# The Marginal Cost of Public Funds

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The marginal cost of public funds is the direct tax burden plus the marginal welfare cost produced in acquiring the tax revenue. This paper estimates that the marginal cost of public funds for taxes on labor income in the United States ranges from \$1.09 to \$1.16 per dollar of tax revenue, depending on the progressivity of the change in the tax structure. Thus, government expenditures must be at least 9–16 percent more productive than private expenditures to produce a net welfare gain. In addition, the total welfare cost of income taxes in 1974 is estimated at \$19 billion.

Taxes introduce distortions in the allocation of resources, and much theoretical and empirical work in economics has been devoted to analyzing and estimating the welfare costs (or excess burdens) of the variety of taxes in existence. Very little attention has been given, however, to the significance of the welfare cost of taxation for the analysis of public expenditure programs. If the financing of expenditure programs involves a welfare cost, then this cost should be considered part of the opportunity cost of the expenditure programs. Put briefly, when the government spends \$100, the opportunity cost is \$100 plus the additional welfare cost involved in acquiring the funds. Thus, an expenditure program will be efficient only if its benefits exceed the direct tax cost by an amount at least as large as the additional welfare cost of the funds.

A number of economists have, of course, recognized the importance of considering (in some way) the welfare cost of taxation in analyzing government expenditures. Pigou (1947) mentioned this point many years ago, and more recently Buchanan and Tullock (1965), Vickrey (1963),

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and Johnson and Pauly (1969) have discussed this aspect of tax-induced distortions. In addition, in his survey of cost-benefit analysis, Musgrave (1969) has suggested that Harberger's estimates of the average welfare costs of taxes on labor and capital should be added to the direct costs of taxes.[1] The present paper builds on the insights of these works by examining the problem of measuring the marginal cost of public funds. Section 1 develops the basic theory for an economy using a tax on labor income to finance government expenditures. In Section 2 estimates for taxes on labor income in the United States tax system are developed. The results suggest that the marginal cost of public funds is between \$1.09 and \$1.16 per dollar of tax revenue.

## 1. The Marginal Welfare Cost of Income Taxation

We shall assume an economy with a competitive private sector where the government uses a tax on labor income to finance its expenditure programs. Taxes on labor income distort the labor supply decisions of workers, and the problem is to determine exactly how this distortion should be incorporated into an analysis of government expenditures. It will be assumed that the expenditure programs themselves do not distort labor supply decisions at the margin—that is, they can be viewed as lump sum transfers.[2] This simplifying assumption allows us to concentrate on the tax-induced distortions and ignore possible differential effects resulting from the specific way the tax revenue is used.

A tax on labor income with a marginal tax rate of $m_i$ lowers a worker's net wage rate from $w$, the market wage rate, to $w(1 - m_i)$. As a consequence, the quantity of labor services supplied will be below the quantity the worker would supply with a tax which did not distort his labor supply decision. Figure 1 illustrates this situation. The worker's supply curve is $S$, and is drawn to include only substitution effects of wage rate changes. With a marginal tax rate of $m_i$, $L_2$ units of labor are supplied. By supplying $L_2$ units rather than $L_1$ units the worker sacrifices earnings of $BAL_1L_2$ and gains leisure time valued at $DAL_1L_2$. The difference, area $BAD$, is the total welfare cost of the tax.

If the government were to implement a new expenditure program, or expand an existing one, it must raise additional revenue. Suppose the

[1] Musgrave errs, however, in suggesting the use of average welfare cost per dollar of revenue since it is the marginal welfare cost that is relevant for cost-benefit analysis. As will be shown below, marginal welfare costs of taxes are typically much larger than average welfare costs.

[2] In some cases, particularly those involving redistribution, this assumption would not be valid. For example, when the income tax is used to finance transfers of a negative income tax variety, the marginal tax rates of both taxpayers and recipients will rise. This distorts the labor supply decisions of both groups, and an analysis of such a policy should ideally evaluate both distortions. I have attempted to do this in Browning (1975*b*).

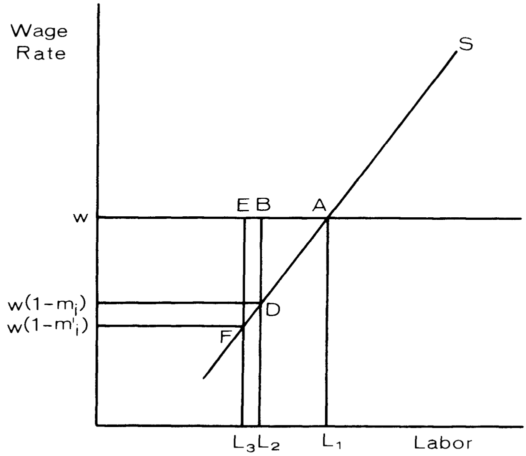


FIG. 1

revenue requirements necessitate an increase in the marginal rate from $m_i$ to $m_i'$. Then the marginal welfare cost of this increment in the tax rate is the area *BEFD*. Thus, the cost associated with the new expenditure program is clearly the direct burden of the higher tax rate—the amount of revenue raised—plus the added distortion, area *BEFD*. (In addition, there may be additional administrative and compliance costs, but they will be ignored in this section.) If economic efficiency is the criterion for judging the expenditure program, then its benefits must exceed the required revenues plus area *BEFD*. Clearly, neither the total welfare cost nor the average welfare cost of the tax is really relevant in evaluating expenditure programs; instead it is the marginal welfare cost that is critical.

