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The Marginal Social Cost of Taxation in Ireland

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In addition to raising revenue to cover the expenses of the State, taxation has an undesirable side-effect through the distortion of the economic decisions of individuals. In an ideal world, economic agents will face relative prices which accurately reflect true relative social opportunity costs. Except where monopoly power or externalities are important, the untaxed economy will tend to experience undistorted prices in this sense. Some taxation may be corrective, inasmuch as it serves to correct for price distortions induced by the exercise of monopolistic market power or the existence of externalities. (An example could be the taxation of alcohol and tobacco, whose consumption is often thought to impose social costs not borne by the consumer).

We believe it is fair to say, however, that most taxation is not corrective, but is governed by the primary objective of raising revenue.

Much of Government spending is for worthwhile purposes. In particular the redistributive role of Government spending (Murphy 1984) is something for which it would be hard to find a private sector substitute. But for every pound raised in taxation and applied to a Government spending programme, there is a deadweight loss to society resulting from the distortion of private decisions. In order to earn its keep, therefore, a spending proposal must have a social benefit large enough to cover not only the cash costs, but also the deadweight loss resulting from the taxation that will be needed.

Analysis in other countries has estimated this deadweight loss, or excess burden, of taxation at the margin to be quite substantial. The most comprehensive of these studies (Ballard, Shoven and Whalley, 1985), estimated the loss to
be between 17 and 51 cents per dollar of revenue raised in the US from all sources. Stuart (1984) estimated the losses resulting from a marginal increase in the tax on labour; he found them to lie in the range 20 cents to one dollar per dollar of tax revenue raised, depending on the labour supply elasticities used.

A characteristic of these outcomes is that the excess burden increases approximately with the square of the tax rate. Consequently it would be surprising to find estimates for Ireland even in the higher range of those for the US, given the sharp rate increases that have been experienced in Ireland in recent years (Figure 1). The share of taxation in GNP is higher in a few other countries (all of which have a higher level of per capita GNP, Figure 2), but the Irish tax system is noteworthy for the narrowness of its base: much of income and expenditure is either effectively tax-free or taxed at very low rates (Commission on Taxation 1982, de Buitlear 1983). This means that rates of tax on other goods or incomes have to be higher to obtain a given level of revenue. These are reasons for supposing the excess burden of taxation in Ireland to be very high.

The purpose of this paper is to arrive at some tentative estimates of just how high this excess burden is in Ireland today. To do this we draw on existing empirical work on the Irish economy in order to obtain estimates of supply and demand responses to price changes, and combine these with some simple models of the main distortions in the economy. Our focus is exclusively on taxation: Government spending programmes can also distort prices and incentives, but we have chosen to ignore such additional deadweight costs by assuming that any new tax revenues are either returned to individuals or spent on public goods of equivalent marginal value to private spending; and that this redistribution or spending does not distort private decisions.
Part I discusses the direct excess burden of income taxation, under the simplifying assumption that the labour/leisure choice is separable from other expenditure decisions. The innovative aspect of our approach is to examine the role played by wage-fixing behaviour. Part II looks at commodity taxation, distinguishing between the excess burden on the highly taxed exciseable items and that on goods with lower or zero rates. Part III presents estimates which cover both the direct and indirect burden, being based on an integrated model of labour supply and commodity demands. Part IV relates our findings to the prescriptions which emerged from the Commission on Taxation. Part V offers some conclusions.
I DISTORTIONS IN THE LABOUR MARKET

Our approach to calculating the excess burden in the labour market is the standard one of estimating the marginal loss in consumer plus producer surplus: i.e. in the gap between the supply and demand curve for labour (cf. Broadway and Bruce, 1984).

Ireland exhibits large measured unemployment which cannot easily be explained away by considerations of frictional or voluntary unemployment. If we are to retain a demand and supply approach, we must either have a horizontal supply curve, or a failure of the wage to clear the market, if we are to encompass this unemployment. In a country as highly unionised as Ireland (with about a half of non-agricultural employees in unions) it is natural to suppose that unions may play a large role in determining wage rates, and that their behaviour may not result in market clearing wages. This indeed has been implicit in most studies of the labour market (for example Mulvey and Trevithick, 1973, Sapsford, 1979, Committee on Costs and Competitiveness, 1981). The aggregate labour supply curves in the recent empirical work of Hughes (1985), Murphy and Fagan (1986) and Bradley and Fanning (1984), can most plausibly be interpreted as being the outcome of union wage-setting behaviour, especially when one considers that attempts to estimate household demand for leisure at the microeconomic level imply low labour supply elasticities (Murphy and Thom, 1986).

Three functional relationships may therefore be relevant in making our calculations on the labour market: the demand price of labour, \( p^D(x) \) a function of the quantity of labour employed \( x \); the true, but perhaps ineffective supply price of labour based on individual household preferences, \( p^C(x) \); and the union determined supply price of labour, \( q(x) \), the arguments of which will be discussed later. We write \( w \) for
the net of tax wage rate, and $t$ for the wage tax. Thus the employer pays a gross wage of $w + t$, while the employee receives only $w$.

The general formula for the marginal deadweight loss $B$ resulting from an increase in $t$ in a labour market that clears is:

$$B = - (p^o(x) - p^e(x)) \frac{dx}{dt}. \quad (1)$$

We will wish to express the loss as a percentage of the increase in taxation $T$:

$$T = dt \frac{x}{dt} = x + t \frac{dx}{dt}. \quad (2)$$

In the absence of taxes, and if there is no union-induced distortion, we can expect the supply and demand price to be equated, so that this expression vanishes: the marginal deadweight loss of introducing taxation into an undistorted market is zero. In Ireland however, the size of the wedges which existing distortions have inserted between demand and supply price cannot be ignored.

