

## The Marginal Social Cost of Taxation in Ireland\*

PATRICK HONOHAN

*University College, Dublin*

IAN IRVINE

*Concordia University, Montreal*

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*Abstract:* The purpose of this paper is to examine the deadweight losses associated with different forms of taxation in Ireland. Hitherto this aspect of the tax system has been neglected. We find that the high rates of taxation combined with the narrowness of the tax base lead to losses which are very high. Depending upon the assumptions made regarding redistribution of the revenue and the corrective content of the taxes, the losses are in the neighbourhood of one pound per pound of revenue raised at the margin.

### I INTRODUCTION

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*, in as much 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.

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Much of Government spending is for worthwhile purposes. In particular the redistributive role of Government spending (Murphy, 1983/84) 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 1 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 not 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 (*Irish Commission on Taxation* 1982; de Buitlear, 1983/84; National Economic and Social Council, 1986). 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 II discusses tax distortions in the labour market, under the simplifying assumption that the labour/leisure choice is separable from other expenditure

Figure 1: *Taxation as Per Cent of GNP, 1979-87*

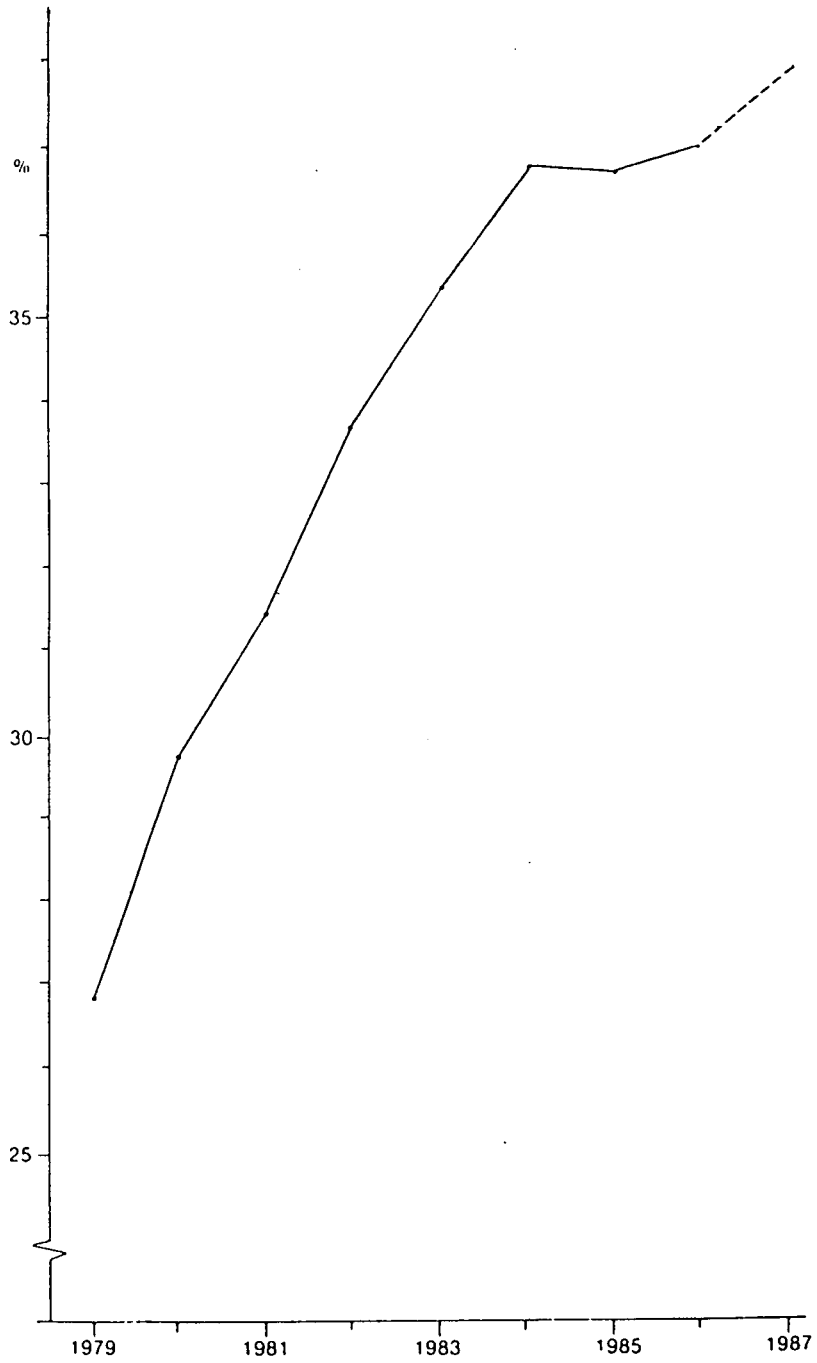
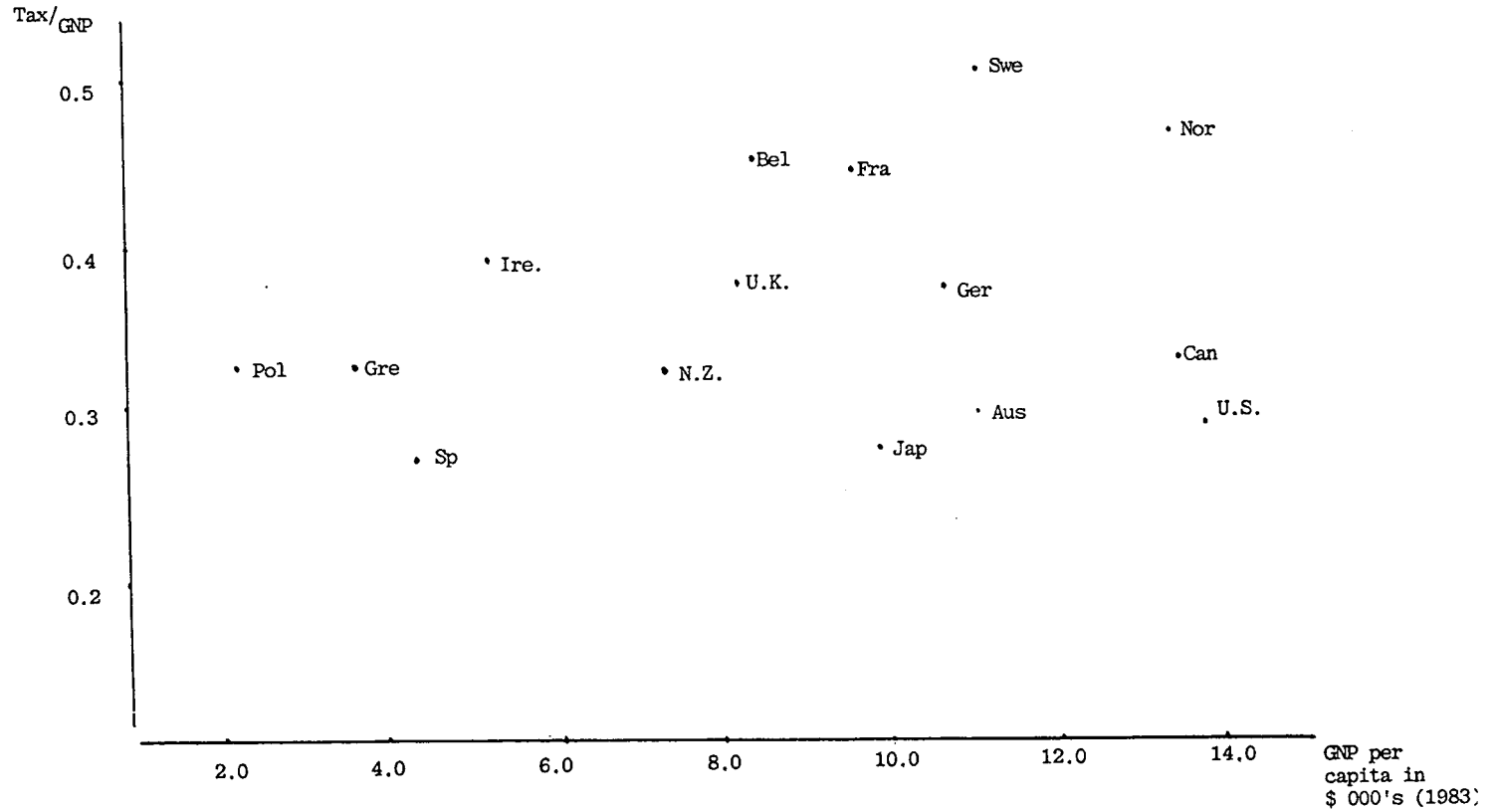