The size of the marginal welfare cost is, then, of great importance in the evaluation of government expenditures. Harberger's pioneering work in this area provides the basis for evaluating this cost for income taxation. Harberger (1964) shows that the total welfare cost for an individual worker can be expressed as:

$$W_i = \tfrac{1}{2}\eta(m_i)^2 Y_i, \tag{1}$$

where $W_i$ is the total welfare cost, $m_i$ is the marginal tax rate, $\eta$ is the elasticity of labor supply (expressing the substitution effect alone), and $Y_i$ is gross labor income, or earnings.[3] Now let us assume that the tax is a proportional tax on labor income ($m_i$ is thus the same for all taxpayers

[3] This expression measures only the welfare cost due to the distortion in the worker's decision concerning hours of work. An income tax also distorts occupational choice by inducing a substitution in favor of jobs with nonpecuniary advantages. Thus, estimates of welfare costs using equation (1) will be biased downward to some degree.

and is equal to the average tax rate), and that the elasticity of labor supply is the same for all workers. Then the total welfare cost aggregated over all workers is:

$$W = \tfrac{1}{2}\eta m^2 \sum Y_i, \tag{2}$$

where $\sum Y_i$ is total labor income.[4]

With a proportional tax, total tax revenue, $T_p$, can be expressed as:

$$T_p = m \sum Y_i. \tag{3}$$

Assuming that the tax base, $\sum Y_i$, is not affected by a small change in the tax rate, the additional welfare cost produced by a change in the tax rate is:

$$dW = \eta m \sum Y_i \, dm, \tag{4}$$

and the additional revenue produced is:

$$dT_p = \sum Y_i \, dm. \tag{5}$$

The marginal welfare cost per dollar of revenue is then equation (4) divided by equation (5), or:

$$dW/dT_p = \eta m. \tag{6}$$

The marginal cost of public funds is the marginal welfare cost of taxation plus the direct cost, or simply $\eta m + 1$.[5] Note that the marginal welfare cost is greater than the average welfare cost. The average welfare cost is equal to $W/T_p$, or $\tfrac{1}{2}\eta m$, exactly half the marginal welfare cost.

To get some feeling for the likely quantitative importance of the marginal welfare cost of income taxation, let us assume some plausible values for $\eta$ and $m$. On the basis of recent empirical work, it appears that

[4] The summation of individual welfare costs as given by (1) to derive the total welfare cost as given by (2) is not fully appropriate unless the marginal product of labor does not decline with a simultaneous increase in hours of work by all workers. In other words, expression (2) is valid only if the aggregate demand curve for longer hours of work per worker is perfectly elastic. If this is not true, the correct formula is $\tfrac{1}{2}[\eta\varepsilon_d/(\eta + \varepsilon_d)]m^2 \sum Y_i$, where $\varepsilon_d$ is the elasticity of this demand curve. Estimates based on equation (2) when demand is less than perfectly elastic are therefore biased upward. However, for low values of $\eta$ (as will be assumed in this study), this bias is not very large. For example, with $\eta = 0.20$ and $\varepsilon_d = 2.0$, equation (2) will overestimate the true welfare cost due to labor supply distortions by only 10 percent. In addition, there is an opposite bias involved in using equation (2), as noted in the previous footnote, so the net bias is not clear.

[5] In this derivation it was assumed that the tax base did not change in response to a change in the tax rate. If this assumption is dropped, the marginal welfare cost equals $\eta m/\varepsilon + 1$, where $\varepsilon$ is the elasticity of the tax base with respect to a change in the tax rate. Thus, equation (6) will underestimate the marginal welfare cost if the tax base falls ($\varepsilon < 0$) and overestimate the marginal welfare cost if it rises ($\varepsilon > 0$) when the tax rate is increased. Since there is no empirical basis for assigning a value to $\varepsilon$, it will simply be assumed that it is zero in this paper.

