Chapter 8. Tax Reform

8.1 Introduction[1]

In real life it is rarely possible to reach optimal tax rates immediately. It is more likely that all the policy-maker is permitted is marginal changes around existing tax rates. Tax reform, loosely speaking, deals with improving welfare by making marginal changes in tax design and structure.

What exactly is tax reform? A moment's consideration will tell us that there is no agreement about this. Contradictory policy measures have been suggested, at different times, under the general rubric of tax reform. For instance, in the 1960s James Callaghan introduced a selective employment tax in the UK and called it tax reform. In the 1970s this tax was replaced with VAT by the then Chancellor of the Exchequer, Anthony Barber, and this move was once again called tax reform. In the 1970s investment tax allowances were introduced in the UK and then abandoned in the 1980s. Both the adoption of the tax allowances as well as their abandonment were called tax reform. Hence, what a tax reform is depends very much on the value systems prevailing at the time. However, not all changes in taxes should be called tax reform. We would do well to reserve this term for 'significant' changes.

Tax reform, so defined, may take a variety of forms. It can cover increases or decreases in tax rates, brackets or thresholds and changes in the tax base; the introduction of new taxes and the abolition of old taxes; and changes in the tax mix. The indexation of a major tax (in the case of an economy experiencing inflation) also constitutes tax reform as does a radical change in administrative practices and procedures.

To be sure current interest in tax reform has been fueled by almost universal tax reforms in the 1980s. The 1980s was truly a decade of worldwide tax reform. Almost all countries of Western Europe would claim to have undergone tax reform during that period. The USA introduced a major Tax Reform Act in 1986. In Canada the Goods and Services Tax (GST) came into place. Japan is undergoing tax reforms. New Zealand has thoroughly revised its tax structures and Australia has made substantial changes to tax laws.

Several developing countries have also undergone or are currently setting up deep tax reforms. These include large developing countries such as India, where the government has appointed a Tax Reforms Committee, and several smaller ones as well. Cnossen (1992) reports, for

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1 This part draws from Jha (1998, Chap.16, pp.366-71).

example, that approximately forty countries in Africa, Asia, and Latin America have a VAT. Twenty-one of the twenty-four OECD countries have a VAT. It is quite surprising to recall that the VAT was almost unknown twenty-five years ago. The phenomenon of tax reform has been truly universal.

Even more interesting than the universality of reforms is the fact that those taking place in different countries have a lot in common. We discuss below some common characteristics, particularly for the developed countries.

Table 1 Top rates of central government personal income tax 1976, 1986, 1992, for selected OECD countries

Country	Top rates percent			Percentage points reduction
	1976	1986	1992	1976 figure minus 1992 figure
Australia	65	57	48	17
Austria	62	62	50	12
Canada	43	34	29	14
Finland	51	51	39	12
France	60	65	57	3
Germany	56	56	53	3
Ireland	77	58	52	25
Italy	72	62	50	22
Japan	75	70	50	25
Netherlands	72	72	60	12
New Zealand	60	57	33	27
Norway	48	40	13	35
Sweden	57	50	20	37
UK	83	60	40	43
USA	70	50	31	39
Unweighted average	63.4	56.3	41.7	21.7

Source: Various OECD publications

(i) An important feature of tax reforms has been reduction in the top rates of income tax. Table 1 shows the top rates of personal income tax for a set of OECD countries in 1976 (i.e. before the reforms began); in 1986 (when the reforms program was well under way) and in 1992 (when several countries had finished the bulk of economic reforms).

As Table 1 shows the reduction in rates has been quite dramatic for some of the countries. The US and UK top marginal tax rates have been cut by more than half. Norway and Sweden have effected deep cuts as well, whereas France and Germany have had smaller cuts. The unweighted average of the top marginal tax rates has also fallen quite sharply.

Coupled with reductions in the top marginal rates were reductions in rates at the lower and middle ranges of the tax schedule, as well as an increase in the exemption limit. In Sweden, for example, after the 1990 reform, there was a single rate of central government income tax of 20 percent; the lowest rate of tax, hitherto 4 percent, therefore went up to 20 percent; but because the exemption limit was increased, the net effect was to reduce the 4 percent rate to zero.

(ii) Associated with the reduction in tax rates and an increase in the exemption limit was a reduction in the number of slabs in the income tax scale. In the UK the income tax had ten steps in 1976 which came down to three in 1992. At the beginning of the 1980s, New Zealand had nineteen slabs which came down in ten years to just two.

Tax reforms effected were, however, revenue neutral; there was hardly any change in tax revenue as a result of these reforms. How has it been possible to make such marked reductions in income tax while more or less sustaining tax revenue?

This was accomplished:

(a) by broadening the base of the income tax (including tightening up on income-related taxes and/or imposing new income-related taxes);

(b) by changing the tax mix, i.e., raising more from other taxes.

This then leads us to the third and fourth major characteristics of recent tax reforms.

(iii) The third major characteristic of recent tax reforms has been a broadening of the income tax base. This has included reductions and streamlining of different concessions, loopholes, and possible tax shelters.

A particularly important example of this was the taxation of fringe benefits. In New Zealand and Australia, for example, the taxable value of these fringe benefits was raised much closer to their market values and taxed in the hands of the employees.

Another major innovation in this direction was tightening of laws relating to taxing of capital gains. In the USA, for example, capital gains were completely assimilated in the income tax. Similar moves were made in Canada, Australia, Japan and several of the Scandinavian countries.

(iv) Another important characteristic of the tax reform package has been the change in tax mix. Reductions in personal income taxation were partly financed by an increase in other taxes. In most cases this took the form of the introduction of a nationwide VAT. Most European Union (EU) countries have long had the VAT, while New Zealand and Canada introduced it in the guise of a Goods and Services Tax (GST).

