indirect Tax Reform in Ireland