**Case A** Infinitely elastic supply of labour.

The simplest case is where the true supply price of labour is constant at $w$. Unemployment is then observed unless the demand for labour at the corresponding gross wage happens to be sufficient to exhaust the total labour supply. Since the supply price is constant, an increase in the existing tax rate $t$ must be absorbed in the demand price. Thus,

$$p^o(x) = w + t,$$

and

$$d p^o(x)/dt = 1; \quad (3)$$

from which, noting that:
\[ \frac{dp^\circ(x)}{dt} = \frac{\delta p^\circ(x)}{\delta x} \cdot \delta x \cdot \delta t \] (4)

and writing \( \epsilon_\phi \) for the elasticity of demand for labour,

\[ \epsilon_\phi = \frac{p/x}{\delta x/\delta p^\circ(x)} \]

we have,

\[ \frac{dx}{dt} = \frac{1}{\delta p^\circ(x)/\delta x} = x\epsilon_\phi/(w+t). \]

Thus, if,

\[ \tau = t/(w+t), \]

the general formula (1) becomes, in this case,

\[ B = -x\tau\epsilon_\phi \] (5)

Likewise, we easily obtain:

\[ T = x(1 + \tau\epsilon_\phi). \] (6)

So that,

\[ B/T = -\tau\epsilon_\phi/(1 + \tau\epsilon_\phi) \] (7)

**Case B** Supply not perfectly elastic.

There is a simple extension to the case of an upward sloping demand curve. In this case,

\[ p^\circ(x) - p^\circ(x) = t \]

and,

\[ \frac{dp^\circ(x)}{dt} - \frac{dp^\circ(x)}{dt} = 1. \]

Accordingly,

\[ \frac{dx}{dt} = x/[ (w+t)/\epsilon_\phi - w/\epsilon_\phi] \equiv x\bar{y}, \] (8)
so that.

\[ B/T = - t \phi/(1 + t \phi). \]  \hspace{1cm} (9)

The loss in this case is smaller. Note that equation (7) above is a special case of equation (9); likewise another limiting case of equation (9) gives the loss for the case of an infinitely elastic demand, or fixed pre-tax wage.

**Case C** Effective supply price of labour determined by union.

If unions set the wage higher, at \( q \), than the market clearing wage, the loss is greater than given by equation (9). Figure 3 illustrates why: the wage rate is \( w \) and demand and supply schedules of labour are denoted \( D \) and \( S \). Equilibrium in the undistorted market is given by \( w_0 \). Wage setting behaviour results in a wage higher than this with resulting unemployment. Additional welfare losses arise as a result of a tax rate \( t \) which is to be increased to \( t' \).

Clearly \( w = q + t \) and \( w' = q' + t' \). If rationing is efficient, the incremental welfare losses due to the discrete increase in the tax rate from \( t \) to \( t' \) are given by the trapezoidal area \( EFGH \). This loss is obviously more severe the greater the existing tax rate and the greater the effect of wage-setting behaviour.

Note that the nonunion cases \((A)\) and \((B)\) above can be taken as special cases of \((C)\) by setting \( q(x) = w_0 \) for all \( x \) (case \((A)\)) and \( q(x) = p^*(x) \) (case \((B)\)).

New difficulties arise in calculating the excess burden. In the first instance, the gap \( (p^o - p^m) \) evaluated at the actual level of employment \( x \) is now greater than the tax \( t \) by an amount equal to the vertical distance \( (q - p^m) \). Knowledge of this gap requires knowledge of the location as well as the slope of the true supply curve \( p^m \), which is hard to determine since it is not expressed in the market, having
been superseded by the union's wage setting. Furthermore, the gap \( (p^o - p^s) \) at \( x \) no longer necessarily reflects the loss in surplus. The reason is that not every worker willing to work at the (union determined) net market wage \( w \) \((= q)\) is employed. Some rationing mechanism determines who gets a job and who does not. If the rationing mechanism is so efficient that it provides jobs to those with the lowest reservation wage or supply price, the reservation wage \( p^s \) for the worker displaced at the margin by an increase in tax will equal \( p^s(x) \). (We will call this "efficient rationing"). Otherwise, the reservation wage of the marginal worker could lie anywhere below \( w \). Thus in particular some persons with a supply price greater than \( p^s(x) \) may be employed. The equation for \( B \) must therefore be modified in this case to read:

\[
B = - (p^o(x) - p^s) \frac{dx}{dt}, \quad (10)
\]

where,

\[
w = q \geq p^s > 0.
\]

If we knew how the rationing process allocated jobs as between high- and low-reservation wage workers, we could locate \( p^s \) more precisely. While one must distinguish between the impact effect and the steady state effect of a tax change, some evidence on this question has been obtained from layoff data. For specific industrial sectors in the United States, Feldstein (1978) showed that it was individuals with high reservation wages who were more likely to be laid off. However it is not clear that this could be extrapolated to Ireland. Whelan and Walsh (1977) examined the work experience of redundant workers, but their study was not designed to examine who would be more likely to accept redundancy offers. Where the LIFO ("last in is first out") system of allocating compulsory layoffs operates, the reservation wage of those laid off may well be below \( p^s(x) \).
If we think of the union-set wage as being a function $q(x)$ of the quantity of labour, with elasticity $\epsilon$, we can adapt (8) to obtain:

$$\frac{dx}{dt} = \frac{x}{[(w+t)/\epsilon - w/\epsilon] xy}, \quad (11)$$

from which we conclude that,

$$B/T = -(w+t-p\gamma)y(1 + ty). \quad (12)$$

Empirical studies of wage determination in Ireland (e.g. Hughes, 1985) have often assumed an upward sloping supply curve. But there is nothing in their models which rules out this supply function representing union behaviour. Therefore we feel free to refer to the estimated elasticities of supply from previous studies. But it may yet be asked whether a horizontal or upward sloping union wage setting function can be rationalised on theoretical grounds. After all, it may be objected, the offer wage of a single union acting as a monopolistic supplier of labour, would not be a function of the quantity of labour, if the union was trying to maximise the wage bill, or supplier's surplus. Instead, an unique offer wage and quantity would be determined by the elasticity of the demand for labour.

Nevertheless, it is easy to formulate a realistic union objective function which is consistent with an upward sloping relationship between offer wage and total employment, which can be seen as an "as if" supply function. For instance, we could imagine that union behaviour is designed to maximise the total income of their more senior members, and the union believes that the probability of its senior members retaining their jobs is an increasing function of total employment. Then, if this probabilistic dependence is denoted $\pi(x)$, the union chooses $q$, or equivalently $x$, to maximise $q\pi(x)$, subject to $q = p\gamma(x) - t$. 

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A variety of other union behaviours would also support this optimisation problem. An internal optimum will satisfy:

\[ \langle \delta p^a(x) / \delta x \rangle \pi(x) + [p^a(x) - t] \delta \pi(x) / \delta x = 0, \]

or, writing \( \alpha \) for the elasticity of the function \( \pi \),

\[ t = p^a(x) \left( 1 + (\alpha \epsilon \sigma)^{-1} \right). \]  \hspace{1cm} (13)

Taking \( \alpha \) to be constant, we may infer from (13) that in this case,

\[ dx / dt = x / (w + t) \epsilon \sigma / (1 - (\alpha \epsilon \sigma)^{-1}) \equiv xy^\ast. \]  \hspace{1cm} (14)

This provides an alternative expression to (11), and \( y^\ast \) can be substituted for \( y \) in (12). Note also, however, that (14) may be written:

\[ dx / dt = x / \{ (w+t) / \epsilon \sigma - w / ((w / (w+t)) \alpha \epsilon \sigma^2 / \} \}, \]  \hspace{1cm} (15)

Suggesting, by analogy with (11), an "as if" union supply curve with elasticity \( \{ (w / (w+t)) \alpha \epsilon \sigma^2 / \} > 0 \). This interpretation allows us to retain the ideas of Figure 3 for the optimising monopolistic union, despite the non-existence of a conventional supply curve in this case.