Figure 2: Tax Share of GNP Relative to GNP Per Capita in 1983 Dollars



Source: OECD Economic Outlook.

decisions. This part neglects the structure of indirect taxation (as opposed to its overall level). The innovative aspect of our approach is to examine the role played by wage-fixing behaviour. Part III shifts the emphasis to indirect taxation, and presents estimates of the excess burden of taxation based on previously published estimates of an integrated model of labour supply and commodity demands. Part IV is a discussion of some of the policy issues which arise. Part V offers some conclusions.

## II DISTORTIONS IN THE LABOUR MARKET

### (a) *The Problem in a General Equilibrium Context*

A conceptually attractive way to obtain estimates of the deadweight loss of taxation would be to compute the general equilibrium of the economy with and without taxation. After all, the interactions between different markets through patterns of substitution and complementarity are considerable, so that, to take a rather long chain of causality as an illustration, an increase in the tax on a consumer good might, through its impact on the supply of labour, result in a reduction in capital formation in, say, the mining industry.

The development of models in Ireland has not proceeded so far to allow the quantification of such effects. We must rely on a very simplified schema. One way would be to follow Stuart (1984) or Browning (1987) and impose a single sector general equilibrium model. The drawback here is that estimates of the key parameters of the utility and production functions in such an economy have not been the direct focus of much empirical work in Ireland.

Our approach is to use the best of existing empirical estimates for key relationships in the Irish economy. These allow us, working from a partial equilibrium perspective, to approximate the overall costs.

### (b) *The Labour Market*

Our approach to calculating the excess burden in the labour market is based on the simple idea of estimating the marginal loss in consumer plus producer surplus: i.e., in the gap between the supply and demand curve for labour. But there are other distorted markets and it is therefore essential, in measuring excess burden, to take account of the indirect effects in these other markets, following the methodology set out for this purpose in, for example, Boadway and Bruce (1984). (There is also a good account of the issues in Aaron and Pechman, 1981).

Ireland exhibits large measured unemployment which cannot easily be explained away by considerations of frictional or voluntary unemployment.

In order to encompass this unemployment in a simple model of demand and supply, we must either have a horizontal supply curve, or a failure of the wage to clear the market. In what follows we present some estimates of dead-weight loss based on a horizontal supply curve, but we also examine the possibility of market failure, specifically that due to union behaviour.

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).<sup>1</sup>

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,  $p^S(x)$ ; and the union determined supply price of labour,  $q(\cdot)$ , 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:

$$B = - \{ p^D(x) - p^S(x) \} dx/dt. \quad (1)$$

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

$$T = dtx/dt = x + t dx/dt = x - B. \quad (2)$$

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

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).

existing distortions have inserted between demand and supply price cannot be ignored.

*Case A: No union distortions*

(i) *Infinitely elastic supply.* 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,

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

and

$$dp^D(x)/dt = 1; \quad (3)$$

from which, noting that:

$$\frac{dp^D(x)}{dt} = \frac{\delta p^D(x)}{\delta x} \cdot \frac{\delta x}{\delta t}, \quad (4)$$

and writing  $\epsilon_D$  for the elasticity of demand for labour,

$$\epsilon_D = (p/x)(\delta x/\delta p^D(x))$$

we have,

$$dx/dt = 1/\{\delta p^D(x)/\delta x\} = x\epsilon_D/(w+t).$$

Thus, if,

$$\tau = t/w(w+t),$$

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

$$B = -x\tau\epsilon_D \quad (5)$$

Likewise, we easily obtain:

