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The Welfare Cost of Taxation in New Zealand Following Major Tax Reforms: Abstract

The welfare cost of taxation of labour income is the economic loss to employees over and above the taxation revenue acquired by the government. This article estimates total welfare cost in 1986 and 1988 in New Zealand, and also estimates marginal welfare cost and related measures of marginal excess burden for a hypothetical marginal tax reform prior to and following the major discrete reforms of 1986. Estimated welfare costs are generally higher in the post-reform period despite a significant reduction in the progressivity of the statutory personal income tax schedule, the effect of the uniform goods and services tax introduced at that time serving to raise the weighted average effective marginal tax rate. As with recent estimates for the U.S., estimated welfare costs for New Zealand are sensitive to labour supply elasticity parameters, and are higher than for the U.S. Part of this difference, however, is shown to depend on our use of disaggregated income data.

Paul McKeown and Alan Woodfield

The relationships among the excess burden of taxation, marginal welfare cost and the marginal cost of public funds have been explored in detail in recent literature.[1] The purpose of this paper is to provide a contribution to the empirical literature utilising the partial equilibrium approach of Browning (1987). We provide estimates of total and marginal excess burden and welfare cost for labour income taxes in New Zealand following the dramatic tax reforms of 1986 in which the pre-existing wholesale tax (WST) was replaced by a uniform goods and services tax (GST) and significant reductions in marginal income tax rates were introduced.

Particular emphasis is given to comparing marginal welfare costs of similar hypothetical marginal tax reforms before and after the actual discrete reforms of 1986. Attention is also given to the distinction between estimates of the welfare cost of taxation based on disaggregated income data (as used in Browning's (1976) estimates for the United States) and aggregated data (as used in Browning's (1987) estimates).

We first discuss the theoretical basis of the measures of welfare cost to be used, and then describe the 1986 reforms of the personal income tax and indirect tax structures in New Zealand. The nature of the data used for the study is examined, and some difficulties encountered in the estimation process when revenue changes are negative for some groups following a marginal tax reform are considered. Estimated total and marginal welfare costs, along with marginal excess burdens, are presented, and the paper concludes with some comparisons with the literature. The major conclusions of the paper are that marginal welfare costs of labour income taxes appear to be greater for New Zealand than for the United States, that welfare costs were greater following tax reforms that included a reduction in progressivity of the income tax structure, and that estimated welfare costs are quite sensitive to the choice of aggregated versus disaggregated data.

MEASURING WELFARE COSTS OF TAXATION

The literature considers a number of alternative measures of the efficiency loss of distorting taxes, and since similar concepts are at times defined differently, for purposes of interpretation and comparison of results it is useful to make clear exactly what is being estimated.

Consider Figure 1, which illustrates the special case of proportional income taxation and for which the uncompensated elasticity of labour supply equals zero. The ray OG defines the budget constraint for the zero-tax regime T_0, OH is the constraint for the current regime T_1, and OI is the constraint relevant to tax regime T_2 which involves a marginal increase in the tax rate (but which is exaggerated in magnitude for illustrative purposes). Ignoring the disbursement of tax receipts, points F, E, and J would represent uncompensated equilibria in regimes T_0, T_1, and T_2, respectively.

(FIGURE 1 ABOUT HERE)

In the spirit of Diamond and McFadden (1974), in response to an increase in the tax rate, the taxpayer suffers a reduction in Hicksian consumer surplus given by the corresponding compensating variation (CV) or equivalent variation (EV) in income. For example, CV is the lump-sum transfer needed under T_2 to restore utility level U_H consistent with E, and which equals $\overline{BD}$. Since $\overline{BD}$ is the lump-sum transfer that would be required for the taxpayer to be indifferent to the distorting tax reform, if the compensation was paid, only $\overline{CD}$ would be available as additional tax revenue dR* in order to make the compensation. Thus, marginal excess burden MEB* = CV-dR* = $\overline{BD}$-$\overline{CD}$ is the excess of required compensation over the additional resources available to the taxing authority for compensation, if the compensation was paid. Division by dR* = $\overline{CD}$ gives the marginal welfare cost (MWC*) of the tax reform, and which expresses the compensation shortfall per dollar of additional revenue collected if compensation takes place. Clearly, we need some extra (external) source of revenue in order to fully compensate. In the case illustrated in Figure 1, under this interpretation, both marginal excess burden and marginal welfare cost are positive and in no way depend on how actual tax revenue changes. Further, the result of this experiment can be interpreted as resulting from the replacement of a lump sum tax by a revenue equivalent distortionary tax, that is, as a differential rather than a balanced-budget experiment.

Browning (1987), however, develops a measure of marginal welfare cost in the context of an explicitly balanced-budget experiment. This measure, which we shall label MWC^B, is defined as MEB*/dR, where dR denotes the actual revenue change resulting from a tax reform. Now in some very special circumstances, MWC^B yields a numerical value identical to MWC* but bears a different interpretation. In Browning's case, additional revenue raised by the tax reform is spent by the government in a manner which is equivalent to a lump sum income transfer. In defining one of two forms for estimating MWC^B, which we will label MWC_2, Browning assumes that the side effect of the additional government spending on labour supply is to generate the compensated equilibrium, that is, point B in Figure 1. In other words, the tax change generates $\overline{CD}$ dollars. When spent by the government, income-equivalent benefits to the taxpayer equal to the compensating variation in income are assumed to be generated. The result is that the actual change in revenue $dR = \overline{CD}$ equals the compensated change in revenue dR^*; hence the equivalence of the measures MWC^* and MWC_2.[2]

It is not, however, necessary for the side effects of government spending to generate the full compensated equilibrium in order for MWC_2 to equal MWC^*, just that the combined effects of the tax and spending policies generate the same quantity of labour supplied as in the compensated equilibrium.[3] This could even be consistent with zero expenditure effects on labour supply if the income elasticity of demand for leisure is zero, since then the uncompensated and compensated labour supply elasticities will coincide. On the other hand, if expenditure side effects generate the compensated quantity of labour but not the initial level of utility, the uncompensated labour supply elasticity must be negative (unlike the case shown in Figure 1), that is, the substitution effect of the tax change must dominate the income effect. Browning's assumptions are therefore sufficient but not necessary to measure MWC_2 in this manner. The effect of these assumptions, however, is to force an equivalence between the actual change in revenue and the corresponding compensated change.