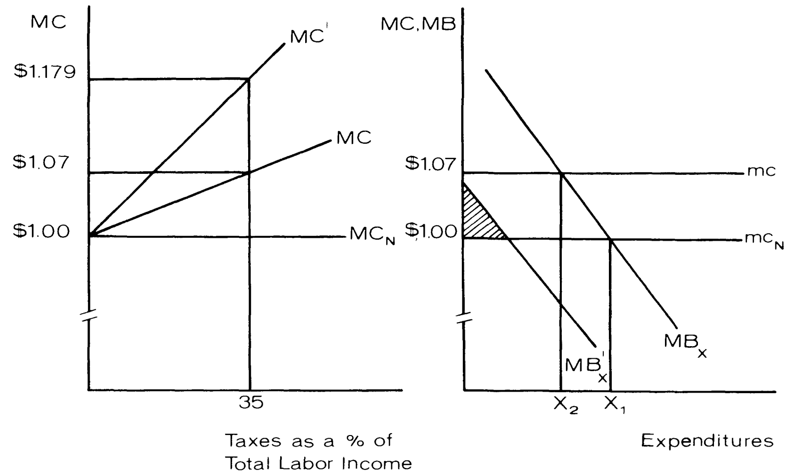


FIG. 2

a value for $\eta$ of 0.20 is a fairly conservative estimate.[6] Since total taxes as a percentage of net national product are about 35 percent in the United States, a value for $m$ of 0.35 will be used. Given these values, the marginal welfare cost is 7 percent of tax revenue, and hence the marginal cost of public funds is 107 percent, or $1.07 per dollar of revenue. Thus, government expenditures would have to be 7 percent more beneficial (at the margin) than private expenditures for the programs to constitute a net welfare gain.

Figure 2 can conveniently summarize the analysis to this point. In the left-hand panel, the marginal cost of public funds is measured vertically and taxes as a percentage of total labor income measured horizontally. The $MC$ curve gives the marginal cost of public funds for a flat rate tax on total labor income. At a tax rate of 35 percent, the marginal cost per dollar of additional revenue is equal to $1.07, as just indicated. The vertical difference between $MC$ and $MC_N$ (the marginal cost of public funds with nondistorting taxes) is the marginal welfare cost per dollar of tax revenue.

The right-hand panel of figure 2 shows how the marginal cost of public funds should be incorporated into an analysis of expenditure programs. The central point here is that the marginal cost of public funds for any specific expenditure program is constant at a level determined by the overall weight of taxes in the economy. Thus, when $m = 0.35$, the

[6] See Bloch (1973) and Cain and Watts (1973). Most recent research has emphasized that labor supply elasticities vary among demographic groups. Insofar as this is true, $\eta$ should be interpreted as a weighted average of the elasticities of different groups. Interpreted in this way, I think the assumption of a value of 0.20 is quite conservative.

marginal cost for *all* expenditure programs is \$1.07 since we may assume that no individual program is large enough to affect the marginal tax rate significantly; the marginal tax rate reflects the combined effect of all tax-financed expenditures, and it is imperceptibly affected by any single expenditure. (For an appropriate analogy, the $MC$ curve may be likened to an upward sloping industry supply curve, while the $mc$ curve is akin to the horizontal supply curve confronting an individual purchaser.)

If the marginal benefits of spending on program $X$ are given by $MB_X$, then the efficient level of expenditures with a proportional income tax is $X_2$, a lower level than if expenditures were financed with distortionless taxes ($X_1$). If the marginal benefit curve is $MB'_X$, then the efficient level of expenditures is zero. Thus, even though there is a potential gain from government spending (given by the shaded area), that gain cannot be realized if the distorting income tax must be used as a method of finance. This conclusion has immediate relevance for the various "market failure" (e.g., externality) arguments for government expenditures. What the present analysis shows clearly is that the presence of a market failure does not necessarily imply that any expenditure program exists which will produce a net welfare gain. Instead, the magnitude of the market failure must exceed some critical value (as determined by the marginal cost of public funds) before an expenditure program can be capable of achieving a net gain.

We may now consider how the use of nonproportional income taxes affects the analysis. As an illustration, we will use the simplest form of progressive taxation—a degressive tax. A degressive tax is a flat rate tax above an exemption. Thus, the marginal tax rate is the same for all taxpayers, but average tax rates rise with total income, and the tax is progressive overall. With such a tax, the total welfare cost is given by:

$$W = \tfrac{1}{2}\eta m^2 \sum_n Y_i, \qquad Y_i > K, \tag{7}$$

where $\sum_n Y_i$ is the total income of those subject to the tax, and $K$ is the amount of exempted income per taxpayer. Total tax revenue is:

$$T_D = m \sum_n (Y_i - K), \qquad Y_i > K. \tag{8}$$

Differentiating (7) and (8) and dividing yields the marginal welfare cost per dollar of revenue:

$$dW/dT_D = \eta m \frac{\sum_n Y_i}{\sum_n (Y_i - K)}. \tag{9}$$

A comparison of equations (9) and (6) shows that the marginal welfare cost of a degressive tax is greater than that of a proportional tax yielding the same total revenue. There are two reasons for this. First, the marginal tax rate must be higher for the degressive tax when both taxes yield the same total revenue since the tax base of the degressive tax is smaller. (The marginal tax rate of the degressive tax will be equal to

$$\frac{\sum_n Y_i}{\sum_n (Y_i - K)}$$

times the marginal tax rate of the proportional tax.) Second, the increment in the marginal tax rate required to raise additional revenue is greater for the degressive tax because of the smaller tax base. This is reflected in (9) by the term

$$\frac{\sum_n Y_i}{\sum_n (Y_i - K)},$$

which is always greater than one. These two factors together imply that the marginal welfare cost of the degressive tax can be expressed as the marginal welfare cost of the proportional tax times

$$\left[\frac{\sum_n Y_i}{\sum_n (Y_i - K)}\right]^2.$$

The squared term always exceeds one for a degressive tax, and will be greater the larger is the exemption.