Another route taken to compensate for the reduction in tax revenue from personal income taxes was to collect more revenue from corporate taxes. This was generally achieved by broadening the base of the corporate tax (without increasing tax rates). This was done in Canada and the USA.

(v) The broadening of the base of the corporate tax was accompanied by a reduction in the rates. In the UK, for example, from 1984 the 100 percent first year write-off for plant and equipment was replaced by a 25 percent depreciation allowance, and provision for stock relief against inflation were withdrawn. In parallel, the rates of corporate tax were cut from 52 percent to 33 percent.

Similarly, in the USA the primary rate of corporate tax was cut from 46 to 34 percent. At the same time, investment incentives were cut. Similar reform were effected by Canada, Australia, New Zealand, and some of the Scandinavian countries.

(vi) Finally, tax reforms were always accompanied by considerable toning up of tax administration.

Reasons for tax reform

An interesting question to ask at this point is why did such substantial tax reforms take place in so many countries simultaneously. There are several reasons for this:

(a) There was extreme discontent with the existing tax system in most of the countries. This took several forms. On the one hand, it was felt that, high marginal tax rates were having serious disincentive effects on savings, labor supply and entrepreneurship. On the other hand, they were providing considerable avenues for tax avoidance and evasion and considerable energies and resources were being diverted to making up tax shelters. Birnbaum and Murray (1988), for example, provide numerous examples of the extent of tax avoidance by individuals and firms and show why the US Tax Reform Act of 1986 had become a dire necessity. Similar examples can be found in the experiences of Canada, Japan, Australia and New Zealand.

(b) It was also felt that apart from diverting resources from work and savings to tax avoidance, high marginal tax rates had not achieved the social and economic objectives they had been designed to meet. For instance, there was a widespread perception that high marginal tax rates had failed to reduce or even limit inequalities of income and wealth which was their objective. The rich were best placed to obtain advice on tax shelters and take advantage of tax loopholes. Thus, the effective progression of many tax systems was much less than the nominal progression. It began to be felt that if the tax concessions were reduced or eliminated, the same degree of progression could be achieved, with less horizontal inequity and with lower marginal tax rates.

(c) At the same time there was concern in almost all OECD countries that governments were taxing and spending too much. As Table 2 indicates, total tax revenues had climbed up substantially. The 1970s were marked by high inflation which, acting on large unindexed tax systems, perpetrated inequities. Those most dependent on tax allowances, which failed to keep pace with prices, were hard hit. Taxpayers climbed into higher tax brackets purely because of inflation, faced higher marginal tax rates and had their real incomes reduced. Interest rates that were not indexed for inflation affected savers. The stagflation that hit major OECD economies (indeed the world economy, generally) in the early 1980s made tax reform more difficult but, at the same time, more necessary. Budget deficits which had grown very large in the 1980s because of higher social sector spending (due to recession) had to be brought under control without undue pain.

The growth in tax revenues across these countries has been achieved, as has been noted above, by reducing marginal tax rates and broadening the tax base. As a result, the shares of various taxes in total tax revenues have not changed much. This is indicated in Table 3 for three major heads of taxes: personal taxes, corporate taxes and commodity taxes. This table indicates the broad stability in revenue sources in member counties during periods of intense tax reforms.

Table 2 Growth in total tax revenue (including social security contributions) as a percentage of GDP at market prices, OECD countries, 1965-85

Country	Tax revenue as % of GDP		Increase of 1985 over 1965	
	1976	1992	Percentage points	Percentage increase
Australia	23.2	30.0	6.8	29.3
Austria	34.7	43.1	8.4	24.2
Belgium	31.2	47.6	16.4	52.6
Canada	25.4	33.1	7.7	30.3
Denmark	29.9	49.0	19.1	63.9
Finland	29.5	37.0	7.5	25.4
France	34.5	44.5	10.0	29.0
Germany	31.6	38.1	6.5	20.6
Greece	22.0	35.1	13.1	59.5
Ireland	27.8	28.8	1.0	3.6
Italy	25.5	34.4	8.9	34.9
Japan	18.3	27.6	9.3	50.8
Luxembourg	30.6	50.1	19.5	63.7
Netherlands	33.2	44.9	11.7	35.2
New Zealand	24.7	34.1	9.4	38.0
Norway	33.3	47.6	14.3	42.9
Portugal	18.4	31.6	13.2	71.7
Spain	14.3	28.8	14.5	101.4
Sweden	35.2	50.4	15.2	43.2
Switzerland	20.7	32.0	11.3	54.6
Turkey	15.0	19.7	4.7	31.3
UK	30.4	37.9	7.5	24.7
USA	25.9	29.2	3.3	12.7
Unweighted average	**26.7**	**37.2**	**10.5**	**39.3**

Source: Various OECD publications

Table 3 Shares of various taxes in total tax revenues

	UK	OECD total	OECD Europe	EC
		Taxes on personal income		
1965	29.8	25.9	24.8	20.9
1970	31.4	27.7	26.1	22.2
1975	37.9	30.7	28.8	26.1
1980	29.8	32.0	29.8	27.5
1985	27.1	30.4	27.7	26.5
1988	26.8	30.2	27.9	26.6
1989	27.1	29.3	27.0	25.3
1990	28.6	29.8	27.5	25.9
1991	28.3	29.7	27.6	26.2
1992	28.4	29.7	27.8	26.3
		Taxes on corporate income		
1965	7.1	8.9	6.3	7.0
1970	9.1	8.7	6.4	7.4
1975	6.7	7.5	5.7	6.5
1980	8.3	7.4	6.0	6.6
1985	12.5	7.8	6.9	7.2
1988	10.7	7.7	6.5	7.2
1989	12.1	7.8	6.6	7.4
1990	10.9	7.7	6.7	7.6
1991	8.8	7.3	6.3	7.1
1992	7.6	6.8	5.8	6.7
		Taxes on goods and services		
1965	33.0	38.0	40.1	38.5
1970	28.8	35.8	38.2	36.7
1975	25.4	31.4	33.2	31.5
1980	29.2	30.2	31.9	31.1
1985	30.7	31.0	32.9	31.5
1988	31.3	31.0	32.9	32.5
1989	30.5	30.4	32.2	31.8
1990	30.5	30.0	31.8	31.8
1991	33.3	30.2	31.8	31.8
1992	34.4	30.3	31.9	32.1

Source: Various OECD publications

8.2 Welfare Evaluation of Economic Changes[2]

Suppose that we know the consumer's preferences $\succeq$ and that indirect utility function $v(p,w)$ can be derived from $\succeq$, then it is a simple matter to determine whether the price change makes the consumer better or worse off, depending on the sign of $v(p^1,w)- v(p^0,w)$.