Browning's other form for estimating MWC^B, which we label as MWC_1, defines the actual revenue change dR as that resulting when government spending has no income-equivalent effects on labour supply and where the uncompensated labour supply elasticity is assumed to be zero. In terms of Figure 1, whereas $MWC^* = MWC_2 =$

$(\bar{B}\bar{D}$-$\bar{C}\bar{D})/\bar{C}\bar{D}$, $MWC_1 = (\bar{B}\bar{D}$-$\bar{C}\bar{D})/\bar{E}\bar{J}$. In the case illustrated, MWC_1 and MWC_2 are both positive, and it is always true that $MWC_1 < MWC_2$. One motivation for estimating MWC^B is that Browning wants to provide estimates of the marginal cost of funds (MCF), conventionally defined as the change in consumer surplus per dollar of actual revenue raised. In the present context, this would be given by CV/dR. Now it is true that in the case of MWC_2, MCF = $1+MWC_2$ = 1+(MEB*/dR) = 1+[(CV-dR*)/dR] since in this very special case, dR = dR*, that is, the changes in actual tax revenue and compensated tax revenue are assumed to coincide. But it is not the case that MCF = $1+MWC_1$ = 1+(MEB*/dR) = 1+[(CV-dR*)/dR] since dR exceeds dR* in this case.[4] The difference between dR and dR* creates some difficulty in the interpretation of MWC_1. It appears to measure the difference between the amount of money needed to compensate for the tax change less the change in revenue if compensation takes place, per dollar of revenue actually generated by the tax change.

Browning's case of a balanced-budget marginal tax reform assumes that taxpayer benefits equivalent to a lump sum income transfer are generated. Browning also defines marginal welfare cost as the extra value that government spending must have in order to restore the initial utility level. In these circumstances, it is more appropriate to define the marginal cost of funds by CV/dR* rather than by CV/dR. Figure 2 considers the introduction of a proportional tax from an initial zero-tax equilibrium at F. The taxpayer's new budget line is OH. Assume that all revenue received is spent by government. For the case of MWC_2, Browning assumes that the spending exactly compensates for the tax change, that is, there is a <u>unique</u> income-equivalent benefit of

$\bar{B}'\bar{D}'$ dollars (= CV), generating a new equilibrium at B′. The quantity of labour supplied, L′, defines the change in tax revenue, $\bar{C}'\bar{D}'$. Division of $\bar{B}'\bar{D}'$-$\bar{C}'\bar{D}'$ by $\bar{C}'\bar{D}'$ (= $\bar{B}'\bar{C}'/\bar{C}'\bar{D}'$) yields MWC_2. This should tell us the additional benefit per dollar of spending that additional government expenditure is required to have in order to exactly compensate for the tax change. But, in constructing MWC_2, a unique value of marginal benefit (= $\bar{B}'\bar{C}'/\bar{C}'\bar{D}'$) has already been assumed. Hence, a circularity appears to be involved.

(FIGURE 2 ABOUT HERE)

This is problematic, since we are trying to find the marginal cost of funds to compare with the marginal benefits of government spending to determine whether the additional spending is worthwhile. In any particular case, the additional government spending may or may not compensate, depending on how it is valued. For example, in Figure 2, suppose that following the change in taxes and spending (with dR = dG), the taxpayer is actually at R. The benefits of the spending (of $\bar{S}\bar{W}$ dollars) have not fully compensated for the tax change and marginal benefit is less than the marginal cost of funds in this case. But, we ask, what would be the critical value for marginal benefit such that the taxpayer is exactly compensated for the tax/spending package? The answer is MB*= CV/dR* (=$\bar{B}'\bar{D}'$-$\bar{C}'\bar{D}'$), that is, MB* satisfies $(MB^*)X(dR^*)\big|_{dR=dG} = CV$.

At R, marginal benefit is less than MB*. Similarly at E, where the additional government spending confers no income-equivalent benefits and the uncompensated labour supply is assumed to be zero (as for MWC_1). Points like E or R, however, do not reveal anything about the benefits that are required for compensation. They merely show that compensation was not achieved. Consequently, we argue that compensated revenue, not actual revenue, is needed to calculate the required critical value for marginal benefit, and, hence, marginal welfare cost (which is just MWC*) and the marginal cost of funds MCF* = 1+MWC*.[5]

The suitability of these various measures depends in part on the motivation behind them. If the analysis wishes to emphasise the fact that the source (and size) of welfare loss from a distorting tax arises because the government cannot collect enough additional revenue in a compensated equilibrium to effect the required compensation, measures which focus on substitution effects and compensated elasticities appear highly appropriate.[6] For the cost-benefit analyst seeking a decision rule which generates a definition of marginal cost of funds in terms of a critical value for the marginal value of benefits resulting from a balanced-budget tax reform, we would argue that we provide a suitable measure.

We would not, however, argue its general applicability, including the widely-discussed case of a balanced-budget increase in expenditures which is separable in utility and which has no income-equivalent effect on labour supply, for which changes in compensated tax revenues (as opposed to actual revenue changes) are deemed to be irrelevant. On the other hand, measures of marginal excess burden and marginal welfare cost which utilise only actual tax changes in their derivation can generate results with which some discomfort might be felt. For example, if the uncompensated labour supply curve is backward-bending, marginal excess burden will be negative since the change in actual revenue will exceed the reduction in consumer surplus,[7] while marginal excess burden will also be negative for a lump-sum tax which is imposed in the presence of a distorting tax (although it will be zero under the Browning definition).[8]

In our empirical analysis, we present estimates of total welfare cost (TWC), MEB*, and MWC* = MWC_2. In what follows, we refer mainly to MWC* rather than MWC_2, while noting their equivalence as measures, but with differing interpretations. Further, we present estimates of MWC_1, mainly for comparative purposes, given difficulties associated with its interpretation. In developing the estimating equations, we closely follow Browning (1987).

(FIGURE 3 ABOUT HERE)

Consider Figure 3. For a representative worker, the labour supply curve compensated for the current utility level where the marginal tax rate is m is L_2^c. The gross wage, assumed constant, is w. Given linearity, aggregate excess burden or total welfare cost (TWC) is the area ACB, and shows the excess of increased earnings over the value of leisure foregone if the tax was removed while maintaining utility constant at the tax-distorted equilibrium A.[9] This measure is shown by Browning (1987, 12-13) to be

$$W = 0.5\eta m^2 wL_2/(1-m), \tag{1}$$

where η is the compensated labour supply elasticity evaluated at A, the point corresponding to the net of tax wage rate.[10]

Define marginal welfare cost as the ratio of the change in total welfare cost to the change in tax revenue in response to a specific variation in tax rates, dW/dR, where dW represents marginal excess burden (MEB*). Referring to Figure 3, when the marginal tax rate increases to m´, the corresponding change in total welfare cost is given by the area CDEA, assuming stationarity of the compensated supply curve. The change in welfare cost is shown to be[11]

$$dW = \left[\frac{m+0.5dm}{1-m}\right]\eta wL_2dm, \tag{2}$$

while the corresponding change in revenue is

$$dR = wL_2dt + wdL(m+dm), \tag{3}$$

where dt is the change in the average tax rate. The first term gives the change in revenue resulting from a given tax base, while the second term accounts for tax-induced erosion or expansion in the tax base. A general expression for marginal welfare cost is then defined by (2)/(3).