**Indirect effects on other markets**

Spending on other markets may also change in response to the tax on labour. To the extent that these markets too are distorted, there is a further change in deadweight loss, but this may be positive or negative according as demand increases or falls. If the proceeds of the tax are redistributed (in lump sum form), we can calculate the change in spending on other markets \( \Delta \) as the change in the gross wage bill \( xp^a(x) \). If we can assume sufficient separability to aggregate the other goods, then writing the
distortion (tax rate) in other markets as \( \sigma \), the indirect or secondary welfare loss is:

\[
S' = (p^o(x) + \alpha \frac{dp^o(x)}{dx}) \sigma \frac{dx}{dt} = (1 + 1/\epsilon_d(x)) \sigma p^o(x) \frac{dx}{dt}.
\] (16)

with \( \frac{dx}{dt} \) given by (5), (8), and (11) or (14), respectively, for the three cases. Note that spending increases if the absolute value of \( \epsilon^o(x) \) is less than unity, thereby reducing the deadweight loss. Conversely if the elasticity of demand for labour exceeds unity, the secondary contribution of other goods to the deadweight loss is positive. As discussed later, the evidence is for an elasticity of demand somewhat larger than unity, suggesting that these secondary effects are positive even when the tax revenue is redistributed.

If the tax proceeds are not redistributed, but spent on some public good which is separable from leisure and the private goods, spending on the private goods will fall, thereby increasing the deadweight loss as well as lowering the tax revenue. Instead of equation (16), the secondary loss for no redistribution becomes:

\[
S = (1 + 1/\epsilon_s(x)) \sigma p^*(x) \frac{dx}{dt} > 0.
\]

\[
= (\sigma + \epsilon_d (1 + \epsilon_s)/(\epsilon_s - \sigma \epsilon_d)) x.
\] (16')

(For case B; note that with no redistribution the secondary effect is greater, the smaller the elasticity of supply). Because the loss of revenue in the commodity markets is equal to the secondary burden, the total burden per pound of net revenue increase is now: \((B+S)/(T-S)\), instead of \(B/T\).

**Numerical Application**

We will proceed on the basis of a single labour market, and illustrate the range of deadweight losses per pound of
additional tax revenue resulting from increased taxation of labour income.

The parameters which are relevant are: \( \tau, \sigma, \varepsilon_0 \) and \( \varepsilon_\psi \) (or \( \varepsilon_\omega \)). Several practical questions arise. First, should the tax rate \( \tau \) reflect average or marginal rates of tax? Two alternative interpretations are possible, either the demand and supply curves are for hours worked, in which case the marginal rates would seem more relevant, or they are for years worked, in which case the gap between before and after tax wages is given by an average tax rate.³

The second question is how large is the elasticity of labour demand? The estimates of Bradley and Fanning (1984) suggest a long-run elasticity of labour demand in industry close to, and perhaps larger than, unity. In our view these estimates supercede the earlier, lower, values because of the more realistic model employed by Bradley and Fanning, which allows the capital stock to adapt in response to changes in labour costs.

A standard assumption in the international literature (cf. Stuart 1984) is that the gross wage, or marginal product of labour supplied to the market sector, is fixed. In our model, that is equivalent to setting \( \varepsilon_0 = \infty \). For high values of the tax rate and the supply elasticity, the deadweight loss becomes very large as the tax revenue shrinks.

Finally, we note from the estimates of Hughes (1985) and Murphy and Fagan (1986), that the elasticity of the effective supply curve of labour to industry may be approximately equal to (absolute value of) the elasticity of demand (leading to their famous conclusion that an increase in payroll taxes was 50% passed on, 50% absorbed in a reduction in net wages). On the other hand, micro studies
in Ireland have not conclusively illustrated a high individual elasticity of labour supply. The reader is free to interpret high values of the supply elasticity as applying to secondary workers and low values to primary workers; for the United States, Heckman (1980) estimated a supply elasticity for females as high as four.

(This evidence has generally related to uncompensated demand and supply. This involves offsetting biases in computing the deadweight losses in that the compensated demand curves will be less elastic than the uncompensated, with the opposite being true for supply curves).

These considerations have led us to report deadweight loss estimates for three values of \(\tau\): 0.2, 0.4 and 0.6. We allow the absolute value of each of the elasticities to take the values 0.2, 0.5 and 1.0, and also \(\epsilon^w = \epsilon\).

Looking first at the primary losses, Table 1a reveals the rapid increase in deadweight losses as elasticities and tax rates increase. Bearing in mind the above remarks, for Case B we might regard the estimates for \(\tau=0.4 \) and 0.6, and both elasticities at 1.0 as being perhaps the most empirically realistic for Ireland. These imply an excess burden of between 33p and 75p in the £ for income tax alone.

When we take into account the additional distortions caused by individuals being off their supply curve reflecting unemployment caused by wage rates being too high (Case C), the deadweight losses become very considerably higher. To calculate these losses we must decide how far below the union supply price \(q\) is the reservation price \(p^*\) of the marginal displaced worker. If individual supply elasticities are very low, then \(p^*\) could be very low indeed: we show the losses for two cases, \(p^*=0\) and \(p^*=q/2\). From the final panel of Table 1a, we see that for low true supply
elasticities, the primary losses could be in the range 83p
to £1.25 per £ of revenue with realistic tax rates.

The estimates discussed so far do not take account of any
indirect losses from commodity markets. Estimates of the
total deadweight loss, primary and secondary, are presented
in Tables 1b and 1c, and are based on equation (16') as
discussed above. The estimate of \( r \), at 0.40, is effectively
the marginal indirect tax revenue from an increase in
consumer spending. This has been computed from the
elasticities of tax revenue presented by Bradley and Fanning
(1984), applied to 1985 tax shares. Table 1b shows the
estimated value of \((B+S)/(T-S)\), while Table 1c, implicitly
assuming that half of indirect taxation is corrective, shows
\((B+WS)/(B-S)\). There is further discussion of corrective
taxation below.

With the addition of secondary losses where the proceeds of
the tax increase are not redistributed, the estimated
deadweight losses rise dramatically. This contradicts the
stance taken by Browning (1987), but is clearly more because
of the loss of tax revenue on the commodity markets than
because of secondary distortions. The range 33p to 75p
discussed above for primary losses jumps to the range 92p to
£2.68 when the secondary losses are included. For the union
distorted case the estimates go as high as £3.74.