Even with a seemingly small exemption, the marginal welfare cost of a degressive tax will be substantially above that of a proportional tax. If, for example, the exemption is equal to 40 percent of average income, the tax base of the degressive tax would be about 62.5 percent of the tax base of the proportional tax, and

$$\frac{\sum_n Y_i}{\sum_n (Y_i - K)}$$

would equal 1.6.[7] To raise 35 percent of total income in taxes would then require a marginal tax rate of 56 percent. Inserting these values into (9) and solving yields a marginal welfare cost of 17.9 percent of tax revenue. (The marginal cost of public funds with the degressive tax is shown by $MC'$ in fig. 2.) Thus, the marginal welfare cost of this degressive tax is 2.5 times larger than that of a proportional tax yielding the same revenue. The important implication of this for expenditure policy is that expenditures should be smaller with a degressive income tax than with a proportional income tax. In general, the more progressive the tax the greater is the marginal cost of public funds, and the lower is the efficient volume of government expenditures.

To this point we have considered taxes that impose the same marginal

[7] This is a rough figure calculated from data in U.S. Bureau of the Census (1973, table 2).

tax rate on all taxpayers. When a tax with a graduated rate structure is employed each rate bracket is subjected to a different marginal tax rate, and each bracket must then be considered separately. A more difficult problem posed by graduated rate taxes arises because additional revenue can be raised by many different changes in the rate structure, and each possible change may correspond to a different marginal welfare cost. Unlike the proportional and degressive taxes, there is no rule inherent in a graduated rate tax that specifies how changes in revenue are to be accomplished. Of course, for any specified method of raising additional revenue the marginal welfare cost can be estimated, as will be seen in the next section.

The analysis in this section has provided some insight into the concept of marginal welfare cost and its relation to the income tax structure. In the next section we will derive estimates of the marginal welfare cost (and, hence, the marginal cost of public funds) for the United States income tax structure.

## 2. Application to the U.S. Tax System

A major difference between the U.S. tax system and the model used in the last section is that there are several different taxes that are levied on labor income in the United States. The federal individual income tax is obviously the most important, but the social security payroll tax, state income taxes, and other taxes also distort labor supply decisions in the same way. This fact necessitates a slight modification in the analysis developed in the last section. If we have two taxes which are levied on labor income at marginal rates of $m_1$ and $m_2$, the total welfare cost for an individual is:

$$W_i = \tfrac{1}{2}\eta(m_1 + m_2)^2 Y_i. \tag{10}$$

Thus, the total welfare cost, and the marginal welfare cost, will depend on the effective marginal tax rate on income, $m_1 + m_2$ in the above example. In this setting it is ambiguous to speak of the total welfare cost of one tax alone since $\tfrac{1}{2}\eta(m_1)^2 Y_i + \tfrac{1}{2}\eta(m_2)^2 Y_i$ does not equal the total welfare cost of the two taxes together. However, the total welfare cost of both taxes together can be estimated by (10), and the marginal welfare cost of a change in either tax can also be estimated without ambiguity.

To estimate the marginal cost of public funds it is necessary to have the set of effective marginal tax rates implicit in the tax system and the total labor income subject to each effective rate. Total wage and salary income by marginal tax bracket in the federal individual income tax is available from the Treasury tax model.[8] We require in addition the increments in

[8] I would like to thank Frederick Hickman and Walter Stromquist of the Treasury Department for making this information available.

marginal tax rates for each federal bracket due to the other taxes on labor income so these increments can be added to the federal rates to arrive at the effective marginal tax rates. There are four major taxes other than the federal income tax that distort labor supply decisions: social security payroll taxes,[9] state and local sales taxes, state and local income taxes, and excise taxes.[10] These taxes raised $148 billion in revenue in 1973, and this represented an *average* tax rate of 18.8 percent on total employee compensation (Council of Economic Advisers 1975). It would, however, be an error to simply interpret this 18.8 percent figure as the effective marginal increment for every federal tax bracket.

Three important factors suggest that the increment in marginal tax rates due to these other taxes will vary among the federal tax brackets. First, the social security payroll tax applies only to the first $14,100 of earnings of each worker. Therefore, for workers earning above this ceiling the marginal rate of the payroll tax is zero.[11] Second, most state and local income taxes are highly progressive. Third, state and local taxes are deductible in computing federal tax liability. This third factor makes the effective marginal tax rate less than the sum of the federal and state-local rates. For example, a person in a 50 percent federal bracket and a 10 percent state income tax bracket is subject only to an effective marginal tax rate of 55 percent because of this deductibility provision in the federal law.