To evaluate marginal welfare cost defined as MWC*, however, requires that the dL term in (3) refers to the change in compensated labour supply, and hence, dR = dR*. Where the changes in compensated and actual labour supply are identical, MWC* coincides with MWC_2, whence

$$MWC* = MWC_2 = \frac{\left[\frac{m+0.5dm}{1-m}\right]\eta\frac{dm}{dt}}{1-\left[\frac{m+dm}{1-m}\right]\eta\frac{dm}{dt}} \tag{4}$$

Treating the term dL in (3) as zero yields

$$MWC_1 = \left[\frac{m+0.5dm}{1-m}\right]\eta\frac{dm}{dt}. \qquad (5)$$

THE 1986 TAX REFORMS IN NEW ZEALAND

New Zealand entered the 1980's with a steeply progressive personal income tax structure, the marginal tax rate rising quickly to 60 percent. The Task Force on Tax Reform (1982) regarded this structure as unsatisfactory, pointing to disincentives to produce and incentives to avoid and evade taxes as major reasons why a much less progressive marginal rate structure should be introduced. Such a structure was introduced on 1 October, 1986 and amended in 1988. A comparison of personal income tax structures prior to and following the 1986 tax reforms is given in Table 1. Compared to 1984, top marginal rates in 1986 were halved, bottom marginal rates fell by 25 percent, and the majority of taxpayers faced a marginal rate of 28 percent rather than 33-56.1 percent.

(TABLE 1 ABOUT HERE)

Accompanying these changes in direct taxation were corresponding significant changes in the indirect tax structure. As noted, a value added type comprehensive goods and services tax at an initial rate of 10 percent replaced the existing wholesale sales tax, while existing excise taxes on alcohol, tobacco and petroleum products were retained. The original sales tax was a non-comprehensive, highly-differentiated rate structure, exemption-riddled indirect tax, the base of which had been eroded to about 37 percent of its potential. According to Scott and Davis (1985), the proximate reason for the introduction of the goods and services tax was to increase the proportion of taxes collected as indirect taxes rather than increase total taxes per se. For the year ended March 1986, the share of indirect taxes in total tax receipts was 32.2 percent, and which increased to 39.4 percent in the year ended March 1988, the first full fiscal year in which the goods and services tax was operative. Total tax revenues, however, increased significantly during the 1980's, partly due to modest income growth and more significantly to bracket creep as a consequence of double-digit inflation, as well as to the tax reforms of the period, rising from about 32 percent of gross domestic product in the period to 1985 to nearly 40 percent in 1990. In nominal terms, total tax revenues approximately doubled between 1986 and 1988.

DATA AND ESTIMATION ISSUES

From equation (1), it is clear that the information required for the estimation of total welfare cost includes the individual's current marginal tax rate, gross income, and compensated labour supply elasticity evaluated at the current distorted tax structure, while from equations (4) and (5), for the estimation of marginal welfare cost it is necessary to also know the changes in the marginal and average tax rates at the re-disturbance income level and tax rates. Ideally, this information is required for each individual as the basis for constructing aggregate welfare cost estimates across individuals. In practice, this level of disaggregation is not feasible. Browning's (1987) aggregative approach sets the marginal tax rate equal to the weighted average value of m over all income ranges, with weights being income shares, and which, along with suitably adjusted gross labour income across all workers and an assumed common compensated labour elasticity, is used to estimate total welfare cost. Corresponding changes in marginal and average tax rates are then applied across taxpayers in general in order to estimate marginal welfare cost. Our study also assumes common compensated labour elasticities across individuals, but distinguishes individuals grouped into 36 income ranges, each with its respective marginal and average tax rate and their corresponding rates of change.

The marginal tax rate is applied in a broader sense than just the statutory marginal income tax rate, since we need to account for all taxes which distort the labour supply decision at the margin. We include personal income taxes, indirect taxes (sales tax or goods and services tax where relevant, and excise taxes), and the negative tax effects on income-reduced beneficiaries of government welfare programmes in calculating the implicit marginal tax rates. We treat goods and services tax and excises, for instance, as equivalent to a proportional wage tax so that the net wage in this case equals w(1-g)(1-m), where w is the gross wage, g is the rate of GST plus excises, the latter specific taxes being treated as an ad valorem equivalent tax on what is a single consumption good in this model, and m is the statutory marginal income tax rate. The implicit marginal tax rate is then given by the difference between the gross and net wage, divided by the gross wage.

In the case of welfare beneficiaries who were working, a negative income tax scheme was in operation which served to reduce the net welfare payout by a percentage of earnings, this percentage being subject to an exemption level, and which was progressive in nature. Welfare payouts were not reduced until earnings exceeded \$2,600, were reduced 30 cents per dollar of earnings in the range \$2,600-\$4,160, and were reduced 70 cents in the dollar for earnings above \$4,160. Clearly, implicit marginal tax rates for income-reduced beneficiaries were very high even for modest levels of earnings, and could easily exceed 100 percent. We separated out income-reduced beneficiaries, namely, recipients of national superannuation, widows and invalid pensions, and sickness, unemployment, and domestic purposes benefits, from other wage and salary earners.

Average tax rates were calculated as the difference between gross income from the current labour supply assuming that distorting tax rates were zero and net of tax income received, divided by the pre-tax income level. If the marginal tax rate is not constant, marginal and average rates will typically differ. Since individuals are grouped into income ranges and the incomes of individuals within an income group will differ, so will their average tax rates. We assumed that incomes within any group were distributed symmetrically about the mean income of the group and calculated the average tax rate for the group at the mean group income.

We assume, as does much of the literature, that the compensated labour supply elasticity is uniform across individuals but without committing ourselves to a particular appropriate value for this elasticity. We are unaware of any estimated labour supply functions for New Zealand to which reference might be made in this context, and simply refer to the survey literature which suggests a range of 0.2-0.6 in which values are thought most likely to lie.[12]

Since a major aim of this paper is to provide a comparison of total and marginal welfare cost estimates before and after the introduction of the goods and services tax in October 1986, we have used the data sets for the last fiscal year prior to its introduction (that is, the year ended 31 March, 1986) and the first full fiscal year following its introduction (that is, the year ended 31 March, 1988). This choice was necessary because the data sets were available only on a yearly basis and the tax changes occurred near the middle of a fiscal year. Unpublished data on incomes of persons disaggregated into 36 income groups, along with total personal income taxes paid, were made available from the New Zealand Department of Statistics. The number of beneficiaries whose incomes were reduced due to additional earnings (classified by additional income and benefit type) and the relevant benefit reduction rates were obtained from the New Zealand Department of Social Welfare Annual Reports for the relevant years. Because income-reduced beneficiaries faced different implicit tax rates to full-time wage and salary earners with the same income, it was necessary to isolate them and calculate their total and marginal welfare cost contributions separately. Prevailing rates of personal income tax and goods and services tax were obtained from relevant Annual Reports of the New Zealand Department of Inland Revenue, while other indirect taxes were derived from Table No. 3, Total Taxation Receipts, in the Government's Annual Financial Statements (the "Budget").[13]

ESTIMATES OF THE WELFARE COSTS OF TAXATION

In this section we present estimates of the total and marginal welfare costs of taxation on labour incomes in New Zealand. First, however, we discuss some preliminary calculations and discuss difficulties regarding their interpretation.