In case of welfare change measurement, *money metric* indirect utility functions can be constructed by means of the expenditure function. Starting from any indirect utility function $v(\cdot,\cdot)$, choose an arbitrary price vector $\bar{p} >> 0$, and consider the function $e(\bar{p}, v(p,w))$. This function gives the wealth required to reach the utility level $v(p,w)$ when prices are $\bar{p}$. This expenditure is strictly increasing as a function of the level $v(p,w)$, thus it is an indirect utility function for $\succeq$. $e(\bar{p}, v(p^1,w)) - e(\bar{p}, v(p^0,w))$ provides a measure of the welfare

[2] This part is drown heavily from Mas-Colell, Whinston and Green (1995), in particular, pages 80-91.

change expressed in money term.

Two natural choices for the price vector $\bar{p}$ are the initial price vector p^0 and the new price vector p^1. These choices lead to two well-known measures of welfare change originating in Hicks (1939), *the equivalent variation* (EV) and *the compensating variation* (CV). Formally, let $u^0 = v(p^0, w)$ and $u^1 = v(p^1, w)$ and note that $e(p^0, u^0) = e(p^1, u^1) = w$, we define

$$EV(p^0, p^1, w) = e(p^0, u^1) - e(p^0, u^0) = e(p^0, u^1) - w \qquad (1)$$

and

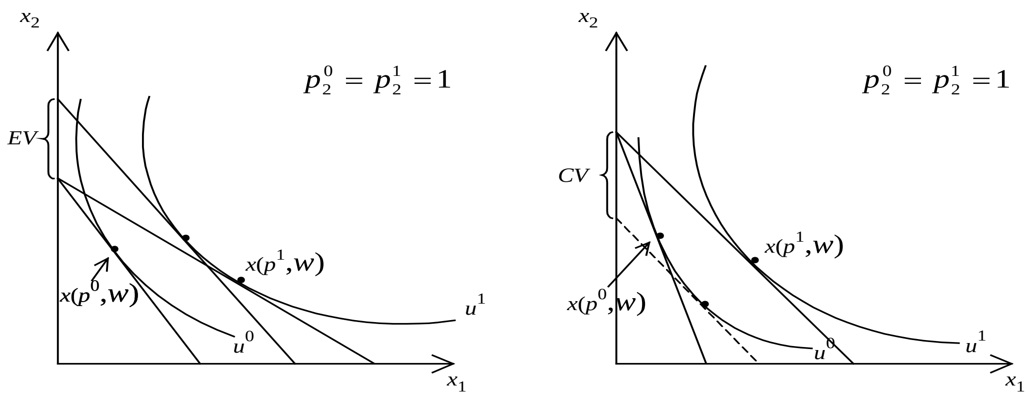
$$CV(p^0, p^1, w) = e(p^1, u^1) - e(p^1, u^0) = w - e(p^1, u^0) \qquad (2)$$

The equivalent variation implies that it is the change in her wealth that would be *equivalent* to the price change in terms of its welfare impact. Note that $e(p^0, u^1)$ is the wealth level at which the consumer achieves exactly utility level u^1, the level generated by the price change, at price p^0.

The compensating variation, on the other hand, measures the net revenue of a planner who must *compensate* the consumer for the price change after it occurs, bringing her back to her original utility level u^0.

Figure 1 depicts the equivalent and compensating variation measures of welfare change.

Figure 1 Welfare Evaluations by Utility



(a) Equivalent Variation (b) Compensating Variation

The equivalent and compensating variations have interesting representations in terms of the Hicksian demand curve. Suppose, for simplicity, that only the price of good 1 changes, so that $p_1^0 \neq p_1^1$ and $p_l^0 = p_l^1 = \bar{p}_l$ for all $l \neq 1$. Because $w = e(p^0, u^0) = e(p^1, u^1)$ and

$h_1(p,u) = \partial e(p,u)/\partial p_1$, we can write

$$\begin{aligned} EV(p^0, p^1, w) &= e(p^0, u^1) - w \\ &= e(p^0, u^1) - e(p^1, u^1) \\ &= \int_{p_1^1}^{p_1^0} h_1(p_1, \bar{p}_{-1}, u^1) dp_1 \end{aligned} \tag{3}$$

where $\bar{p}_{-1} = (\bar{p}_2, ..., \bar{p}_2)$.