It is important to note that these estimates of total
deadweight losses per £ of additional tax revenue, though
they range up to several £s per £, do not assume that the
revenue from the tax is wasted. The implicit assumption is
that the proceeds are spent on public goods with as high a
marginal value as private spending.
TABLE 1a: PRIMARY DEADWEIGHT LOSS PER $t$ OF EXTRA TAX (IN $\$/$t)

**Case A - Equation 7:**

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<thead>
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<th>$\bar{\gamma}$</th>
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<th>0.6</th>
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<td>0.04</td>
<td>0.09</td>
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**Case B - Equation 9:**

(i) $\bar{\gamma} = 0.2$

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(ii) $\bar{\gamma} = 0.4$

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(iii) $\bar{\gamma} = 0.6$

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**Case C - Equation 12:**

(i) $p^* = w/2$

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(ii) Limiting case with $p^* = 0$

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TABLE 1b: TOTAL DEADWEIGHT LOSS PER £ OF EXTRA TAX (IN £)
Tax proceeds not redistributed

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<th>Case A - Equation 7:</th>
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<table>
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<th>Case C - Equation 12:</th>
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<tbody>
<tr>
<td>( \pi^{*} = \pi/2 )</td>
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</tbody>
</table>

| Case C - Equation 12: |
|---------------------|------------------|------|------|
| (i) \( \tau = 0.2 \) | \(-\varepsilon_{12}=\varepsilon_{1}=\) | 0.2  | 0.4  | 0.6  |
|                     | \(-\varepsilon_{12}=\varepsilon_{2}=\) | 0.2  | 0.16 | 0.28 | 0.40 |
|                     | \(-\varepsilon_{12}=\varepsilon_{3}=\) | 0.6  | 0.37 | 0.67 | 1.16 |
|                     | \(-\varepsilon_{12}=\varepsilon_{4}=\) | 1.0  | 1.28 | -    | -    |

<table>
<thead>
<tr>
<th>Case C - Equation 12:</th>
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<tr>
<td>(ii) Limiting case with ( \pi^{*}=0 )</td>
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<td>(-\varepsilon_{0}=\varepsilon_{0}=)</td>
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</table>

-16-
### TABLE 1c: TOTAL DEADWEIGHT LOSS PER $\ell$ OF EXTRA TAX (IN $\ell$)

**Tax proceeds not redistributed**

One-half of expenditure taxes are corrective

#### Case A - Equation 7:

<table>
<thead>
<tr>
<th>$\tau$</th>
<th>0.2</th>
<th>0.4</th>
<th>0.6</th>
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<tbody>
<tr>
<td>$-\varepsilon_0$</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0.2</td>
<td>0.05</td>
<td>0.11</td>
<td>0.17</td>
</tr>
<tr>
<td>0.6</td>
<td>0.17</td>
<td>0.43</td>
<td>0.87</td>
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<tr>
<td>1.0</td>
<td>0.33</td>
<td>1.09</td>
<td>4.50</td>
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</table>

#### Case B - Equation 9:

(i) $\tau=0.2$

<table>
<thead>
<tr>
<th>$\varepsilon_0$</th>
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<th>0.6</th>
<th>1.0</th>
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<tbody>
<tr>
<td>$-\varepsilon_0$</td>
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<td></td>
</tr>
<tr>
<td>0.2</td>
<td>0.07</td>
<td>0.06</td>
<td>0.05</td>
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<tr>
<td>0.6</td>
<td>0.16</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>1.0</td>
<td>0.22</td>
<td>0.22</td>
<td>0.24</td>
</tr>
<tr>
<td>$\infty$</td>
<td>0.62</td>
<td>2.24</td>
<td>-</td>
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</table>

(ii) $\tau=0.4$

<table>
<thead>
<tr>
<th>$\varepsilon_0$</th>
<th>0.2</th>
<th>0.6</th>
<th>1.0</th>
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</thead>
<tbody>
<tr>
<td>$-\varepsilon_0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>0.15</td>
<td>0.12</td>
<td>0.12</td>
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<tr>
<td>0.6</td>
<td>0.33</td>
<td>0.36</td>
<td>0.38</td>
</tr>
<tr>
<td>1.0</td>
<td>0.45</td>
<td>0.60</td>
<td>0.70</td>
</tr>
<tr>
<td>$\infty$</td>
<td>0.97</td>
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</tbody>
</table>

(iii) $\tau=0.6$

<table>
<thead>
<tr>
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<th>0.2</th>
<th>0.6</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-\varepsilon_0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>0.24</td>
<td>0.20</td>
<td>0.19</td>
</tr>
<tr>
<td>0.6</td>
<td>0.60</td>
<td>0.75</td>
<td>0.80</td>
</tr>
<tr>
<td>1.0</td>
<td>0.86</td>
<td>1.63</td>
<td>2.13</td>
</tr>
<tr>
<td>$\infty$</td>
<td>2.45</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Case C - Equation 12:

(i) $p*=w/2$

<table>
<thead>
<tr>
<th>$\tau$</th>
<th>0.2</th>
<th>0.4</th>
<th>0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-\varepsilon_0=\varepsilon_0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>0.12</td>
<td>0.19</td>
<td>0.28</td>
</tr>
<tr>
<td>0.6</td>
<td>0.31</td>
<td>0.53</td>
<td>0.92</td>
</tr>
<tr>
<td>1.0</td>
<td>0.53</td>
<td>1.06</td>
<td>2.66</td>
</tr>
</tbody>
</table>

(ii) Limiting case with $p*=0$

| $-\varepsilon_0=\varepsilon_0$ |       |       |       |
| 0.2     | 0.17  | 0.24  | 0.32  |
| 0.6     | 0.47  | 0.70  | 1.09  |
| 1.0     | 0.82  | 1.42  | 3.18  |

-17-
II COMMODITY MARKETS - PARTIAL EQUILIBRIUM

The approach adopted in measuring the deadweight losses in the commodity markets is dictated by the availability of parameter estimates. In this section we simply present the partial equilibrium analysis of primary effects. While this implicitly assumes that further deadweight losses and changes in tax revenue arising from secondary effects in other markets offset each other (and that is a stronger assumption than direct additivity of the utility function - see Atkinson and Stiglitz, 1972, p.109), we do not believe that such is the case. Indeed, as in the case of labour market taxation, we believe that secondary effects are very considerable. Nevertheless, this approach has the advantage of transparency. In the next section we relax the assumptions of separability by using the estimates of Murphy and Thom (1986). This has the advantage of treating income and commodity taxes simultaneously but the disadvantage of being to some extent a black box where some parameter estimates which are not known with precision may be influencing the results in a way which is difficult to isolate.