As noted, Browning (1987) used an aggregate measure of MWC_1 and MWC_2 calculated from equations (4) and (5) with the marginal tax rate m equal to the weighted average marginal tax rate, the weights being each quintile's share of labour income. This yielded $m = 0.43$ as the benchmark for his study. Browning estimated marginal welfare cost for a range of compensated labour supply elasticities (0.2-0.4) and four values of dm/dt in the range 0.8-2.0. The resulting estimates for MWC_1 and MWC_2 were in the ranges 15.3-30.5 percent and 18.0-44.2 percent, respectively, for the case where $dm/dt = 1$, that is, where a small proportional tax is added to the existing tax structure. Moreover, Browning's estimates, ceteris paribus, all increase monotonically in the compensated labour elasticity, and are very sensitive to the parameter set chosen.

The data set used in the present paper, however, has allowed for disaggregation into a large number of income groups, each with a common marginal tax rate, a situation similar to that of Browning (1976). Here, the aggregation procedure used meant that MWC^* ($= MWC_2$) could be calculated for each group using (4) with dm set equal to the change in the marginal tax rate for the group and dt equal to the change in the average tax rate at the group's mean income. The overall marginal welfare cost is the weighted sum of each group's marginal welfare cost, the weights being each group's respective income share. Preliminary calculations using this aggregation procedure for the 1986 New Zealand data set (but ignoring indirect taxes), however, produced some unusual results. For dm/dt = 1, and for compensated labour elasticities in the range 0.2-0.6 with an interval of 0.05, the resulting estimates of MWC* were, in percentage terms, 18.4, 26.3, 36.0, 49.3, 70.8, 120.1, 732.2, -69.8, and 12.8 respectively. The estimates were violently sensitive to the choice of the labour elasticity, especially in the upper end of the range, and the estimate for $\eta = 0.55$ was negative. Notably, the weighted marginal welfare cost estimates for taxpayers with incomes above $38,000 (whose marginal tax rate was 66 percent) were negative for $\eta > 0.55$. The corresponding estimates for most welfare beneficiaries were also negative for almost the entire range of elasticities once the second level of benefit reduction was reached, that is, once their marginal tax rates had reached very high levels. With $\eta = 0.55$, these negative values dominated and the overall marginal welfare cost estimate was negative. The extremely high overall marginal welfare cost estimate with $\eta = 0.50$ was largely attributable to high positive values for taxpayers with incomes in excess of $25,000; in two income ranges, these exceeded 100 percent.

The reasons for results of this nature can be seen by considering the behaviour of the marginal welfare cost function MWC* (=MWC_2) over the range of plausible compensated labour supply elasticities. Figure 4 maps the values of MWC* for m=0.48 and dm/dt = 2, for a range of values of η. As η approaches 0.535 from below, MWC* approaches $+\infty$, while as η approaches 0.535 from above, MWC* approaches $-\infty$. The explosive behaviour of MWC* in the neighbourhood of $\eta = 0.535$ in this example can be attributed to the denominator in (3). As the term [(m+dm)/(1-m)](dm/dt) approaches unity from below (above), the denominator in (3) becomes unboundedly large (small), and the denominator in (3) is negative when this term exceeds unity. The vanishing (negative) denominator in (3) is associated with a zero (negative) change in compensated (and actual) change in tax revenue from the marginal tax reform proposal.[14]

A simple illustration is given in Figure 1. Prior to the marginal reform, the tax-distorted budget line is 0H. Instead of an increase in the marginal and average tax rate generating the new budget line 0I, suppose that the marginal tax rate is raised in a similar manner, but only for incomes greater than $\tilde{Y}$, so that the new (kinked) budget line is 0NP. The compensated labour supply is, again L_2^c, but CV is now $\bar{B}\bar{Q}$ rather than $\bar{B}\bar{D}$ and dR* is now $-\bar{Q}\bar{C}$ rather than CD. Marginal excess burden CV-dR* = $\bar{B}\bar{N}+\bar{Q}\bar{C}$ is positive and equal in magnitude to $\bar{B}\bar{D}-\bar{C}\bar{D}$. For the nonlinear constraint case, however, MWC* = $(\bar{B}\bar{N}+\bar{N}\bar{C})/(-\bar{N}\bar{C}) < 0$, whereas for the linear constraint case involving the same change in the marginal tax rate, MWC* = $(\bar{B}\bar{D}-\bar{C}\bar{D})/\bar{C}\bar{D}$ (= $\bar{B}\bar{Q}+\bar{Q}\bar{C})/\bar{C}\bar{D}$) > 0. Further, if the nonlinear constraint had passed through point C in Figure 1, CV = $\bar{B}\bar{C}$ (= $\bar{B}\bar{D}-\bar{C}\bar{D}$), dR* = 0, MEB* = $\bar{B}\bar{C}$, and MWC* is undefined. However, $MWC_1 = \bar{B}\bar{D}/\bar{E}\bar{J}$, which is positive.

The apparent anomaly of a trio of tax reforms involving the same change in marginal tax rates and generating identical estimates of marginal excess burden but different estimates of marginal welfare cost (and with different signs) requires some explanation. Browning's definition of marginal welfare cost as the excess of required benefits from government spending over the additional tax revenues collected, per dollar of additional revenue, only makes sense if the change in revenue arising from the tax reform is positive. In two of the cases illustrated, this condition is not satisfied. In cases where the estimated group MWC* is negative, taxes fall in the compensated equilibria. There is no additional tax revenue which can be spent so as to restore initial utility levels for these groups. If their initial utilities are restored, it must be through expenditures financed by taxpayers whose tax contributions increase in the compensated equilibria. The inclusion of individuals with negative estimates of MWC* in the weighted sum will lower overall MWC* even though overall marginal excess burden increases.

In order to avoid the downward bias in estimates of overall MWC* in the presence of taxpayers for whom changes in compensated revenues are negative, we propose an alternative aggregation method. First, we estimate values for MEB* and dR* for each income group and then sum each of these over all groups. The overall estimated MWC* will then be calculated as the sum of MEB* divided by the sum of dR*. The result can be interpreted as the amount of extra value that the aggregate increase in tax revenue must have in order to fully compensate all taxpayers for the tax change, per dollar of additional revenue. For this interpretation to be valid, it must be assumed that the government can allocate its spending in such a way as to return to individuals in each group the amount of additional tax paid plus the compensation needed to restore the initial utility level. If the extra value of government spending is measured in this way, the potential to fully compensate all taxpayers can be realised. This is not the case for the aggregate measure proposed by Browning (1987) since it represents the average of the extra value that government spending must have in order to compensate for the change in taxes. Here, if government spending of the extra revenue were to have this amount of extra value to all groups, some would be over-compensated, others would be under-compensated, and groups with negative MWC* estimates will never be fully compensated.