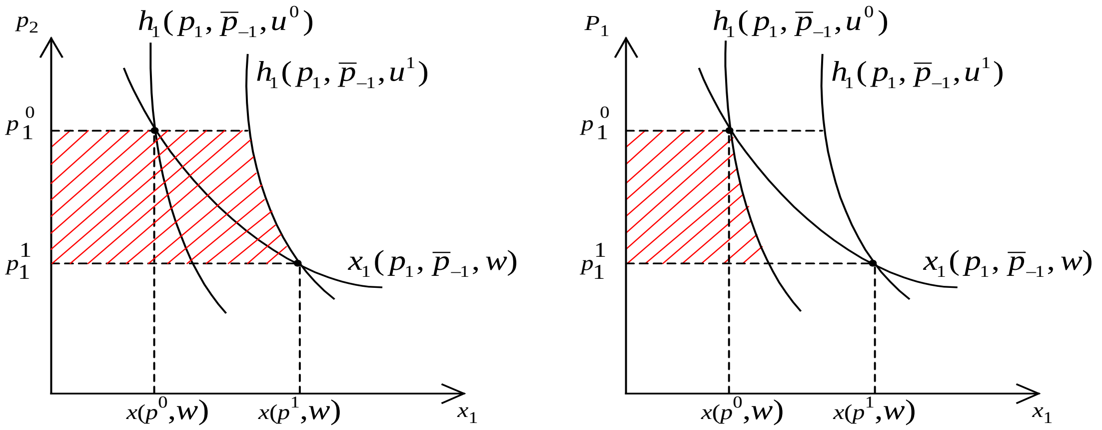
The change in consumer welfare as measured by EV can be represented by the area lying between p_1^0 and p_1^1 and to the left of the Hicksian demand curve for good 1 associated with utility level u^1 (it is equal to this area if $p_1^1 < p_1^0$ and is equal to its negative if $p_1^1 < p_1^0$). The area is depicted as the shaded region in Figure 2 (a).

Similarly, the compensating variation can be written as

$$CV(p^0, p^1, w) = \int_{p_1^1}^{p_1^0} h_1(p_1, \bar{p}_{-1}, u^1) dp_1 \tag{4}$$

See Figure 2(b) for its graphic representation.

Figure 2 Welfare Evaluation by Hicksian Demand



(a) Equivalent Variation (b) Compensating Variation

Figure 2 illustrates a case where good 1 is a normal good. As can be seen in Figure 2, we have $EV(p^0, p^1, w) > CV(p^0, p^1, w)$. This relation between the *EV* and the *CV* reverses when good 1 is inferior. However, if there is no wealth effect for good 1, the *CV* and the *EV* are the same because we have

$$h_1(p, \overline{p}_{-1}, u^0) = x_1(p_1, \overline{p}_{-1}, w) = h_1(p_1, \overline{p}_{-1}, u^1) \quad (5)$$

In absence of wealth effects, the common value of *CV* and *EV* is called as the change in *Marshallian consumer surpurs*.

8.3 The Deadweight Loss from Commodity Taxation

Suppose that the government taxes commodity 1, setting a tax on the consumer's purchases of good 1 of t per unit. This tax changes the effective price of good 1 to $p_1^1 = p_1^0 + t$ while prices for all other commodities ($l \neq 1$) remain fixed at p_l^1 (so we have $p_l^1 = p_l^0$ for all $l \neq 1$). The total revenue raised by the tax is $T = tx_1(p^1, w)$.

An alternative to this commodity tax that raises the same amount of revenue for the government without changing prices is imposition of a "lump-sum" tax of T directly on the consumer's wealth. Is the consumer better or worse off facing this lump-sum wealth tax rather than the commodity tax?

She is worse off under the commodity tax if the equivalent variation of the commodity tax $EV(p^0, p^1, w)$, which is negative, is less than $-T$, the amount of wealth she will lose under the lump-sum tax.

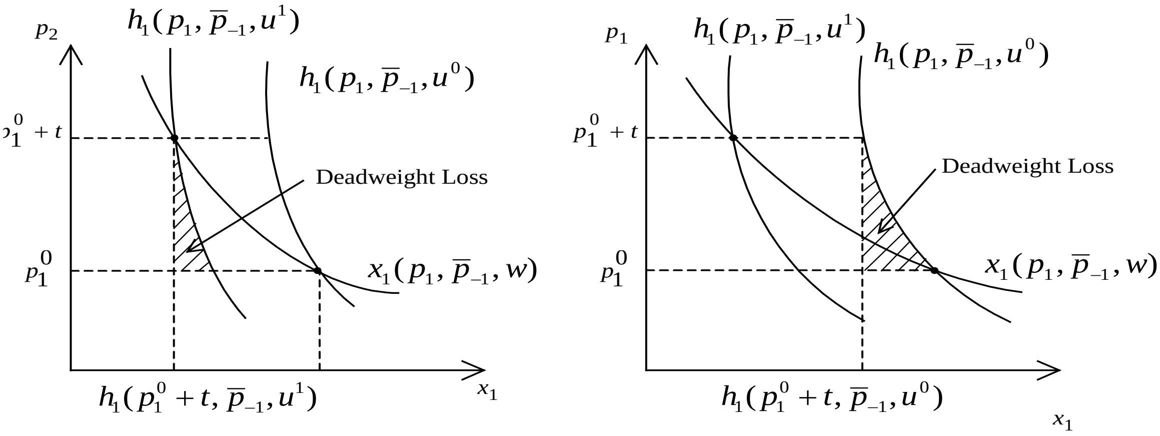
Put in terms of the expenditure function, she is worse off under commodity taxation if $w - T > e(p^0, u^1)$, so that her wealth after the lump-sum tax is greater than the wealth level that is required at prices p^0 to generate the utility level that she gets under the commodity tax u^1. The difference $(-T) - EV(p^0, p^1, w) = w - T - e(p^0, u^1)$ is known as *the deadweight loss of commodity taxation*. It measures the extra amount by which the consumer is made worse off by commodity taxation above what is necessary to raise the same revenue through a lump-sum tax.