Lest the criticism be levelled against our calculations that they neglect the possibility that some of the commodity taxes are corrective in nature (as will be discussed in section IV), we also provide calculations on the assumption that alcohol and tobacco tax rates above the standard 25% are corrective and therefore do not generate a deadweight loss.

In the partial equilibrium approach, the total deadweight loss in the commodity markets is the sum of the losses in each market without secondary price effects. Furthermore, the cost of raising one pound in tax revenue via a marginal increase in the tax rate on each commodity is the sum of marginal losses, appropriately weighted. To illustrate, consider the case where each good is produced subject to constant marginal cost (as, for example, with a competitive domestic market structure or in
a small open economy). Efficiency losses are then experienced on the demand side of the market alone. This is illustrated in Figure 4. The marginal welfare loss from an increase in \( t \) to \( t' \) is given by the area AEDC in a representative market.

Analytically, the marginal loss per dollar raised from any given commodity is equivalent to case (A) in section I, given by equations (5) and (6).

We may consider two classes of general tax increase. In the first, the additional tax raised from each commodity is proportionate to the existing contribution of that commodity to tax revenue; we call this the revenue-proportionate increase. The second class has additional tax raised in proportion to net expenditure on each commodity— an expenditure-proportionate increase. Very loosely, we could classify a tax change that increased a 5% rate to 6% and a 50% rate to 60% as being closer to a revenue-proportionate increase; while increasing the 5% rate to 6% and the 50% rate to 51% would be closer to an expenditure-proportionate increase. In each case the overall efficiency loss per pound raised is given, with appropriate choice of weights \( w_i \), by:

\[
B/T = - \sum w_i \left[ \frac{\tau_i \varepsilon_i D^d}{1 + \tau_i \varepsilon_i D^d} \right].
\] (17)

For the revenue-proportionate tax increase the weights \( w_i \) are the initial revenue shares; for the expenditure-proportionate increase the weights are the initial net expenditure shares.

Numerical Application
For Ireland we have price elasticity estimates for about seven commodity groupings. Several authors have obtained such estimates over the years. We have chosen to use the estimates based on the Linear Expenditure System and published by McCarthy (1977). We also refer to estimates by O’Riordan (1979). Before taking the use of these estimates too seriously, we should draw attention to the fact that they were
estimated on the assumption of non-zero cross elasticities, which contradicts the assumption used in our methodology to obtain the deadweight losses. However, since all of the own-price elasticities have absolute value less than one implying that the secondary effects will tend to increase the deadweight losses. Nevertheless, we feel that our results in this section are essentially illustrative.

Within each commodity group a variety of tax rates applies, so that we are presented with both the practical problem of constructing an appropriately weighted average of the applicable tax rates, and the conceptual problem of deciding whether a weighted average is appropriate given the wide range of tax rates involved. At this stage we have decided that the best light on the subject is likely to be thrown by employing a "typical" tax rate for each commodity group. Appendix 1 explains the basis for the assignments of tax rates.

Computation of equation (17) using expenditures as weights with the elasticities given in the appendix yields a deadweight cost of 31 pence per pound of revenue (Table 2). With tax revenue shares as weights, the figure rises to 78 pence. The reason for the difference is that in the former case the experiment assumes that all taxes would be increased by the same number of percentage points (including zero rates), whereas in the latter case only tax rates that are non-zero would be increased, and the percentage point increase in the tax rate would be roughly proportionate to existing tax rates. Of course, the more the additional revenue is being raised from already distorted markets, the higher the cost. It is not surprising that deadweight losses can be reduced dramatically by shifting the relative burden of taxation to zero-rated goods.

Lowering the tax rate on alcohol and tobacco, in order to take account of the possibility that alcohol and tobacco taxation is
corrective, lowers the deadweight losses to 23p and 55p respectively.

Using the O'Riordan Rotterdam system estimates gives higher figures, but that is mainly because of the high own-price elasticity for motor vehicles estimated for that system. This interacts with the high tax rate to give very high losses on this commodity alone.

Note that these calculations effectively ignore the existence of income tax, and the secondary losses arising therefrom. Furthermore, grouping goods in such large categories tends to bias the estimates downwards. Subcategories may have higher tax rates, and the average deadweight loss is greater than the deadweight loss computed at an average tax rate. Furthermore price elasticities may be very much larger for subcategories than for an aggregate category (reflecting the potential of substitution between goods in different but similar subcategories).

Finally the omission of subsidies, which further distort relative prices, probably also contributes to these figures being underestimates.

### TABLE 2: PRIMARY DEADWEIGHT LOSSES FROM COMMODITY TAXATION

<table>
<thead>
<tr>
<th></th>
<th>McCarthy</th>
<th>O'Riordan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drink and Tobacco</td>
<td>0.59</td>
<td>0.41</td>
</tr>
<tr>
<td>Clothing</td>
<td>0.08</td>
<td>0.11</td>
</tr>
<tr>
<td>Durable Household Goods</td>
<td>0.19</td>
<td>0.11</td>
</tr>
<tr>
<td>Transport Equipment</td>
<td>0.85</td>
<td>3.88</td>
</tr>
<tr>
<td>Other Goods</td>
<td>0.21</td>
<td>0.18</td>
</tr>
<tr>
<td>Other Expenditure</td>
<td>0.15</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Revenue Proportionate</strong></td>
<td>0.78</td>
<td>0.55</td>
</tr>
<tr>
<td><em>(Corrective Taxation)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Expenditure Proportionate</strong></td>
<td>0.31</td>
<td>0.23</td>
</tr>
<tr>
<td><em>(Corrective Taxation)</em></td>
<td>-21-</td>
<td></td>
</tr>
</tbody>
</table>
III INTEGRATED LABOUR AND COMMODITY MARKETS

In their 1986 paper, Murphy and Thom estimated cost functions for Ireland assuming that utility, derived from consumption of leisure and non-durable goods, had the "Gorman polar" functional form. If we are satisfied that the estimated parameters provide a realistic picture of the demand system, we can use them to provide a complete picture of deadweight losses, without having to rely on assumptions of separability, or of the absence of secondary effects.