These factors suggest that, on balance, the increments in marginal tax rates due to these taxes will be lower the higher the federal tax rate. Table 1 shows estimates of the incremental marginal tax rates in column 2 for each federal tax bracket (column 1).[12] (Note that the highest federal rate is 50 percent due to the recently enacted maximum tax on earned

[9] It is assumed that social security benefits are not closely related to previous taxes paid. If they are, social security taxes may produce no labor supply distortion. On this point, see Browning (1975*a*).

[10] Excise taxes are not identical to general taxes on labor incomes, but they do distort the choice between leisure and the taxed goods (and also between taxed and untaxed goods). In theory, an excise tax may lead to greater, less, or the same work effort as an equal yield income tax. In the absence of evidence to the contrary, it seems preferable to assume that excises have the same effect on work effort than to ignore them altogether. Ignoring them, however, would make little difference to the estimates made here since they represent only 2 percent of total employee compensation.

[11] It would be incorrect to infer that the labor supply decisions of all *families* with earnings above $14,100 are unaffected by the social security tax. Not only may such families have multiple earners, one or both of whom are subject to the tax at the margin, but also the labor supply decisions of unemployed family members may be influenced by the tax. For example, a wife may choose not to work partly because of the social security taxes she would have to pay on the first $14,100 of her earnings.

[12] Interpreting these marginal rates as effective rates of taxation is not fully correct when some uses of income are not subject to tax because of the deductions permitted in the tax law. Deductions serve to lower the effective rate of earnings, but they also introduce distortions in the use of income so the net effect on welfare cost is theoretically indeterminate.

TABLE 1

TOTAL WELFARE COST BY MARGINAL RATE CLASS IN 1974

| Marginal Rate in Federal Income Tax ($m_i^F$) (%) (1) | Increment Due to Other Taxes (%) (2) | Effective Marginal Tax Rate ($m_i$) (%) (3) | Wage and Salary Income in Class ($ millions) (4) | Total Welfare Cost by Rate Class ($ millions) (5) | Total Welfare Cost by Rate Class Using ($m_i^F$) ($ millions) (6) |
|---|---|---|---|---|---|
| 14 ........ | 20 | 34 | 27,603 | 319.1 | 54.1 |
| 15 ........ | 20 | 35 | 17,443 | 213.7 | 39.2 |
| 16 ........ | 20 | 36 | 20,430 | 264.8 | 52.3 |
| 17 ........ | 19 | 36 | 24,485 | 317.3 | 70.8 |
| 18 ........ | 19 | 37 | 5,405 | 74.0 | 17.5 |
| 19 ........ | 19 | 38 | 146,828 | 2,120.2 | 530.0 |
| 21 ........ | 18 | 39 | 21,782 | 331.3 | 96.1 |
| 22 ........ | 18 | 40 | 148,265 | 2,372.2 | 717.6 |
| 23 ........ | 18 | 41 | 3,857 | 64.8 | 20.4 |
| 24 ........ | 17 | 41 | 21,340 | 358.7 | 122.9 |
| 25 ........ | 17 | 42 | 121,023 | 2,134.9 | 756.4 |
| 27 ........ | 16 | 43 | 8,577 | 158.6 | 62.5 |
| 28 ........ | 16 | 44 | 59,426 | 1,150.5 | 465.9 |
| 29 ........ | 15 | 44 | 4,688 | 90.8 | 39.4 |
| 31 ........ | 15 | 46 | 3,858 | 83.6 | 37.1 |
| 32 ........ | 14 | 46 | 32,469 | 687.0 | 332.5 |
| 34 ........ | 14 | 48 | 1,705 | 39.0 | 19.7 |
| 35 ........ | 13 | 48 | 224 | 5.2 | 2.7 |
| 36 ........ | 13 | 49 | 18,884 | 453.4 | 244.8 |
| 38 ........ | 12 | 50 | 936 | 23.4 | 13.5 |
| 39 ........ | 12 | 51 | 10,556 | 274.6 | 160.6 |
| 40 ........ | 11 | 51 | 1,098 | 28.6 | 17.6 |
| 41 ........ | 10 | 51 | 67 | 1.7 | 1.1 |
| 42 ........ | 9 | 51 | 7,066 | 183.8 | 124.6 |
| 45 ........ | 8 | 53 | 5,446 | 153.0 | 110.3 |
| 48 ........ | 7 | 55 | 3,403 | 103.3 | 78.4 |
| 50 ........ | 6 | 56 | 24,842 | 779.0 | 621.1 |
| Total ... | ... | ... | 741,706 | 12,786.8 | 4,809.1 |

income.) While these estimates are, admittedly, inexact, I think they are probably reliable enough for our purposes.