The deadweight loss measure can be represented in terms of the Hicksian demand curve at utility level u^1. Since $T = tx_1(p^1, w) = th_1(p^1, u^1)$, we can write the deadweight loss as follows:

$$\begin{aligned}(-T) - EV(p^0, p^1, w) &= e(p^1, u^1) - e(p^0, u^1) - T \\ &= \int_{p_1^0}^{p_1^0+t} h_1(p_1, \overline{p}_{-1}, u^1) dp_1 - th_1(p_1^0 + t, \overline{p}_{-1}, u^1) \quad (6) \\ &= \int_{p_1^0}^{p_1^0+t} \left[h_1(p_1, \overline{p}_{-1}, u^1) - h_1(p_1^0 + t, \overline{p}_{-1}, u^1)\right] dp_1\end{aligned}$$

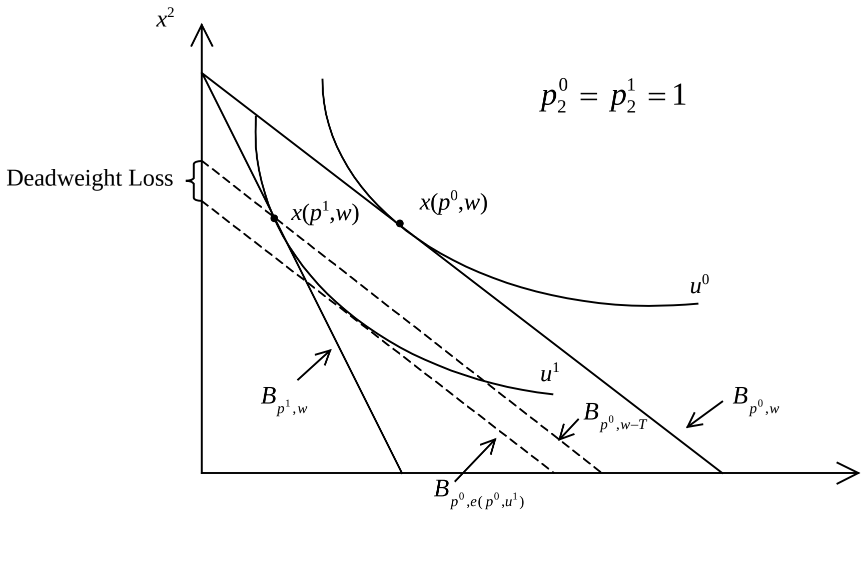
Because $h_1(p,u)$ is non increasing in p_1, this expression is nonnegative, and it is strictly positive if $h_1(p,u)$ is strictly decreasing in p_1. Figure 3 (a) shows the deadweight loss in the area of the shaded triangular region (*the deadweight loss triangle*).

Figure 3 Deadweight Loss from Commodity Taxation



(a) Measure based at u^1 (b) Measure based at u^0

Figure 4 Alternative way to Express Deadweight Loss from Commodity Taxation



Since $(p_1^0+t)x_1(p^1,w)+p_2^0x_2(p^1,w)=w$, the bundle $x(p^1,w)$ lies not only on the budget line associated with budget set $B_{p^1,w}$, but also on the budget line associated with budget set $B_{p^0,w-T}$. In contrast, the budget set that generates a utility of u^1 for the consumer at prices

p^0 is $B_{p^0,e(p^0,u^1)}$. The dead weight loss is the vertical distance between the budget lines associated with budget sets $B_{p^0,w-T}$ and $B_{p^0,e(p^0,u^1)}$.

A similar deadweight loss triangle can be calculated using the Hicksian demand curve $h_1(p_1,u^0)$. It also measures the loss from commodity taxation, but in a different way.

Suppose that we examine the surplus or deficit that would arise if the government were to compensate the consumer to keep her welfare under the tax equal to her pretax welfare u^0. The government would run a deficit if the tax collected $th_1(p^1,u^0)$ is less than $-CV(p^0,p^1,w)$ or, equivalently, if $th_1(p^1,u^0) < e(p^1,u^1) - w$. Thus, the deficit can be written as

$$
\begin{aligned}
-CV(p^0,p^1,w) - th_1(p^1,u) &= e(p^1,u^0) - e(p^0,u^0) - th_1(p^1,u^0) \\
&= \int_{p_1^0}^{p_1^0+t} h_1(p^1,\overline{p}_{-1},u^0)dp_1 - th_1(p_1^0+t,\overline{p}_{-1},u^0) \qquad (7) \\
&= \int_{p_0^1}^{p_1^0+t} \left[h_1(p^1,\overline{p}_{-1},u^0)dp_1 - h_1(p_1^0+t,\overline{p}_{-1},u^0)\right]dp_1
\end{aligned}
$$

This is strictly positive as long as $h_1(p_1,u)$ is strictly decreasing in p_1. This deadweight loss measure is shown in the shaded area in Figure 3 (b).

8.4 Using the Walrasian Demand Curve as An Approximate Welfare Measure

As we have seen above, the welfare change induced by a change in the price of good 1 can be exactly computed by using the area to the left of an appropriate Hicksian demand curve. However the Hicksian demand curve is not directly observable. A simple procedure is to use the Walrasian demand curve instead. We call this estimate of welfare change the *area variation measure* (*AV*):

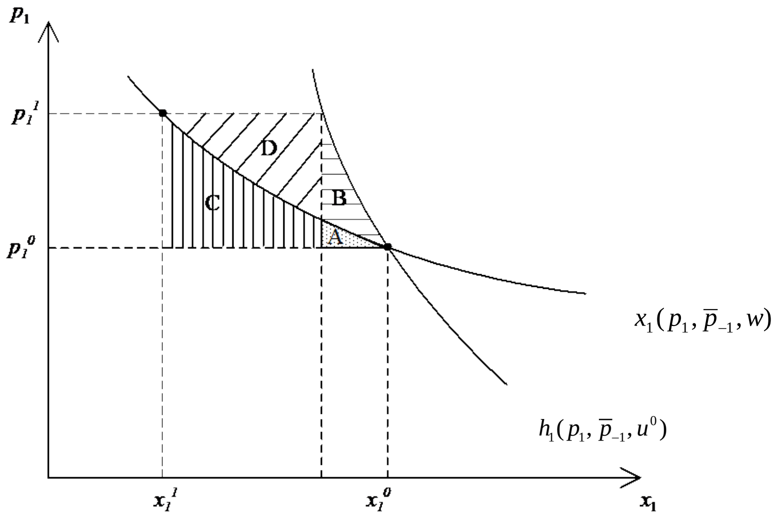
$$AV(p^0,p^1,w) = \int_{p_1^1}^{p_1^0} x_1(p_1,\overline{p}_{-1},w)dp_1 \qquad (8)$$

As Figure 2 (a) and (b) show, when good 1 is normal good, the area variation measure overstates the compensating variation and understates the equivalent variation. When good 1 is inferior, the reverse relations hold. Thus when evaluating the welfare change from a change in prices of several goods, or when comparing two different possible price changes, the area variation measure need not give a correct evaluation of welfare change.