$$T = x(1 + \tau\epsilon_D). \quad (6)$$

So that,

$$B/T = -\tau\epsilon_D / (1 + \tau\epsilon_D) \quad (7)$$

(ii) *Supply not perfectly elastic.* There is a simple extension to the case of an upward sloping demand curve. In this case,

$$p^D(x) - p^S(x) = t$$

and,

$$dp^D(x)/dt - dp^S(x)/dt = 1.$$

Accordingly,

$$dx/dt = x / [(w+t)/\epsilon_D - w/\epsilon_S] = x\phi, \quad (8)$$

so that,

$$B/T = -t\phi / (1 + t\phi). \quad (9)$$

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.

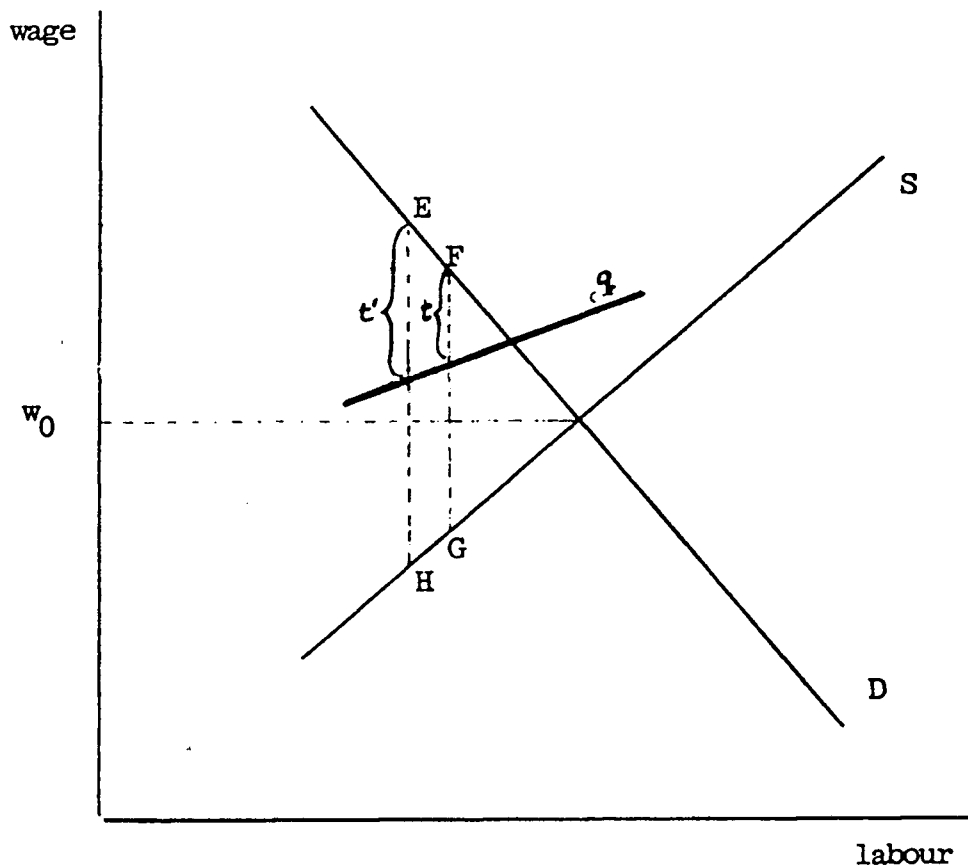
*Case B:* Effective supply price of labour determined by union

In order to address the possibility that the labour market does not clear, as is suggested by the empirical evidence already mentioned, the potential role of union-determined wages is explored. If unions set the wage higher, at  $q$ , than the market clearing wage, the marginal deadweight loss from taxation is greater than given by Equation (9). This is because the gap between the true supply price of labour and the demand price is now greater than the tax wedge. Each further reduction in the quantity of labour used (resulting from an increase in taxation) is therefore more costly.

Figure 3 illustrates the point: 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 non-union case (A) above can be taken as a special case of (B) by setting  $q(x) \equiv p^S(x)$ .