Column 3 gives the effective marginal tax rates and column 4 the total wage and salary income in each marginal rate class. Before we turn to the estimation of the marginal welfare cost, it is interesting to use these data to compute the total welfare cost due to labor supply distortions arising from taxes on labor income. Column 5 gives the total welfare cost for each tax bracket; in making these calculations it was assumed, as earlier, that $\eta = 0.20$ and is the same for all rate classes. Summing the figures in column 5 gives the total welfare cost due to labor supply distortions in 1974: $12.8 billion. This figure does not include the welfare cost borne by those who did not pay federal income taxes (but who still paid social security and other taxes), and adjusting for this omission would probably raise the total above $13 billion. In addition, government administrative costs and citizen compliance costs are also elements of the welfare cost that should be added. Musgrave and Musgrave (1973, p. 460) suggest that (at least at the federal level) these costs are 2–2.5 percent of tax revenue. Since the taxes under consideration here produced about $287 billion in revenue in 1974, administrative and compliance costs can be estimated at approximately $6 billion. Thus, the total welfare cost of these taxes was in the neighborhood of $19 billion in 1974, or 6.6 percent of tax revenue.

The data in table 1 can also be used to demonstrate the importance of using the effective marginal tax rates in the computations. Harberger (1964), when examining the welfare cost of the federal income tax, used only the marginal rates of the federal tax in his calculations. As mentioned earlier, this procedure is incorrect when there are other taxes on labor incomes, but the results of such a calculation do serve to suggest the importance of considering all taxes together. Column 6 uses the marginal rates of the federal income tax to estimate the total welfare cost at $4.8 billion, far below the $12.8 billion estimate when the effective tax rates are used in the calculation. Since the total welfare cost varies with the square of the effective marginal tax rate, ignoring even a small part of the effective rate can lead to substantial underestimation of the total welfare cost. The "cumulative tax rate" problem that has been emphasized in connection with welfare programs is clearly also of considerable importance in the analysis of tax programs.[13]

Turning now to the estimation of marginal welfare costs, we shall consider three changes in the tax structure corresponding to the proportional, degressive, and graduated rate taxes considered in the last section. To estimate the marginal welfare cost of a proportional tax that is added to the present system we cannot simply apply equation (6) of the last section since that equation was derived on the simplifying assumption that the initial marginal tax rates were the same for all taxpayers. The appropriate formula for the case when taxpayers are in different initial rate classes, however, is easily derived. The total welfare cost is:

$$W = \tfrac{1}{2}\eta(m_1)^2 \sum_j Y_{lj} + \tfrac{1}{2}\eta(m_2)^2 \sum_k Y_{2k} + \cdots, \qquad (11)$$

where $m_1$ is the effective marginal tax rate in the first marginal rate class and $\sum_j Y_{lj}$ is the total labor income in that bracket, and so on for the other brackets. Then

$$dW = \eta m_1 \sum_j Y_{1j}\, dm_1 + \eta m_2 \sum_k Y_{2k}\, dm_2 + \cdots, \qquad (12)$$

[13] The "cumulative tax rate" effect refers to the fact that recipients of transfers from several different welfare programs, each with its own implicit marginal tax rate, will often be subjected to a very high combined, or effective, tax rate. The same phenomenon occurs for taxpayers who pay several different taxes, and it is the effective marginal rate that is relevant in analyzing the taxpayers' reactions. A good discussion of the cumulative tax rate problem in existing welfare programs can be found in Aaron (1973).

TABLE 2

Marginal Welfare Cost: Various Changes in Tax Structure (%)