Formally, define

$$\text{Overall MWC}^* = \sum_{i=1}^{n} dW_i / \sum_{i=1}^{n} dR_i^*, \tag{6}$$

where i denotes income group i, $dW_i = \sum_{j=1}^{k_i} dW_{ij}$, and $dR_i^* = \sum_{j=1}^{k_i} dR_{ij}^*$, and where k_i is the number of taxpayers in group i. Where dW is calculated using (2) and dR* is calculated using (3), we have

$$dW_i = \left[\frac{m_i + 0.5dm_i)}{1 - m_i}\eta dm_i\right] Y_{1i}, \tag{7}$$

where $Y_{1i} = \sum_{j=1}^{k_i} Y_{1ij}$ is the initial gross income of individual j in group i and dt_i = dt calculated at the mean income in group i.

The marginal tax reform considered is a one percentage point increase in all marginal income tax rates, that is, $dm_i = 0.01$ for all i. As a consequence, average tax rates all increase by the same amount because the change applies to the entire income range, so that dm = dt = 0.01 and dm/dt = 1. This tax reform is applied to the 1985-86 and 1987-88 fiscal year data sets. Estimated values of total welfare costs, marginal excess burdens and overall MWC* and MWC_1 for these years are given in Table 2, along with corresponding estimates of marginal welfare cost obtained by applying Browning's (1987) aggregative measure using weighted average marginal tax rates to the data.

(TABLE 2 ABOUT HERE)

Consider first the estimates for total welfare cost given in rows 1 and 10 of Table 2. For 1986, these estimates range from \$1,106-\$3,319 millions for values of the compensated labour supply elasticity in the range 0.2-0.6, and range from \$1,496-\$4,487 millions for a similar range of elasticities for 1988. For a given value of the compensated labour supply elasticity, estimated total welfare cost in 1986 is only 74 percent of that estimated for 1988. The revenue base, however, measured by the estimated direct and indirect taxes paid by wage and salary earners was \$3,936 millions less in 1986 than the \$12,408 millions for 1988. When total welfare cost is expressed as a percentage of the revenue base for each year, rows 2 and 11 of Table 2 show this to be about 8 percent higher for 1986 than in 1988, and ranges from 13.0-39.2 percent for $\eta \in (0.2\text{-}0.6)$ in 1986 compared to 12.1-36.2 percent for 1988. It should be noted, however, that estimates of total welfare cost are conditioned by the strong assumption of a linear compensated labour supply curve.

As Browning (1987, 13) noted, if aggregate rather than individual data is used to estimate total welfare cost, the resulting estimates will be biased downwards. He did not, however, believe that the actual dispersion in marginal tax rates in the U.S. would be large enough to make substantial differences to his estimates. The estimated total welfare costs for New Zealand as presented in Table 2, however, and which are constructed from disaggregated income data, turn out to be significantly greater than the corresponding estimates obtained from aggregate data. For example, in the case of the 1986 data set, the difference is 31 percent while for 1988 the difference is 20 percent.

Consideration of rows 3 and 12 of Table 2 shows that the estimated marginal excess burden resulting from a one percent change in the average and marginal tax rates (based on the disaggregated data set) ranges between \$38.4-\$115.2 millions for 1986 and between \$46.5-\$139.6 millions for 1988, for $\eta \in (0.2\text{-}0.6)$. For a given value of η, estimated marginal excess burden is some 21 percent greater for 1988 than for 1986. Rows 7 and 16 report the estimated values for MWC* (= MWC_2) for 1986 and 1988 respectively, again for the disaggregated data set. As expected, for a given η, the estimated marginal welfare costs are higher than the corresponding average welfare costs reported in rows 2 and 11. For 1986, estimated MWC* ranges from 24.6 percent to 146.4 percent for $\eta \in (0.2\text{-}0.6)$, while for 1988 the corresponding range of estimates is 25.6-161.2 percent. The estimates of MWC* are highly sensitive to the value of the compensated labour supply elasticity, and, unlike total welfare cost and marginal excess burden, are nonlinear in η. The result is that the ratio of marginal to average welfare cost increases in η. For example, for 1986, estimated MWC* is 1.9 times as great as average welfare cost for $\eta = 0.2$, but is 3.7 times as great for $\eta = 0.6$.

A surprising result is that estimated MWC* (and MWC_1) is greater for 1988 than for 1986, given that the discrete tax reform between the periods was allegedly intended to reduce the distortionary effects of a highly progressive income tax without changing tax revenues. In the event, the outcome was a significant increase in revenue, and given the combined effect of reduced exemptions, bracket creep, and the fact that we have modelled the goods and services tax as a proportional income tax, the net effect of the major reform was to increase the effective weighted average marginal tax rate from 0.41 in 1986 to 0.45 in 1988. Thus, the discrete tax reform of October 1986 had properties consistent with a view held in the public choice literature that all empirical tax reforms serve to raise revenues rather than serve economic efficiency. It might also be noted that the maximum marginal rate of income tax (on incomes above $30,875) was reduced to 33 percent on October 1, 1988, while the rate of goods and services tax was raised to 12.5 percent.

An important finding is that as with estimated total welfare cost, estimates of marginal welfare cost for New Zealand are sensitive to the decision to use disaggregated data. The difference between estimates of MWC* based on disaggregated versus aggregated data ranges from 18.8 percent for $\eta = 0.2$ to 36.7 percent for $\eta = 0.6$ for 1986, again suggesting that the dispersion of marginal tax rates across income groups "matters". The corresponding differences for 1988, however, are smaller, and range from 9.4 percent for $\eta = 0.2$ to 21.3 percent for $\eta = 0.6$. These results are to be expected, given the reduction in the dispersion of tax rates generated by the 1986 reforms.

Estimates of overall MWC_1 are given in rows 7 and 16 of Table 2. They are greater than corresponding estimates of average welfare cost, and are (necessarily) smaller than the corresponding estimates o MWC*, ranging from 19.7-59.1 percent for 1986, and from 20.3-60.9 percent for 1988. Since estimated uncompensated tax revenue change is invariant with respect to changes in η, while compensated revenue change decreases in η, estimates of MWC_1 increase at a much less rapid rate than MWC* as η increases. For example, in 1986, the ratio MWC_1/MC^* for $\eta = 0.2$ is 0.8, and falls to 0.4 for $\eta = 0.6$. Inspection of rows 9 and 18 again shows that estimates of MWC_1 are greater for the disaggregated data sets than the corresponding aggregated sets. The percentage differences, however, are both smaller than for MWC*, and are independent of η, whereas for MWC*, they are increasing in the compensated labour supply elasticity.

CONCLUDING REMARKS

We have estimated the welfare costs of labour income taxes in New Zealand prior to and following a major reform to the tax structure, utilizing partial equilibrium methods developed by Browning (1976, 1987). The general nature of our results suggests, rather surprisingly, that the welfare costs of labour taxes in New Zealand were greater following a tax reform that significantly reduced the progressivity of the personal income tax schedule. A major reason for these results is that the introduction of a uniform rate goods and services tax, along with the removal of tax exemptions and deductions and the presence of bracket creep due to inflation, raised rather than lowered the effective weighted average marginal tax rate across taxpayers. Further, to the extent that comparisons are valid, our results suggest that compared to the United States, welfare cost per dollar of revenue is higher in more-heavily taxed New Zealand.