The underlying assumption in the Murphy and Thom (1986) framework is that preferences can be represented by an expenditure function of the aggregable form:

\[ C(w, p; U) = F(w, p) + G(w, p) \cdot U \]

where \( C(w, p; U) \) is defined as the expenditure required, at commodity prices \( p \) and wage \( w \), to achieve utility level \( U \). The functions \( F \) and \( G \) are homogeneous of degree one. Murphy and Thom have proposed specific functional forms for \( F \) and \( G \), and have estimated the relevant parameters. We assume that the functions \( F \) and \( G \) are known and equal to Murphy and Thom's point estimates. We then consider base values of \( w \) and \( p \), and values perturbed by an increase in tax \( (w', p') \). Given an initial endowment \( E \) of time and non-wage income \( Y \), equation (18) can be solved for the base level of utility \( U \):

\[ U = \left( wE + Y - F(w, p) \right)/G(w, p). \quad (18) \]

The cost at the perturbed prices of reaching the base level of utility is then,

\[ C(w', p'; U) = F(w', p') + \left( wE + Y - F(w, p) \right) G(w', p')/G(w, p). \quad (19) \]
which may be compared with the value of the perturbed endowment. Assuming that the tax revenue (which can readily be computed since the demand for each good and supply of labour is known from the expenditure function) is redistributed in lump sum fashion, and amounts to \( T \), the deadweight loss is per pound of additional tax revenue immediately obtained as:

\[
\frac{B}{T} = [C(w', p'; U) - w'E - Y - T] / T.
\]  

(20)

Computation of this expression resulted in the deadweight losses shown in Table 3. Thus if only income tax is raised, but taking account of the secondary effects, the loss is as high as £1.73; if the tax revenue is redistributed, this falls to £1.21, a figure which may be compared with the entries for \( \tau = .4 \) and \( \epsilon_D = \infty \) in Table 1. If a proportional increase applies to expenditure taxes as well, deadweight losses per pound of extra revenue are somewhat lower. (Once again if we pretend that the tax rate on alcohol and tobacco is only 25 per cent, the deadweight loss falls, as shown by the asterisked rows in Table 3).

For the no-distribution case we also computed deadweight losses for less than infinite elasticity of demand for labour.

**TABLE 3: DEADWEIGHT LOSSES FROM DEMAND SYSTEM**

in £ per £ of extra tax

<table>
<thead>
<tr>
<th>( -\epsilon_D )</th>
<th>Income tax</th>
<th>All Taxes</th>
<th>Tax proceeds redistributed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \infty )</td>
<td>1.73</td>
<td>1.44</td>
<td>no</td>
</tr>
<tr>
<td>( \epsilon^* )</td>
<td>1.54</td>
<td>1.34</td>
<td>no</td>
</tr>
<tr>
<td>2.0</td>
<td>1.23</td>
<td>1.25</td>
<td>no</td>
</tr>
<tr>
<td>1.0</td>
<td>0.96</td>
<td>1.13</td>
<td>no</td>
</tr>
<tr>
<td>0.5</td>
<td>0.67</td>
<td>0.96</td>
<td>no</td>
</tr>
<tr>
<td>( \infty )</td>
<td>1.21</td>
<td>0.83</td>
<td>yes</td>
</tr>
<tr>
<td>( \epsilon^* )</td>
<td>1.00</td>
<td>0.75</td>
<td>yes</td>
</tr>
</tbody>
</table>

*Alcohol and Tobacco Taxes Corrective*
IV POLICY IMPLICATIONS

The findings presented above bear upon tax reforms in two related ways. First there is the question of the appropriate alignment of the existing set of taxes; second the question of what the tax base should be. Neither of these issues can be considered without reference to the open nature of the economy.

Before advocating a particular set of options it is important to distinguish between taxation policy designed to yield a given tax revenue with minimum efficiency losses, and policy on what the optimal level of taxation should be. The latter question cannot be considered independently of the nature and benefits of government expenditures, whereas the former may be amenable to an independent answer. Thus the aggregate of deadweight losses from the present level of taxation might be reduced by a restructuring of tax rates. A change in overall tax revenue (matched by a change in expenditure) will be appropriate if the marginal benefit of public expenditure differs from the marginal cost of taxation inclusive of deadweight losses. The figures calculated in the earlier sections of the paper illustrate the size of the hurdle which has to be passed by proposals for additional expenditure before they can be justified. (It should however be noted as a general proposition that the social benefits of certain public expenditure can exceed, pound for pound, their cash cost. Thus, for example, if we measure social benefit by a social welfare function which reflects aversion to inequality, an expenditure which effectively benefits the poorest classes will have a benefit exceeding, pound for pound, that of an equal lump sum payment to all.)

Three main strands emerge from the literature on optimal taxation. First of all there is the view that the tax base should be as wide as possible and that tax should be levied at a uniform rate on the whole of the tax base. Second, there is
the view that taxes should fall more heavily on goods in inelastic supply or demand. Third, in an open economy, the potential for smuggling of taxed goods and for factor mobility argues for harmonizing tax rates across international frontiers.

Uniform Taxation on a Wide Base. This view, which was argued by the Commission on Taxation, can be based either on assumptions concerning elasticities or on administrative considerations related to evasion and avoidance. If the supply of labour were perfectly inelastic, then neither an income tax or an uniform commodity tax would be distortionary and neither would impose deadweight losses. In the absence of firm estimates for Ireland it is left to the reader to consider whether the assumption of zero labour supply elasticities is an empirically relevant one for Ireland. Recent studies for the United States (cf. Stuart, 1984) begin to overturn the previous conventional wisdom (cf. Abbott and Ashenfelter, 1975) that significant supply elasticities existed only for secondary workers. In our view the administrative arguments for uniform tax rates carry considerable weight. The potential for converting taxable income into virtually tax free gains in Ireland is well illustrated by the phenomenon of "Section 84" loans (explained in Flynn and Honohan, 1983). These, and other tax avoidance schemes were perfectly legal; many other illegal schemes, applying to commodity as well as to income taxation have caused the effective tax rates to differ from the nominal rates. The extreme difficulty of legislating against or policing tax avoidance or evasion when the tax code has many rates and many loopholes is a strong argument against retaining such complexities.

Tax Inversely Proportional to Elasticities. The so-called Ramsey rule for minimising deadweight losses relates closely to our earlier discussion of deadweight losses in the commodity markets. If labour supply is infinitely elastic, the Ramsey
rule will be theoretically optimal. Insofar as it concerns indirect taxation, the Commission on Taxation's view might also be loosely justified by reference to this prescription if we take the empirical evidence reviewed earlier as indicating that demand elasticities are approximately uniform across commodities. If so, then exempting some commodities from taxation while others must bear a high tax rate is clearly far from loss-minimising.

There are two main qualifications to the Ramsey rule. First is the issue of corrective taxation designed to discourage activities which generate negative externalities. Examples in the Irish tax structure are alcohol, tobacco and petrol, though one supposes that while heavy taxation of these commodities can be justified through the argument of externalities (cost of public health services, cost of maintaining roads, etc.), the real reason why they are so taxed is administrative convenience and, by now, social acceptability: one can hardly imagine a 400 per cent. tax on children's shoes being enacted. The second main qualification to the Ramsey rule is the potential for achieving redistributional objectives through a deviation from the Ramsey rule at less deadweight loss than would be incurred by a targeted expenditure programme. For example, it may be more efficient to retain a low tax on food while abolishing subsidies on selected food items (as was done in Ireland during 1984-86), or in preference to granting food stamps to the needy.