| Proportional Tax | | | Degressive Tax | | Progressive Tax | |
|---|---|---|---|---|---|---|
| $m_i$ (1) | $\eta m_i$ (2) | $\eta m_i \frac{\sum_j Y_{ij}}{\sum Y_i}$ (3) | $\frac{\sum_j Y_{ij}}{\sum (Y_i - K)}$ (4) | $\eta m_i \frac{\sum_j Y_{ij}}{\sum (Y_i - K)}$ (5) | $\frac{m_i^F}{r^F}$ (6) | $\eta m_i \left[\frac{\sum_j Y_{ij}}{\sum (Y_i - K)}\right] \frac{m_i^F}{r^F}$ (7) |
| 34 ... | 6.8 | 0.253 | 6.06 | 0.413 | 64.5 | 0.266 |
| 35 ... | 7.0 | 0.164 | 3.83 | 0.268 | 69.1 | 0.185 |
| 36 ... | 7.2 | 0.198 | 4.49 | 0.323 | 73.7 | 0.238 |
| 36 ... | 7.2 | 0.238 | 5.38 | 0.387 | 78.3 | 0.303 |
| 37 ... | 7.4 | 0.054 | 1.19 | 0.089 | 82.9 | 0.074 |
| 38 ... | 7.6 | 1.505 | 32.23 | 2.449 | 87.6 | 2.145 |
| 39 ... | 7.8 | 0.229 | 4.78 | 0.373 | 96.8 | 0.361 |
| 40 ... | 8.0 | 1.599 | 32.55 | 2.604 | 101.4 | 2.640 |
| 41 ... | 8.2 | 0.043 | 0.85 | 0.070 | 106.0 | 0.074 |
| 41 ... | 8.2 | 0.236 | 4.68 | 0.384 | 110.6 | 0.425 |
| 42 ... | 8.4 | 1.371 | 26.57 | 2.232 | 115.2 | 2.571 |
| 43 ... | 8.6 | 0.100 | 1.88 | 0.162 | 124.4 | 0.202 |
| 44 ... | 8.8 | 0.705 | 13.05 | 1.148 | 129.0 | 1.481 |
| 44 ... | 8.8 | 0.055 | 1.03 | 0.091 | 133.6 | 0.122 |
| 46 ... | 9.2 | 0.048 | 0.85 | 0.078 | 142.9 | 0.111 |
| 46 ... | 9.2 | 0.403 | 7.13 | 0.656 | 147.5 | 0.968 |
| 48 ... | 9.6 | 0.022 | 0.37 | 0.036 | 156.7 | 0.056 |
| 48 ... | 9.6 | 0.003 | 0.05 | 0.005 | 161.3 | 0.008 |
| 49 ... | 9.8 | 0.250 | 4.15 | 0.407 | 165.9 | 0.675 |
| 50 ... | 10.0 | 0.013 | 0.21 | 0.021 | 175.1 | 0.037 |
| 51 ... | 10.2 | 0.145 | 2.32 | 0.237 | 179.7 | 0.426 |
| 51 ... | 10.2 | 0.015 | 0.24 | 0.024 | 184.3 | 0.044 |
| 51 ... | 10.2 | 0.001 | 0.01 | 0.001 | 188.9 | 0.002 |
| 51 ... | 10.2 | 0.097 | 1.55 | 0.158 | 193.5 | 0.306 |
| 53 ... | 10.6 | 0.077 | 1.20 | 0.127 | 207.4 | 0.263 |
| 55 ... | 11.0 | 0.051 | 0.75 | 0.083 | 221.2 | 0.184 |
| 56 ... | 11.2 | 0.375 | 5.45 | 0.610 | 230.4 | 1.405 |
| Total | ... | 8.250 ($dW/dT_P$) | ... | 13.436 ($dW/dT_D$) | ... | 15.572 ($dW/dT_G$) |

where $dm_1 = dm_2 = \cdots = dm$ for a proportional tax. Since the change in tax revenue, $dT_p$, is $\sum_n Y_i \, dm$, the marginal welfare cost is:

$$dW/dT_p = \eta m_1 \frac{\sum_j Y_{1j}}{\sum_n Y_i} + \eta m_2 \frac{\sum_k Y_{2k}}{\sum_n Y_i} + \cdots . \tag{13}$$

Thus, to calculate the marginal welfare cost, we multiply $\eta m_i$ for each rate class by the share of total wage and salary income accounted for by that class, and sum over all tax rate classes.

Columns 2 and 3 of table 2 present the results of these calculations for the proportional tax. The marginal welfare cost due to labor supply distortions is the sum of the figures in column 3, or about 8.3 percent of tax revenue. The marginal administrative and compliance costs should be added to this figure. Average administrative and compliance costs are 2–2.5 percent of tax revenue, but presumably the marginal costs are less than this. Perhaps a figure of 0.7 percent is reasonable, and on that assumption the marginal welfare cost (due to labor supply distortions plus administrative and compliance costs) would be on the order of 9 percent of tax revenue. The marginal cost of public funds would then be $1.09 per dollar of revenue.

To estimate the marginal welfare cost for a degressive tax that is added to the present system, it will be assumed that a certain amount of labor income is exempt from taxation. Since actual taxable income under the federal income tax was only 61.4 percent of adjusted gross income in 1974, we shall assume that only 61.4 percent of total wage and salary income is subject to tax. The formula for estimating the marginal welfare cost of labor supply distortions (which can be derived in a manner similar to equations [11]–[13] above) is then:

$$dW/dT_D = \eta m_1 \frac{\sum_j Y_{1j}}{\sum_n (Y_i - K)} + \eta m_2 \frac{\sum_k Y_{2k}}{\sum_n (Y_i - K)} + \cdots, \qquad (14)$$

where $\sum_n (Y_i - K)$ is total taxable wage and salary income ($455 billion), or 61.4 percent of total wage and salary income.

Columns 4 and 5 give the estimates for the degressive tax. The marginal welfare cost due to labor supply distortions is 13.4 percent of tax revenue. With marginal administrative and compliance costs included, the figure would be about 14 percent.