Figure 3: *Deadweight Losses in the Labour Market with Wage Setting Behaviour*

*New difficulties now arise in calculating the excess burden.* In the first instance, the gap  $(p^D - p^S)$  evaluated at the actual level of employment  $x$  is now greater than the tax  $t$  by an amount equal to the vertical distance  $(q - p^S)$ . Knowledge of this gap requires knowledge of the location as well as the slope of the true supply curve  $p^S$ , 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  $(p^D - p^S)$  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  $p^*$  for the worker displaced at the margin by an increase in tax will equal  $p^S(x)$ . (This might be called "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:

$$B = - \{p^D(x) - p^*\} dx/dt, \quad (10)$$

where,

$$w = q \geq p^* \geq 0.$$

If we knew how the rationing process allocated jobs as between high- and low-reservation wage workers, we could locate  $p^*$  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  $\epsilon_Q$ , we can adapt (8) to obtain:

$$dx/dt = x/[(w+t)/\epsilon_D - w/\epsilon_Q] \equiv x\psi, \quad (11)$$

from which we conclude that,

$$B/T = - (w+t-p^*)\psi(1 + t\psi). \quad (12)$$

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. Appendix 1 discusses the theoretical considerations allowing use of an upward sloping "as if" demand curve to model the behaviour of a monopolistic union.

### (c) *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

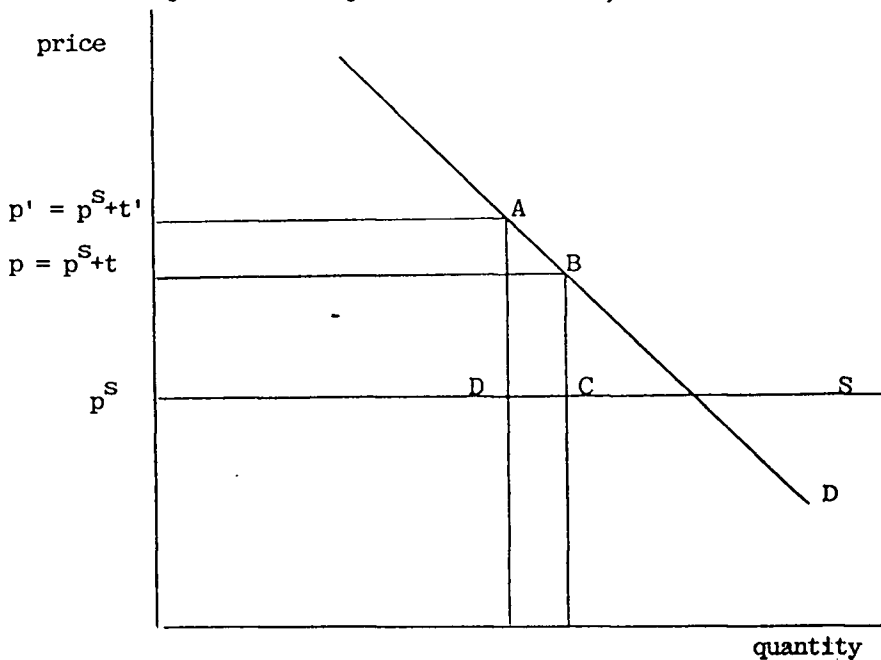
change in deadweight loss, but this may be positive or negative according as demand increases or falls. This point is discussed in Boadway and Bruce (1984). *If the proceeds of the tax are redistributed* (in lump sum form), we can calculate the change in spending on other markets  $\Delta$  as the change in the gross wage bill  $x p^D(x)$ . 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:

$$S' = \{p^D(x) + x \delta p^D(x) / \delta x\} \sigma dx/dt$$

$$= \{1 + 1/\epsilon_D(x)\} \sigma p^D(x) dx/dt. \tag{13}$$

with  $dx/dt$  given by (5), (8) and (11), respectively, for the three cases. Note that spending increases if the absolute value of  $\epsilon^D(x)$  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.

Figure 4: *Deadweight Losses in Commodity Markets*



Notes:  $p^S$  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.