If the wealth effects for the goods under consideration are small, the approximation errors are also small and the area variation measure is almost correct.

If $(p_1^1 - p_1^0)$ is small, then the error involved using the area variation measure becomes small as a fraction of the true welfare change.

Figure 5 Area Variation Measure of Welfare Change



In Figure 5, the area B+D, which measures the difference between the area variation and the true compensating variation becomes small as a fraction of the true compensating variation when $(p_1^1 - p_1^0)$ is small. The area variation measure is a good approximation of the compensating variation measure for small price changes.

However, the approximation error may be quite large as *a fraction of the deadweight loss*. In Figure 5, the deadweight loss calculated using the Warlasian demand curve is the area A+C, where as the real one is the area A+B. The percentage difference between these two areas need not grow small as the price change grows small.

When $(p_1^1 - p_1^0)$ is small, there is a superior approximation procedure available. Suppose we take a first-order Taylor approximation of $h(p, u^0)$ at p^0,

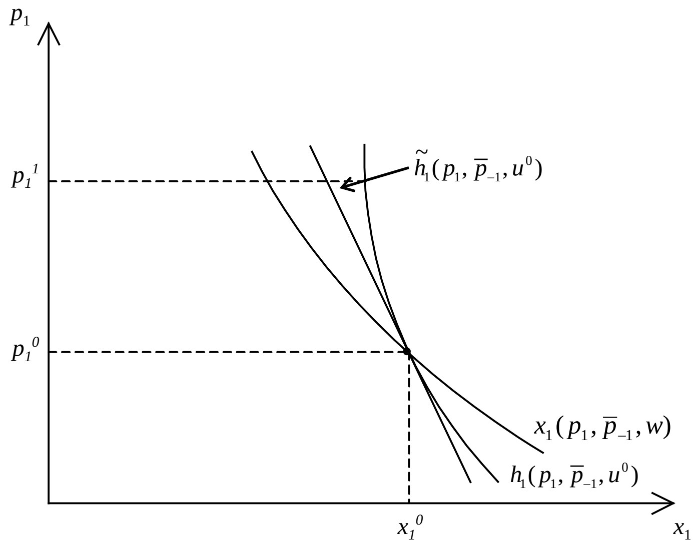
$$\tilde{h}(p,u^0) = h(p^0,u^0) + D_p h(p^0,u^0)(p - p^0) \qquad (9)$$

and we calculate

$$\int_{p_1^1}^{p_1^0} \tilde{h}_1(p_1, \bar{p}_{-1}, u^0)dp_1 \tag{10}$$

as an approximation of the welfare change. The function $\tilde{h}_1(p_1, \bar{p}_{-1}, u^0)$ is depicted in Figure 6.

Figure 6 A First-Order Approximation of Demand Function



Because $\tilde{h}_1(p_1, \bar{p}_{-1}, u^0)$ has the same slope as the true Hicksian demand function $h_1(p, u^0)$ at p^0, for small price changes, this approximation comes closer than expression (8) to the true welfare change.

The approximation in (10) is directly computable from knowledge of the observable Walrasian demand function $x^1(p,w)$. To see this, note that because $h(p^0, u^0) = x(g^0, w)$ and $D_p h(p^0, u^0) = s(p^0, w), \tilde{h}(p, u^0)$ can be expressed solely in terms that involve the Walrasian demand function and its derivatives at the point (p^0,w).

$$\tilde{h}(p, u^0) = x(p^0, w) + s(p^0, w)(p - p^0) \tag{11}$$

In particular, since only the price of good 1 is changing, we have

$$\tilde{h}_1(p_1, \overline{p}_{-1}, u^0) = x_1(p_1^0, \overline{p}_{-1}, w) + s_{11}(p_1^0, \overline{p}_{-1}, w)(p_1 - p_1^0) \quad (12)$$

where $s_{11}(p_1^0, \overline{p}_{-1}, w) = \dfrac{\partial x_1(p^0, w)}{\partial p_1} + \dfrac{\partial x_1(p^0, w)}{\partial w} x_1(p^0, w)$

When (p^1- p^0) is small, this procedure provides a better approximation to the true compensating variation than does the area variation measure. On the other hand, when (p^1- p^0) is large, it is difficult to judge which is the better approximation.

It is entirely possible for the area variation measure to be superior. After all, its use guarantees some sensitivity of the approximation to demand behavior away from p^0, whereas the use of $\tilde{h}(p, u^0)$ does not.

8.5 Tax Reform in A Dynamic Context[3]

One of the important aims of tax reform, in recent years, has been to increase savings and to affect the intergenerational distribution of resources. In this section we study intergenerational transfers and the efficiency of tax reforms. Tax revenues are assumed to be age independently transferred to households. We follow, in the main, the work of Felder (1993).