For a graduated rate tax above an exemption, the formula when taxpayers are in different initial marginal rate classes is:

$$dW/dT_G = \eta m_1 \frac{\sum_j Y_{1j}}{\sum_n (Y_i - K)} \frac{dm_1}{dr} + \eta m_2 \frac{\sum_k Y_{2k}}{\sum_n (Y_i - K)} \frac{dm_2}{dr} + \cdots, \qquad (15)$$

where $dr$ is the change in the average tax rate on total taxable wage and salary income (not the change in the average tax rate for each bracket). As mentioned earlier, to calculate the marginal welfare cost for such a tax, it is necessary to specify a particular change in the rate structure. For ease of computation, we shall assume that the federal income tax rates are changed in a way that maintains constant share progressivity so that the $dm_i/dr$ terms in (15) are equal to $m_i^F/r^F$, or each federal marginal tax rate divided by the average federal tax rate on taxable income.[14]

Columns 6 and 7 give the estimates for this change in the tax structure. The marginal welfare cost due to labor supply distortions is 15.6 percent, or slightly above 16 percent when marginal administrative and compliance

[14] Musgrave and Thin (1948) discuss share progressivity, although it is referred to as "liability progression." Constant share progressivity simply means that each person's share of total tax liability remains unchanged. The federal tax surcharge of 1968 had this characteristic.

costs are included. Comparing the results of the three alternative methods of raising additional tax revenue, we can see that the marginal cost of public funds is greater the more progressive the change in the rate structure. However, the exact magnitudes of all the estimates should be viewed as highly tentative since they are quite sensitive to the value of $\eta$ assumed. Unfortunately, empirical research has produced no consensus about the sizes of compensated labor supply elasticities, and my assumption of a value of 0.20 may be substantially off the mark.

As was probably clear in the last section, I consider the major use of an estimate of the marginal cost of public funds to be in the evaluation of government expenditures: the marginal cost of public funds is the social opportunity cost of government spending. This interpretation, however, immediately creates a difficult problem: *which* estimate of marginal welfare cost should be used in the evaluation of a specific expenditure program? The difficulty arises because expenditure programs are not tied to particular tax changes in existing political institutions, and therefore the source of funds to finance any expenditure program can never really be known. And matters become even more complex when still other changes in the income tax structure are considered, and when changes in nonincome taxes are also a source of potential revenue.

It is important to recognize that it is literally impossible to determine the exact source of funds when governments use general fund financing (enacting tax and expenditure bills separately). In this type of situation what is clearly needed is a convention, or rule of thumb, that the applied economist can use in the evaluation of expenditure programs.[15] It would appear that this convention should represent a judgment of the type of change in the tax structure that the government typically makes when more or less revenue is required. Changes in the federal income tax over the past several years have tended to maintain the degree of progressivity (in the "constant share progressivity" sense), as in 1968, or to increase the degree of progressivity, as in 1964 and 1975. Thus, I would be prepared to argue that the assumption that public funds derive from progressive changes in the tax law (as in the third type of tax change considered above) would provide a reasonable convention to use in expenditure analysis. Not everyone will agree with this judgment, but the need for *some* convention should be apparent.

The importance of measuring tax distortions at the margin is not restricted solely to income taxes since other taxes are also potential sources of funds for the finance of expenditure programs. There is reason to suspect, however, that marginal welfare costs are lower for income taxes than for other taxes. Consider the case of selective excise taxes. If

[15] Harberger (1971) has argued persuasively for the adoption of a convention in the analogous context of the choice of a social rate of discount.

we assume that these taxes do not influence labor supply, then the principal distortion of excise taxes is to influence relative output levels. The total welfare cost of this distortion can be estimated (ignoring second best problems, and assuming constant costs) by $\frac{1}{2}\varepsilon_d t^2 PQ$, where $PQ$ is total expenditures on the taxed good, $\varepsilon_d$ is the compensated demand elasticity, and $t$ is the tax rate. The marginal welfare cost of an excise tax is then $\varepsilon_d t$ if it is assumed that quantity consumed is unresponsive to a change in the tax rate. Treating all goods subject to excise taxes as a composite good, we can use the estimates of Musgrave and Musgrave (1973, p. 459) of 0.8 for $\varepsilon_d$ and 0.33 for $t$ to estimate the marginal welfare cost. At 26 percent it is well above the marginal welfare cost of income taxation. If this is any indication of the magnitudes of marginal distortions of nonincome taxes, it suggests that income taxation may be the least expensive source of finance for expenditure programs.[16] Further research, however, is clearly needed to check this conjecture.

Even though the marginal welfare cost of income taxes may be lower than for alternative sources of revenue, at 14–16 percent (for progressive changes in the tax structure), it is still a large part of the opportunity cost of government expenditures. Thus, it appears that the conditions under which expenditure policies can improve welfare are more restrictive than conventional analysis might suggest.

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[16] It also suggests, of course, that substituting income taxes for excise taxes while keeping total revenue unchanged would lower the total welfare cost of the tax system.

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