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.<sup>2</sup> Instead of Equation (13), the secondary loss for no redistribution becomes:

$$\begin{aligned} S &= \{1 + 1/\epsilon_S(x)\} \sigma p^S(x) dx/dt > 0. \\ &= \{\sigma \tau \epsilon_D (1 + \epsilon_S)/(\epsilon_S - \tau \epsilon_D)\} x. \end{aligned} \quad (14)$$

(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  $B/T$ .

#### (d) 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:  $\tau$ ,  $\sigma$ ,  $\epsilon_D$  and  $\epsilon_S$  (or  $\epsilon_Q$ ). 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.<sup>3</sup>

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 supersede 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.

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 per cent, 48 per cent, and 58 per cent, with the higher rates applying at the margin to more than two in every five taxpayers; for incomes up to almost 1½ times average earnings there were also Social Insurance Contributions of as much as 7½ per cent for employees and over 12 per cent for employers. Using, for example, a 48 per cent marginal tax rate and the full rate of Social Insurance would lead to a value of  $\tau$  just over 60 per cent.

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). Specifically it is reasonable to assume that changes in the tax code affect marginal and average taxes proportionately.

International considerations would also point to an elasticity of demand in excess of unity. Indeed, 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  $\epsilon_D = \infty$ . 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 conclusion that an increase in payroll taxes was 50 per cent passed on, 50 per cent 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 4. On the other hand, Mroz (1987) has cast doubt on these larger estimates.

(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 show results for a selection of demand and supply elasticities.

We use an estimate of  $\sigma$ , at 0.40, which 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 1a shows the estimated value of  $(B+S)/(T-S)$ , while Table 1b, implicitly assuming that half of indirect taxation is corrective, shows  $(B+\frac{1}{2}S)/(B-S)$ . There is further discussion of corrective taxation below.

The tables reveal the rapid increase in deadweight losses as elasticities and tax rates increase. Bearing in mind the above remarks, we regard the estimates for  $\tau=0.4$  and 0.6, and both elasticities at 1.0 (highlighted in the tables) as being perhaps the most empirically realistic for Ireland. These imply an excess burden of between 92p and 2.68p in the £. The reader's own interpretation of the empirical literature may lead him/her to prefer some other cells in the table.

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 B), 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 a middle case:  $p^*=q/2$ . From the final panel of Table 1b, we see that for low true supply elasticities, the primary losses could go as high as £3.21 with realistic tax rates.

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

Table 1a: *Total Deadweight Loss per £ of Extra Tax (in £), Tax Proceeds Spent; Not Redistributed*

<i>Case A – Equation (9):</i>					
	$\epsilon_S =$	0.2	0.6	1.0	
(i) $\tau = 0.2$					
	$-\epsilon_D =$				
	0.6	0.27	0.21	0.20	
	1.0	0.39	0.33	0.32	
	$\infty$	1.13	3.76	—	
(ii) $\tau = 0.4$					
	$-\epsilon_D =$				
	0.6	0.53	0.50	0.50	
	1.0	0.72	0.84	0.92	
	$\infty$	1.59	—	—	
(iii) $\tau = 0.6$					
	$-\epsilon_D =$				
	0.6	0.89	0.99	1.01	
	1.0	1.27	2.13	2.68	
	$\infty$	3.55	—	—	
<i>Case B – Equation (12): <math>p^* = w/2</math></i>					
		$\tau =$	0.2	0.4	0.6
	$-\epsilon^D = \epsilon^S =$				
	0.2		0.16	0.28	0.40
	0.6		0.37	0.67	1.16
	1.0		0.62	1.28	3.21

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.<sup>4</sup>

Table 1b: *Total Deadweight Loss per £ of Extra Tax (in £), Tax Proceeds Spent; Not Redistributed. One-half of Expenditure Taxes are Corrective*

<i>Case A – Equation (9):</i>			
	$\epsilon_S = 0.2$	0.6	1.0
(i) $\tau = 0.2$			
$-\epsilon_D =$			
0.6	0.16	0.15	0.15
1.0	0.22	0.22	0.24
$\infty$	0.62	2.24	—
(ii) $\tau = 0.4$			
$-\epsilon_D =$			
0.6	0.33	0.36	0.38
1.0	0.45	0.60	0.70
$\infty$	0.97	—	—
(iii) $\tau = 0.6$			
$-\epsilon_D =$			
0.6	0.60	0.75	0.80
1.0	0.86	1.63	2.13
$\infty$	2.45	—	—
<i>Case B – Equation (12): <math>p^* = w/2</math></i>			
	$\tau = 0.2$	0.4	0.6
$-\epsilon^D = \epsilon^S =$			
0.2	0.12	0.19	0.28
0.6	0.31	0.53	0.92
1.0	0.53	1.06	2.66

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.