For example, for a small proportional tax added to the existing tax structure, Browning (1987) estimated marginal welfare cost to lie in the range 18.0-44.2 percent for his preferred parameter set, depending on assumptions made about labour supply responses. A comparable parameter set yields estimates for New Zealand in the range 24.6-65.4 percent for 1986, and a range 25.6-69.4 percent for 1988. Roughly half of these differences, however, can be attributed to our use of disaggregated income data. For New Zealand at least, it appears that the dispersion of marginal tax rates is sufficiently large to have an appreciable impact on estimates of the welfare costs of taxation.

Nevertheless, the use of partial equilibrium analysis assumes that the gross wage is invariant to changes in the tax structure. Although the estimated welfare costs of taxation for New Zealand are substantial, they are likely to be biased downwards on this account, the extent of which requires examination in a general equilibrium framework.

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NOTES

1. The literature emphasizing theoretical issues includes Atkinson and Stern (1974), Diamond and McFadden (1974), Kay (1980), Pazner and Sadka (1980), Zabalza (1982), Pauwels (1986), Topham (1984, 1985), Wildasin (1979, 1984), Auerbach (1985), Triest (1990) and Mayshar (1990), while emphasis on empirical issues is provided by Harberger (1974), Browning (1976, 1987), Stuart (1984), Hansson and Stuart (1985), Ballard, Shoven, and Whalley (1985), Ballard (1990) and Fullerton (1991).

2. This discussion may help resolve some rather puzzling comments in the literature. Browning (1987, 18) explicitly refers to his analysis of MWC as "balanced-budget", and in his discussion of Browning's estimates, Fullerton (1991, 304, fn.6) clearly agrees. Ballard (1990, 264), however, argues that Browning "compares his <u>differential</u> results with the <u>balanced-budget</u> results of Stuart (1984) and Ballard, Shoven and Whalley (1985a)", but also notes that "Harberger formulas will be approximately correct for small balanced-budget changes in tax rates <u>if</u> the exhaustive government expenditures are perfect substitutes for cash". Clearly, Browning is making the latter special assumption the result of which is to generate an equivalence between the differential experiment giving MWC* and the <u>particular</u> balanced-budget experiment giving MWC_2.

3. Note that in Figure 1, MEB* (= BC) is the difference between the compensated reduction in earnings using the market wage, KC, and the increment in the value of leisure, KB, while dR* (= dR = CD) is the sum of the increment in tax revenue if earnings are unchanged, EJ (= CM), minus the reduction in revenue due to the fall in the (actual and compensated) quantity of labour supplied, DM.

4. As Fullerton (1991) notes, in the situation shown in Figure 1, an increase in the labour income tax will have a distortionary effect and an income effect, which are exactly offsetting when the uncompensated labour elasticity is zero and labour supply is independent of government spending. By using dR* rather than dR in the definition of MEB*, the income effect is ignored, and estimates of MCF using MWC_1 will be biased upwards. Properly, MCF = MWC_1 + (dR*/dR). As Fullerton also remarks, however, this problem does not arise for MWC_2. Also, Fullerton believes that Browning's MWC_1 measure involves EV rather than CV, on the basis of the argument in footnote 24 of Browning (1987). This appears to be a misreading; MWC_1 is clearly derived as MEB*/dR where MEB* is calculated on the basis of a labour supply curve compensated for the pre-tax change level of utility, not the post-tax change level.

5. An alternative procedure would be to define marginal excess burden as MEB = CV-dR, and marginal welfare cost as MWC = MEB/dR. From Figure 1, it appears that estimated MEB and MWC would be negative, while estimates of

MCF would be less than unity, since CV = BD is less than dR = EJ. However, as has been argued by Kay (1980), Pazner and Sadka (1980), Pauwels (1986) and Triest (1990), in this case the welfare change and the revenue change are measured in terms of different reference prices (post-tax-change and pre-tax-change prices, respectively), causing serious difficulties of interpretation. Instead, if the uncompensated revenue change is used to estimate MEB, the appropriate measure of welfare change is EV since both the revenue change and the welfare change will then be measured in terms of the pre-tax-change prices. For a truly marginal tax change, however, Mayshar (1990) has shown that EV and CV are equal, while Wildasin (1984), Triest, and Mayshar have demonstrated that the welfare change equals the actual revenue change when the uncompensated labour elasticity is zero, the uncompensated demand for leisure is independent of government spending, and proportional income taxes alone are considered. In terms of Figure 1, for a truly marginal tax change in these circumstances, EV = CV = BD = EJ, both MEB and MWC are zero, and MCF = 1. In this context, a puzzle in the literature is noted by Triest, namely, that a zero (negative) marginal excess burden generated under a balanced budget distortionary tax when the uncompensated labour supply elasticity is zero (positive) can be consistent with positive estimated welfare costs associated with distortionary taxation. Triest argues that the source of resolution of this puzzle lies in the choice of different reference price vectors for the two types of analysis.

6. Topham (1984) goes even further in suggesting a modification of Browning's (1976) measure on the grounds that the change in compensated tax revenues, not actual revenues, are relevant for evaluating the denominator in the expression for marginal welfare cost.

7. See Atkinson and Stern (1974) and Wildasin (1984).

8. See Mayshar (1990) and Fullerton (1991).

9. In Figure 3, the labour supply curve is drawn compensated at A, the initial tax-distorted equilibrium. Consequently, total welfare cost involves an equivalent variation measure of the change in consumer surplus while marginal excess burden and marginal welfare cost involve a compensating variation measure of this change. For total welfare cost estimates, Kay (1980) and Pazner and Sadka (1980) show that use of CV rather than EV can lead to incorrect welfare rankings of tax systems; hence the use of an EV-based measure of TWC by Browning, which is followed here. For marginal welfare cost estimates, however, Mayshar (1990) shows that CV and EV measures of marginal surplus are equal, implying indifference between their use. In the empirical applications of Stuart (1984) and Fullerton (1991), for small but discrete changes in tax rates, the differences between CV and EV measures appear negligible.

10. The expression in (1) corrects a formula derived in Browning (1976), the application of which leads to a significant downward bias in the estimated welfare cost of taxation.

11. See Browning (1987, 17-18) for details of these derivations.

12. See, for example, Killingsworth (1983) and Burtless (1987).

13. There were two instances where the statutory marginal tax rates changed within an income band. In the 1986 fiscal year, the marginal tax rate changed at an income level of $38,000, which lay in the $35,000-$40,000 income range. In 1988, there was a change at $9,500 which was within the $9000-$10,000 range. Individuals in these respective income ranges could have been facing one of two marginal tax rates, while we have assumed a uniform marginal tax rate within any income range. To deal with this problem, income groups containing two different marginal tax rates have been broken into two sub-groups with each sub-group facing a single marginal rate. The total income in the initial income range was then apportioned to the two sub-groups, the proportion of the income in each of the two sub-groups being equal to the proportion of sub-group range to the initial group range. The mean income in the newly created sub-groups was assumed to be the midpoint in the income range.