The framework of the analysis is the standard life-cycle model of savings (with fixed labor). For a young person at time t we define utility from first- and second-period consumption and write the utility of a representative household as:

$$U_t = U(c_t^1, c_{t+1}^2) \quad (13)$$

where the notation is obvious. This worker inelastically supplies one unit of labor in the first time period for which the gross wage is w_t and the net wage is $w_t(1-\tau_w^t)$ where τ_w^t is the proportional rate of wage tax in time period t. In each period the worker gets a transfer of g and this is assumed to be constant. Thus the consumer's budget constraint with the wage tax is:

$$\begin{aligned} c_t^1 + c_{t+1}^2/(1+r_{t+1}) &= w_t(1-\tau_w^t) + g + g/(1+r_{t+1}) \\ &= w_t(1-\tau_w^t) + g[2+r_{t+1}]/(1+r_{t+1}) \end{aligned} \quad (14)$$

where r_{t+1} is the interest rate prevailing in period $(t+1)$.

If, instead, we had a consumption tax at the rate τ_c^t the budget constraint of the consumer would have been written as:

$$c_t^1/(1-\tau_c^t) + c_{t+1}^2/[(1+r_{t+1})(1-\tau_c^{t+1})] = w_t + g[(2+r_{t+1})/(1+r_{t+1})]. \quad (15)$$

Finally let us consider an income tax which consists of a wage tax at rate τ_w^t and a savings (or second-period consumption) tax at the rate τ_c^t. In this case we can write the individual's budget constraint as:

$$c_t^1 + c_{t+1}^2/[(1+r_{t+1})(1-\tau_c^{t+1})] = w_t(1-\tau_w^t) + g[(2+r_{t+1})/(1+r_{t+1})]. \quad (16)$$

Let us assume that the population grows exogenously at the rate *n*. We further assume that the government transfers all revenues to the households, then the budget constraint of the government can be written in the three cases as:

(a) wage tax case:

$$\tau_w^t w_t = g + g/(1+n) = g(2+n)/(1+n) \quad (17)$$

since the relation between population this period and the population last period is $1/(1+n)$ and this period the government has to make transfers to the young of this period and the old of the last period.

(b) consumption tax case:

$$\tau_c^t[c_t^1 + c_t^2/(1+n)]/(1-\tau_c^t) = g(2+n)/(1+n). \quad (18)$$

The consumption of the young of today is $c_t^1/(1-\tau_c^t)$. The number of old people from the last generation per young person today is, by virtue of population growth, $1/(1+n)$. Hence consumption by the old of last period is $c_t^2/(1+n)/(1-\tau_c^t)$. This then explains the lefthand side of equation (8.17). The right-hand side has already explained above.

(c) income tax: the budget constraint of the government is now:

$$\tau_w^t w_t + \tau_c^t[c_t^2/(1+n)]/(1-\tau_c^t) = g(2+n)/(1+n). \quad (19)$$

The first term on the left-hand side is the revenue from the wage tax and the second term is the

[3] This part draws from Jha (1998, Chap.16, pp.377-82).

revenue from the consumption tax on the old of the last period who, because of population growth, are fewer than the number of young today.

Now since taxes paid are dependent on age whereas transfers do not depend on age, it follows that there is an *intergenerational transfer*. Let us denote $a_t^w w_t$ as the net tax paid (gross tax paid less transfers received) with the wage tax in place. In a similar manner we define $a_t^c w_t$ and $a_t^y w_t$ as the net tax paid under the consumption and income taxes respectively. The net tax paid in each case is linked to the wage rate although wage income is not the base for, say, the consumption tax.

First-period net tax payment with the wage tax on substitution from equation (17) is:

$$a_t^w w_t + \tau_w^t w_t - g = \tau_w^t - \tau_w^t w_t (1+n)/(2+n) = \tau_w^t w_t /(2+n) . \quad (20)$$

For the consumption tax on substitution from equation (18) we will have:

$$a_t^c w_t = \tau_c^t (c_t^1 - c_t^2)/[(1-\tau_c^t)(2+n)] . \quad (21)$$

For the income tax upon substitution from equation (19) we will have:

$$a_t^y w_t = [\tau_w^t w_t - \tau_c^t (c_t^2 /(1-\tau_c^t))]/(2+n) . \quad (22)$$

Only the young pay the wage tax whereas both the young and the old pay the consumption and income taxes.

The second-period payments received by old households equals the net tax payments of young households multiplied by the growth factor. For any household, each tax system looks like an intergenerational transfer mechanism to which it contributes $a_t w_t$ when young and receives $a_{t+1} w_{t+1}$ when old. Intergenerational transfers plus the wealth and substitution effects associated with different taxes determine the influence of these respective taxes on the savings decisions of households.

When labor is inelastically supplied, as is being assumed so far, utility is a monotonic function of wealth. Hence, to find out the effects of different taxes we have to examine their effects on lifetime wealth.

In steady state the rate of return on net tax payments in the first period always equals the growth factor so that lifetime wealth W^{j} under tax regime $j(\mathrm{j} = w, c, y)$ can be written as:

$$W^{\mathrm{j}} = a^{\mathrm{j}} w(n-r)/(1+r) . \quad (23)$$

Hence whether wealth increase over one's lifespan would depend upon the sign of a^j which itself depends upon the direction in which intergenerational transfers are going and on the sign of $(n - r)$. When $r < n$ then tax regimes involving a transfer from the young to the old, for example, will increase wealth. This is because the net of return on tax paid (n) exceeds that on productive investment (r). When $r < n$ transfers to the young increase and transfers to the old would decrease wealth. When we are at the golden rule $(r = n)$ then there is no opportunity to get a rate of return different from that given by productive investment and there are no wealth effects.

With a wealth tax a^w is positive and, hence, there is a transfer from the young to the old. Thus lifetime wealth increases (decreases) with the wage tax as $r < n(r > n)$. With the consumption tax a^c can take either sign. With a constant elasticity type of utility function it can be shown that a^c will be negative so that the young are subsidized by the old. Thus lifetime wealth decreases (increases) as $r < n(r > n)$. With an income tax at the same rate on both wage and consumption, the same results as those with wage tax will hold.