The introduction of income tax loopholes to encourage specific types of enterprise, as has frequently been done in Ireland over the years, as with Export Sales Relief, Bloodstock exemptions and indeed the 10 per cent Corporation Tax rate for manufacturing and certain services, also reflects the inverse elasticity rule.
International Tax Harmonisation. The argument that taxes on goods or on mobile factors of production should deviate little from international levels can be seen as an extension of the argument that taxes should be inversely proportionate to elasticities, in that international arbitrage will tend to create high elasticities of demand when tax rates at home differ significantly from those abroad.

Since most goods and factors are not perfectly internationally mobile, the international harmonisation argument need not be taken too literally. However it does point in two important directions. First, it draws attention to the need to include the price of competing foreign goods, or foreign employment opportunities, in estimating elasticities. This has not generally been done for goods, though there has been a recognition in the literature of its importance in labour migration (Walsh, 1977, McCarthy, 1979, Honohan, 1984). As the long term elasticities will be higher than short term elasticities, possibly with quite long lags in the case of international flows, the modelling here must be quite careful as to the dynamic specification if the leakage abroad is not to be underestimated. Second, it draws attention to a serious limitation on the potential for corrective taxation at rates which differ substantially from those abroad. One need only refer to the problem of cross-border smuggling of alcohol in recent years to realise the weight of this consideration.

The Tax Base
Income, expenditure and wealth have traditionally been regarded as the natural bases for taxation. In a tidy world, all income would eventually be spent. Furthermore, all wealth would generate taxable income, and all income would be derived from wealth, human or non-human. Thus the three possible bases are aspects of each other. The use of more than one base may be an attempt to achieve a more comprehensive coverage, for example by sweeping in tax from expenditure out of income sources that
had somehow been neglected in the tax collection. Or more than one of the bases may be used in order to obtain a more effective application of the inverse elasticity rule. The taxation of real property (including land) provides a good example of both motives. Not only are tax rates low at present on non-cash income from many classes of property, but in particular land is typically in inelastic supply, thus inviting taxation on efficiency grounds. A higher tax revenue from property would allow lower tax rates on labour and goods.

In order to quantify the potential gains from a shift to increased taxation of residential property we again need estimates of supply and demand elasticities and an appropriate tax rate. In the short run the supply elasticity is very low as the housing stock is almost fixed, and as a consequence the welfare loss is almost zero. In the longer run, competition in the construction industry should ensure a higher elasticity. But the size of the supply elasticity is limited by the fact that inputs, particularly land, will not themselves be in infinitely elastic supply (cf. White and White, 1977). On the demand side, the literature (extensively surveyed by Mayo, 1982) universally finds elasticity estimates below unity in absolute value both for renters and owners. For owners, most estimates lie between one-half and two-thirds. We estimate, by reference to the number of households and average house prices obtained from sources listed below**, that a tax rate of as little as 10% on an imputed income from residential property could raise up to 5% of total tax revenue (say, £ 300 million). Replicating the calculations of Table 1a (equation 9), we obtain partial equilibrium estimates of the primary marginal deadweight loss per pound of a property tax of 10% which are much lower than those estimated for income tax and some of the commodity taxes. Short run losses (assuming zero supply response) would be close to zero; long term losses at around 5p or 6p in the £. The optimal rate of tax here would probably be
higher, therefore, in order to allow further reductions in other tax rates.

**TABLE 4: MARGINAL DEADWEIGHT LOSSES FOR A 10% TAX**

(Primary losses only)

<table>
<thead>
<tr>
<th>$\varepsilon_s$ =</th>
<th>0.0</th>
<th>0.5</th>
<th>1.0</th>
<th>5.0</th>
<th>$\infty$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-\varepsilon_0$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>0.0</td>
<td>0.03</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>0.7</td>
<td>0.0</td>
<td>0.03</td>
<td>0.04</td>
<td>0.06</td>
<td>0.07</td>
</tr>
<tr>
<td>1.0</td>
<td>0.0</td>
<td>0.04</td>
<td>0.05</td>
<td>0.09</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Note: Figures in the first column $\varepsilon=0$ may approximate to the short-run impact of a property tax; the third or fourth column may give the long-run loss.
IV CONCLUSION

The purpose of this paper has been to examine the deadweight losses associated with different forms of taxation in Ireland. In much of the recent discussions of tax policy emphasis has been placed on the redistributive impact of taxation and on disincentive effects. Our focus is on the welfare losses which arise because of the foregone surplus which would accrue if, for instance, output were increased; such a surplus exists because the marginal valuation of output exceeds its marginal cost.

Our efforts have been directed at labour market and commodity market taxation: these account for about 85% of total tax revenue at present. The direct or primary marginal losses in the labour market associated with an increase in tax revenue there of £1 amount to not less than 50p, and may exceed £1. Our estimates of the primary losses in the goods market due to taxation of goods are based on tentative parameter values and assignment of tax rates to commodity groups, but they appear to be in the same range, unless alcohol and tobacco taxation is regarded as corrective. Lower losses would result if goods at present zero-rated were brought into the tax net.

These estimates for the labour market and commodity markets respectively in each case ignore the secondary losses on the other market. Integrated estimates of deadweight losses from raising tax in both labour and commodity markets give figures well in excess of £1 per £ of additional tax revenue. This is so for both aggregative calculations, and those based on disaggregated data for commodity groups. A wide range of estimates is presented, referring to different elasticity assumptions: but even the lower estimates shown for plausible elasticities are extremely high.
With tax rates as high as they are in Ireland, estimates of deadweight losses become very sensitive to assumptions regarding elasticities of supply and demand. Where elasticities are high, marginal deadweight losses could be several times the increased tax revenue.

These results may surprise readers familiar with modest estimates obtained by others of, for example, the overall deadweight loss of tariffs in proportion to GNP. But the difference is easy to understand if we bear in mind that the estimates here relate to marginal increases in taxation, and not to the average burden of taxation.

Our results have several strong implications for public policy. First, they indicate that cost-benefit analysis of public projects must take into account the very substantial losses which are merely associated with generating the revenue to pay for the project (cf. Honohan, 1985). For example, if the welfare cost of an additional pound of public expenditure is a further pound, then the project should have a net present value of at least twice its cost if it is to go ahead. It is of course true that with reasonable weights in a social welfare function, redistribution from the very rich to the very poor generates a welfare improvement far in excess of the deadweight losses which we have provided. But the marginal public expenditure does not have this strongly redistributitional characteristic. Much of public expenditure if it redistributes progressively at all does so only between persons of not dissimilar income levels (some evidence is provided in Murphy, 1984).