14. The case discussed in this paragraph was considered by Browning for $\eta \in (0.2\text{-}0.4)$. Browning (1987, 14) notes that "values substantially larger than 0.4 have been used in the literature", but rejects these as implausible in spite of supporting empirical evidence. Our point is that if estimates of η in the interval (0.4-0.6) are considered plausible, Browning's estimates of MWC_2 will first explode and then become negative, with serious problems of interpretation resulting.

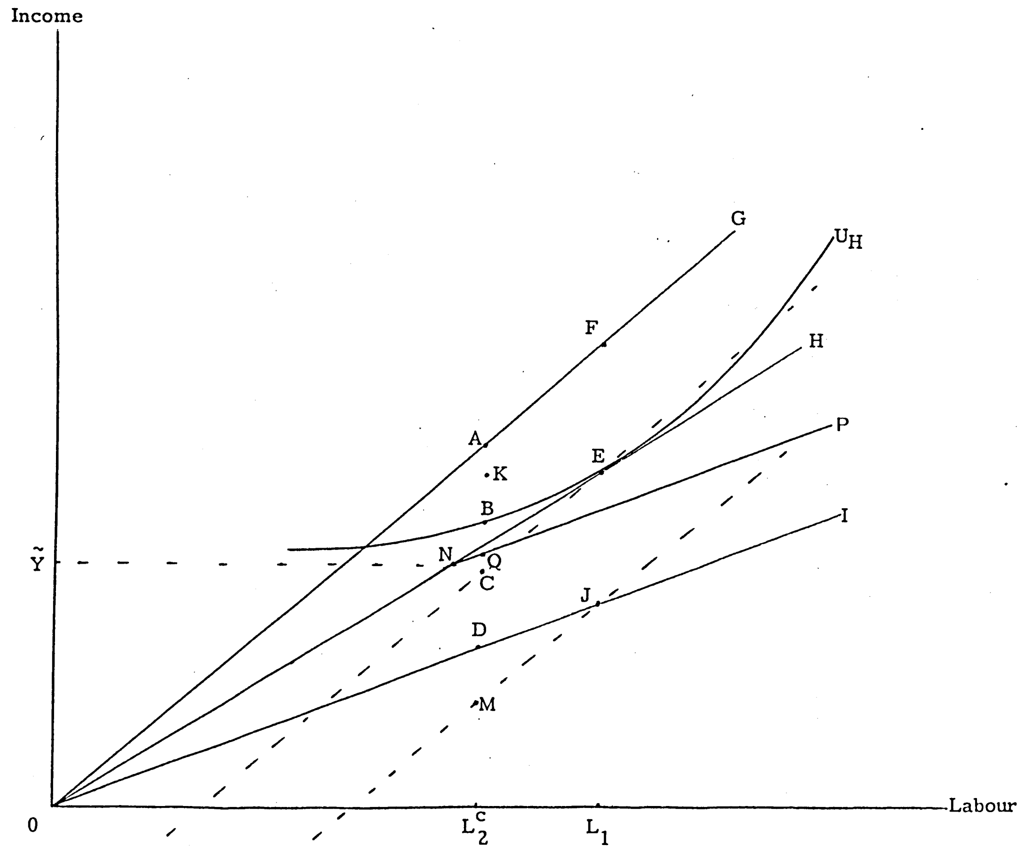

Figure 1: Labour Supply Responses to Changes in Tax Rates

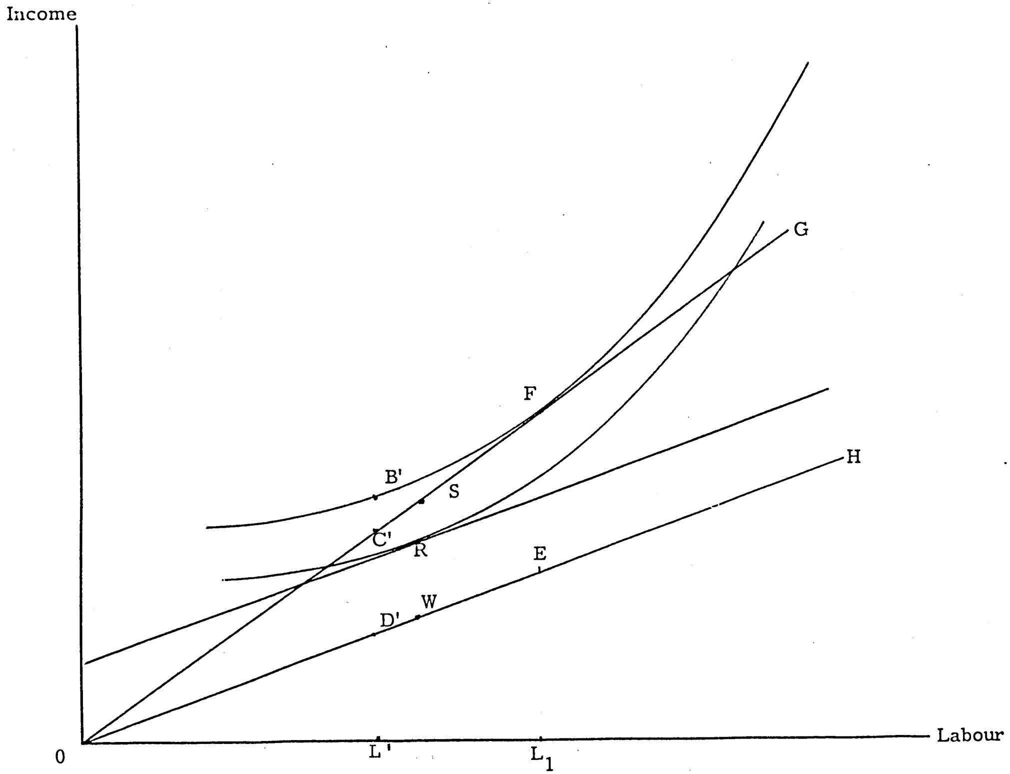

Figure 2: Alternative Compensation Effects of Government Spending

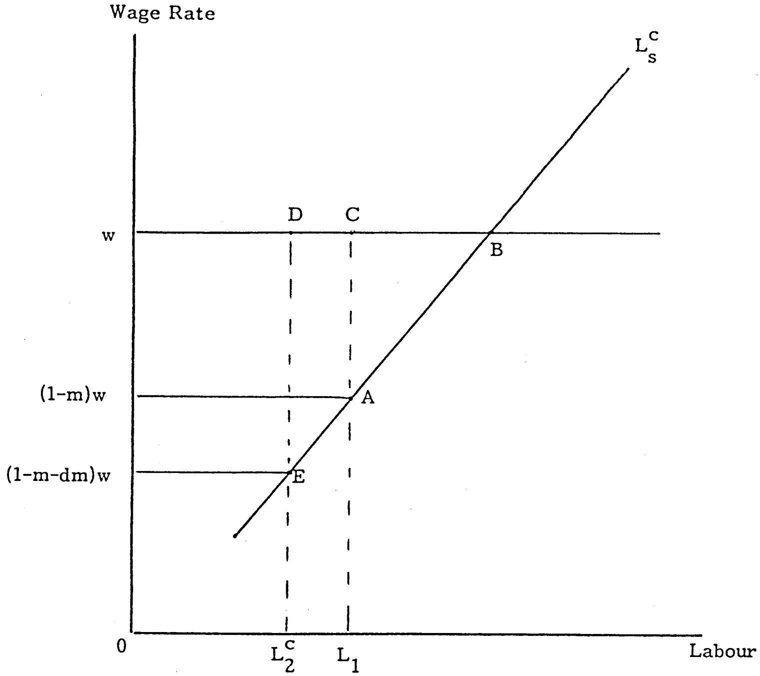

Figure 3: Compensated Labour Supply and Tax Rate Changes

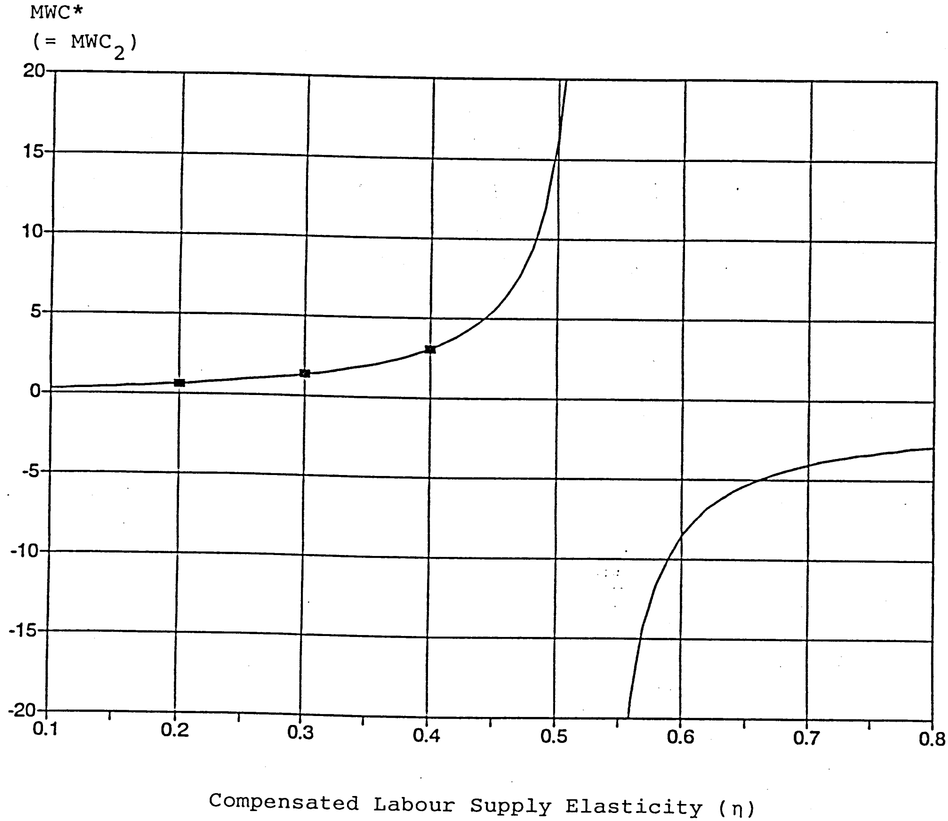

Figure 4. Behaviour of the Marginal Welfare Cost Function

TABLE 1: Rates of Personal Income Tax New Zealand, 1984-86

Annual Taxable Income (Dollars)	Tax Rate per Dollar (Per cent)
<u>1 Dec. 84</u>	
0 - 6,000	20.00
6,001 - 25,000	33.00
25,001 - 30,000	45.10
30,001 - 38,000	56.10
38,001 and above	66.00
<u>1 Oct. 86</u>	
0 - 9,500	15.00
9,501 - 30,000	30.00
30,001 and above	48.00

Source: Department of Inland Revenue

TABLE 2 : Excess Burdens and Welfare Costs of Taxation of Labour Incomes in New Zealand, 1985-86 and 1987-88

		Compensated Labour Supply Elasticity (η)								
		0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60
	<u>1985 - 1986</u>									
1	Total Welfare Cost ($ millions)	1,106	1,383	1,660	1,936	2,213	2,490	2,766	3,043	3,319
2	Total Welfare Cost (percentage of revenue)	13.0	16.3	19.6	22.9	26.1	29.4	32.6	35.9	39.2
3	Marginal Excess Burden ($ thousands)	38,393	47,991	57,590	37,188	76,786	86,385	98,983	105,581	115,180