### III INTEGRATED LABOUR AND COMMODITY MARKETS

The discussion of the previous section provided no method of estimating the marginal deadweight loss of indirect taxes, though the existence of such taxes was not ignored. There is no guarantee that marginal deadweight losses would be the same for direct and indirect taxes, or even for indirect taxes on different commodities.

Once again elasticities of demand are important, and there are several earlier estimates (with consumption broken down into about seven categories), for example those of McCarthy (1977) and O'Riordan (1979). We prefer to use the recent estimates of Murphy and Thom (1987), because they simultaneously measured commodity demand and labour supply elasticities. If we are satisfied that the estimated parameters provide a realistic<sup>5</sup> picture of commodity demand and labour supply, we can use them to provide a complete picture of deadweight losses, without having to rely on assumptions of separability.<sup>6</sup> Readers are referred to Murphy and Thom's paper for a full account of their method and estimates including the various demand and labour supply elasticities which they estimated. We would caution that these parameters have not been estimated with great precision: the quantity of information which is sought from the data militates against this.

The Murphy and Thom (1987) estimates are based on the assumption that preferences can be represented by an expenditure function of the aggregable ("Gorman Polar") form:

$$C(w,p;U) = F(w,p) + G(w,p).U$$

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

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 to which we have referred 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 non-durables, 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 system such as this still falls short of what would be required to predict the pattern of demands with confidence.



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 ( $w'$  and  $p'$ ). Given an initial endowment  $E$  of time and non-wage income  $Y$ , Equation (15) can be solved for the base level of utility  $U$ :

$$U = [wE + Y - F(w,p)]/G(w,p). \quad (15)$$

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

$$C(w',p';U) = F(w',p') + [wE + Y - F(w,p)] G(w',p')/G(w,p). \quad (16)$$

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 £ of additional tax revenue immediately obtained as:<sup>7</sup>

$$B/T = [C(w',p';U) - w'E - Y - T]/T. \quad (17)$$

We need to use tax rates which are not readily available for the commodity breakdown on which the elasticity estimates are based. One particular problem is that the tax rates on specific goods differ widely even within a single commodity class, so that simple average tax rates may not be appropriate. Our approach has been to use judgment in arriving at typical tax rates for each commodity class, and these are presented in Appendix 2.

Computation of Expression (17) resulted in the deadweight losses shown in Table 2. Thus, if only income tax is raised,<sup>8</sup> 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  $\tau=0.4$  and  $\epsilon_D=\infty$  in Table 1. If a proportional increase<sup>9</sup> applies to expenditure taxes as well, deadweight losses per £ of extra revenue are somewhat lower.

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 per cent income tax rate.

9. That is a tax change that increased a 5 per cent rate to 6 per cent and a 50 per cent rate to 60 per cent. Alternative concepts of proportionality could include an increase that preserved the ratios of revenue from each tax, and one which increased each rate by the same number of percentage points.

It is desirable also, as discussed above, to provide estimates taking account of the possibility that alcohol and tobacco taxes are largely corrective, so that distortion of spending resulting from them does not impose a social cost. The commodity breakdown allows us to do this in a different manner to that adopted in the previous section. Thus, to get estimates for this case, we redo the calculations pretending that the tax rate on alcohol and tobacco is only 25 per cent. Then the deadweight loss falls, as shown by the asterisked rows in Table 2.<sup>10</sup>

For the no-distribution case we also computed deadweight losses for less than infinite elasticity of demand for labour.<sup>11</sup>

Table 2: *Deadweight Losses from Demand System in £ per £ of Extra Tax*

$-\epsilon_D =$	<i>Income Tax</i>	<i>All Taxes</i>	<i>Tax Proceeds Redistributed?</i>
$\infty$	1.73	1.44	no
$\infty^*$	1.54	1.34	no
2.0	1.23	1.25	no
1.0	0.96	1.13	no
0.5	0.67	0.96	no
$\infty$	1.21	0.83	yes
$\infty^*$	1.00	0.75	yes

\*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.