A corollary of this is that even internally held national debt represents a significant real cost to the economy because of the deadweight costs of the tax required to service it. This cost is additional to that imposed by the impact of higher domestic interest rates on capital formation.
Above all, there are implications for tax policy. We have argued that the high tax rates in Ireland call for an assessment of ways of reducing the deadweight burden by adjusting the structure of taxation even at existing levels. This seems to call for an extension of the tax base, for example the reintroduction of taxation of residential property. Though the long run elasticity of supply of reproducible property is certainly non-zero, we have shown that a substantial reduction in deadweight losses would probably result from the substitution of property taxation for some of the existing income and expenditure taxes in Ireland.


Hughes, J. G. (1985), "Payroll Tax Incidence, the Direct Burden, and the Rate of Return on State Pension Contributions in Ireland" Memorandum Series No. 120, (Dublin: Economic and Social Research Institute).


Whelan, B. and B. Walsh (1977), Redundancy and Re-employment in Ireland Memorandum Series No. 89, (Dublin: Economic and Social Research Institute).


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Appendix I

Choice of tax rates for commodity groups.

**Food.** Most food is zero rated for VAT, with certain exceptions such as confectionary, ice cream, potato crisps and restaurant meals. We take the rate zero to be typical.

**Alcohol and Tobacco.** In March 1986 the total tax rate on selected items of this commodity group was as follows:

- Pint Stout (typical bar price) 96%
- Glass whiskey (do.) 85%
- £3.50 bottle wine 140%
- Cigarettes (typical retail price) 288%

We use 150% as a representative rate (except where we treat these taxes as being corrective, when the rate used is 25%).

**Clothing and footwear.** Other than children's clothing and footwear (and fur), these are chargeable at 10 per cent. We take this rate to be typical.

**Rent, fuel and power.** There are income tax reliefs on mortgage interest and, for older persons, rent. Rent in local authority dwellings is also subsidised. Electricity is zero rated for VAT, other fuels carry a 10 per cent. rate. Altogether this group is a most heterogeneous one from the point of view of tax rates. We assign it a zero rate, somewhat arbitrarily.

**Household goods.** Most household goods are taxable at the standard 25% rate. TVs carry an additional excise duty. We use a 25% rate.

**Transport and Communication.** In March 1986 the total tax rate on a litre of premium gasoline was 158%. On a motor vehicle, the rate was 138%. On the other hand bus and especially train travel is heavily subsidised. Telephone charges are zero rated. We use 100% as our typical tax rate in section II; but in section III, where only non-durables are modelled, we use a rate of 50%

**Recreation, Entertainment and Education; Miscellaneous.** We use the standard rate of VAT, i.e. 25%, for these commodity groups, even though education and certain other services are taxed at lower rates.
Footnotes

1. This is in the spirit of the literature on union behaviour and "insider-outsider" theories; a similar type of objective function is used for example by Blanchard and Summers (1986).

2. No redistribution was assumed, for example, by Stuart in his influential 1984 paper.

3. When Social Insurance contributions are taken into account, the distribution among persons of marginal tax rates on labour income in Ireland is quite complex, and data is not readily available. In 1986, the main income tax rates were 35%, 48%, and 58%, with the higher rates applying at the margin to more than two in every five taxpayers; for incomes up to almost 1¼ times average earnings there were also Social Insurance Contributions of as much as 7¾% for employees and over 12% for employers. Using, for example, a 48% marginal tax rate and the full rate of Social Insurance would lead to a value of \( \tau \) just over 60%.

Gerard Boyle pointed out to us that increases in income tax in Ireland in recent years have preserved the ratio of marginal to average tax rates. This allows us to avoid some complications discussed by Browning (1987).

4. How might our approach be modified to deal with an extensive black economy for employment? To the extent that earnings from this black economy were also spent in untaxed markets, the black economy could be regarded, for our purposes, as part of the leisure sector, necessitating no change in the formulae. However, if an increase in the tax on labour earnings induced workers to earn money in the black economy and those earnings were then spent on taxed goods there would be smaller secondary losses than we have shown. A similar revision would be in order if the tax were perceived as temporary, and resulted in intertemporal substitution of labour, with use of savings to maintain current consumption.

5. In recent years there has been a substantial growth in cross-border trade, including smuggling, as consumers responded to price differentials between Northern Ireland and the Republic which were partly induced by taxation. In principle, there is no need to make any adjustment to take account of smuggling, as the estimated elasticities should already have taken account of this. However in fact the demand studies which we are quoting did not explicitly model substitution between taxed goods and smuggled imports, and they were based on demand patterns for the period before the cross-border trade became so widespread. Clearly, the availability of identical goods at a much lower price (adjusted for the busfare to the border plus some risk of smugglers being caught), will tend to increase the price elasticity of demand. That means that our estimates here of primary deadweight loss will tend to be underestimates.

6. Among the notes of caution which one should attach to this method of evaluation are the fact that the Murphy-Thom study relates only to consumption of nondurables, yet it assumes no savings out of income. Furthermore no account is taken of further leakages through smuggling and the black economy. Finally, the goodness of fit of integrated demand systems such as this still falls short of what would be required to predict the pattern of demands with confidence.
7. This is the compensating variation; we also computed equivalent variation and found little difference between the two measures in any case. Calculation of these quantities was an iterative procedure because of the need to work out the change in tax revenue, which also entered as a lump sum in the consumer's budget constraint.

8. We assumed a flat 40% income tax rate.

9. Since we did not take account here (we did in Section 1) of the secondary loss of taxation from the corrective part of the tax this underestimates the loss in the corrective tax case.

10. If the elasticity of demand for labour is not infinite, a full evaluation of welfare changes when tax proceeds are distributed would require an explicit modelling of the employer sector. The reason is that some of the tax burden will fall on the employers; redistributing that revenue to wage earners would increase their welfare only at the expense of that of the employers.


12. There has been a widespread neglect of this excess burden, indeed one detects an implicit view that growth in the domestic component of the National Debt, i.e. that part not owed to foreigners, involves virtually no net cost, but simply represents internal bookkeeping - the "what we owe ourselves doesn't matter" view. Neither of the two major studies on the National Debt (Bruton, 1978; FitzGerald, 1986) made any attempt to quantify the net cost of internal debt.
Figure 1
TAXATION AS % OF GNP 1979-87
Tax share of GNP relative to GNP per capita in 1983 dollars

Source: OECD Economic Outlook.
Deadweight losses in the labour market with wage setting behaviour.
Figure 4.

Deadweight losses in commodity markets.

$p^s$ is the undistorted equilibrium. $p$ is the gross of tax price. $p'$ is the price at the higher tax rate. The incremental deadweight loss from the tax increase is $ABCD$. 