4	Marginal Welfare Cost * (percentage)	24.6	32.8	42.1	52.9	65.4	80.2	97.9	119.5	146.4
5	Marginal Welfare Cost * (aggregate : percentage)	20.7	27.4	34.8	43.1	52.5	63.2	75.6	90.1	107.1
6	Percentage Difference (4) - (5)	18.8	19.7	21.0	22.7	24.6	26.9	29.5	32.6	36.7
7	Marginal Welfare Cost 1 (percentage)	19.7	24.6	29.5	34.5	39.4	44.3	49.2	54.2	59.1
8	Marginal Welfare Cost 1 (aggregate : percentage)	17.3	21.7	26.0	30.3	34.7	39.0	43.3	47.7	52.0
9	Percentage Difference (7) - (8)	13.9	13.4	13.5	13.9	13.5	13.6	13.6	13.6	13.7
	<u>1987 - 1988</u>									
10	Total Welfare Cost ($ millions)	1,496	1,870	2,244	2,618	2,992	3,366	3,740	4,113	4,487
11	Total Welfare Cost (percentage of revenue)	12.1	15.1	18.1	21.1	24.1	27.1	30.1	33.1	36.2
12	Marginal Excess Burden ($ thousands)	46,533	58,166	69,800	81,433	93,066	104,700	116,333	127,966	139,600
13	Marginal Welfare Cost * (percentage)	25.6	34.3	44.2	55.8	69.4	85.7	105.4	130.0	161.2
14	Marginal Welfare Cost * (aggregate : percentage)	23.4	31.1	39.8	49.7	61.2	74.6	90.5	109.6	132.9
15	Percentage Difference (13) - (14)	9.4	10.3	11.1	12.3	13.4	14.9	16.5	18.8	21.3
16	Marginal Welfare Cost 1 (percentage)	20.3	25.4	30.5	35.5	40.6	45.7	50.8	55.9	60.9
17	Marginal Welfare Cost 1 (aggregate : percentage)	18.9	23.7	28.4	33.1	37.9	42.6	47.3	52.1	56.8
18	Percentage Difference (16) - (17)	7.4	7.2	7.4	7.3	7.1	7.3	7.4	7.3	7.2

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* Copies of these Discussion Papers may be obtained for $4 (including postage, price changes occasionally) each by writing to the Secretary, Department of Economics, University of Canterbury, Christchurch, New Zealand. A list of the Discussion Papers prior to 1989 is available on request.