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

11. 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.

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 nor a 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. Abbot and Ashenfelter, 1976) 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. In so far 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. The second main qualification to the Ramsey rule is the potential for achieving redistributive 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.

### *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 elas-

ticities, 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 smuggling of alcohol between Ireland and Northern Ireland 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 bringing 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 the short run the supply elasticity of residential property 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 various sources,<sup>12</sup> that a tax rate of as little as 10 per cent on an imputed income from residential property could raise up to 5 per cent of total tax revenue (say, £300 million). Some simple calculations along the lines of Equation (9) confirm that shifting some of revenue collection to this market would reduce the overall excess burden; with much lower marginal losses even at a tax rate of 10 per cent.

12. Irish Central Statistics Office (1986) and Irish Department of the Environment (1986).

## V 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 per cent of total tax revenue at present. Our estimates of deadweight losses from raising tax in both labour and commodity markets give figures ranging to 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: we have indicated our preferred estimates. 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. (As we have pointed out, the marginal deadweight cost of taxation increases as taxation increases. Therefore the average cost falls below the marginal.)

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. In such a case, the net change in welfare resulting from the combination of tax and spending can be positive. But most of what can be regarded as the marginal public expenditure does not have this strongly redistributive

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.<sup>13</sup> 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. 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 point has already been made, for example, by the Commission on Taxation (1982). There ought to be an extension of the tax base, as has been widely advocated (cf. National Economic and Social Council). We have suggested, as an example of such beneficial widening of the base, the reintroduction of taxation of residential property. Though the long-run elasticity of supply of reproducible property is certainly non-zero, 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.

But property taxation is not the only measure available. The policy agenda is clear, our contribution has been to attempt to measure the gains to be made.

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13. 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.

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#### APPENDIX 1: An "As If" Supply Function for a Monopolistic Union

1. It may 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, a 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  $q = p^D(x) - t$ . A variety of other union behaviours would also support this optimisation problem. An internal optimum will satisfy:

$$(\delta p^D(x)/\delta x) \pi(x) + [p^D(x) - t] \delta \pi(x)/\delta x = 0,$$

or, writing  $\alpha$  for the elasticity of the function  $\pi$ ,

$$t = p^D(x) \{1 + (\alpha \epsilon_D)^{-1}\}. \quad (\text{A.1})$$

Taking  $\alpha$  to be constant, we may infer from (A.1) that in this case,

$$dx/dt = \{x/(w+t)\} \epsilon_D / [1 - (\alpha \epsilon_D)^{-1}] \equiv x \psi^*. \quad (\text{A.2})$$

This provides an alternative expression to Equation (11), and  $\psi^*$  can be substituted for  $\psi$  in Equation (12). Note also, however, that Equation (A.2) may be written:

$$dx/dt = x / [(w+t)/\epsilon_D - w / \{(w/(w+t)) \alpha \epsilon_D^2 / \}], \quad (\text{A.3})$$

suggesting, by analogy with Equation (11), an “as if” union supply curve with elasticity  $\{(w/(w+t)) \alpha \epsilon_D^2 / \} > 0$ . 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.

## APPENDIX 2: *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 (typical bar price)	85
£3.50 bottle wine	140
Cigarettes (typical retail price)	288

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

*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 per cent rate. TVs carry an additional excise duty. We use a 25 per cent rate.

*Transport and Communication.* In March 1986 the total tax rate on a litre of premium gasoline was 158 per cent. On a motor vehicle, the rate was 138 per cent. On the other hand, bus and especially train, travel is heavily subsidised. Telephone charges are zero rated. In Section II, only non-durables are modelled, and we use a rate of 50 per cent.

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