With non-distortionary taxation second-period consumption can be written as:

$$c^2_{t+1} = s_t(1 + r_{t+1}) + (1 + n)a_{t+1}w_{t+1}. \quad (24)$$

where s_t represents first-period savings. When the tax changes *b* will change. Differentiating s_t with respect to a_t and assuming that $a_t = a_{t+1}$, we will get:

$$ds_t/da_t = [dc^2_{t+1} / da_t - (1 + n)w_{t+1}]/(1 + r_{t+1}). \quad (25)$$

The second term within parenthesis is negative. The higher the tax, the higher the grant and the lower, therefore, the incentive to save. The first term is also negative if second-period consumption is a normal good. The higher the *a*, the lower the net wage and the lower the second-period consumption. These results are due to the partial equilibrium exercise of Feldstein (1974) and carry over to general equilibrium provided that it is unique and stable.

Tax Reform

Tax reforms subject to a balanced budget requirement can easily be analyzed. Since $a^c > a^w$, it follows that when consumption taxes are substituted for a wage tax savings will increase. This is independent of whether wealth is rising or falling ($r > n$ or $r < n$). If preferences are Cobb-Douglas then, with uniform income tax rates, $a^w > a^y > a^c$. Savings would be highest with a consumption tax and lowest with a wage tax with the income tax case falling in between.

Let us now discuss production efficiency. Suppose that production is carried on with capital and labor as inputs using a standard neoclassical production function: $f(k_t)$ where k_t is the capital-labor ratio and $f(.)$ is the intensive production function. Factors are paid their marginal products so that $r_t = f'$ and $w_t = f - kf'$. Current capital stock is the amortized value of last period's savings: $k_t = s_{t-1}/(1+n)$, where s_t denotes savings per worker.

Suppose now that we substitute a consumption tax for the wage tax. Suppose this change occurs at time period $t = 0$. Now, since $a^w > a^c$ there will be a transfer from the old to the young. Hence the old in time period 0 will find their pensions lower by the amount $(a^w - a^c)(1+n)w$. If $r > n$ then[4] the lifetime wealth of everyone else increases. One can always get more from productive investments than the increased commitments toward the elderly. Hence, savings will also rise. Moreover, since $k_t = s_{t-1}/(1+n)$ it follows that per worker capital stock (k_t^c) will be higher for the consumption tax case as opposed to the wage tax case (k_t^w). This will have the consequence that the rate of return to capital in the consumption tax case (r_t^c) will be lower than that in the wage tax case (r_t^w):

$$r_t^c < r_t^w \text{ for } t = 0, 1, 2, \dots \tag{26}$$

The fact that the capital-labor ratio is higher means that output per worker is higher but it can be shown that this increase in production is not high enough to support an intergenerational transfer mechanism that would improve the welfare of every generation.

Let us now define total consumption per worker c_t as:

$c_t = c_t^1 + c_t^2/(1+n)$.

In period 0 the change in consumption:

$\Delta c_0 = c_0^c - c_0^w < 0$.

This decrease in consumption can be completely offset by an increase in consumption in the subsequent period if:

$$(1+n)\ \Delta c_1 / (1 + r_1^w) > -\Delta c_0. \tag{27}$$

In expression (27) Δc_1 is the change in consumption in period 1. Because of the increase in population it will be (1+n) times this value in time period 0. But the change in consumption will occur in a later period and will, therefore, need to be discounted back. Hence the left-hand side of expression (26). If this condition holds then the young can fully compensate the old for their loss. Substituting Δs_0 for $-\Delta c_0$ and rearranging allows us to write (27) as:

[4] The case r<n is not very interesting since no generation would profit from the shift to consumption taxes.

$$\Delta c_1 > \Delta s_0 (1+r_1^w)/(1+n) . \qquad (28)$$

Now, the increase in gross output (Δy_t^g) can be written as: $\Delta y_t^g = \Delta k_t + f'\Delta k_t$ but $f' = r$, because factor markets are competitive. Hence, we will have:

$$\Delta y_1^g = \Delta k_1 (1+\bar{r}_1) = \Delta s_0 (1+\bar{r}_1)/(1+n) . \qquad (29)$$

where $\bar{r}$ is the average[5] rate of return on capital increase from k^w to k^c. But since $r^w > \bar{r}$ we can write (27) and (28) that:

$$\Delta y_1^g < \Delta c_1 . \qquad (30)$$

Hence the increase in consumption in period 1 does not allow the formerly young generation to be compensated adequately. Hence, it can never be efficient to substitute a consumption tax for a wage tax in this sense. Felder (1993) shows htat this result easily generalizes to the many period case.

There we had gone through Summers' (1981) analysis of the so-called 'human wealth effect' where he had shown that in many period life-cycle models savings are very interest elastic. Consequently tax reforms of the above sort can create big change in the capital stock and result in high steady-state welfare gains. The proposition here shows that a mere increase in the capital stock is not enough to guarantee an increase in welfare.

Summary

Since labor supply is exogenously given in this model, a wage tax is not distortionary. Moreover, a consumption tax is also not distortionary here. Hence the growth path of the economy is dynamically efficient. In this situation the substitution of one tax for another leading to an increase in savings is not necessarily Pareto superior. One the other hand, a policy which reduces savings along such a dynamically efficient path will improve welfare by inducing intergenerational transfers. Examples of such policies are increases in the wealth tax or the substitution of a consumption tax by a wage tax. In the case of the income tax, an excess burden is imposed on the economy because the income tax alters the rate at which the households can exchange present for future consumption. The growth path associated with an income tax is dynamically inefficient as contrasted to the growth path associated with the wage tax or the consumption tax.

[5] This follows from the mean value theorem of differential calculus where $f'(\bar{k}) = [f(k^c) - f(k^w)]/(k^c - k^w)$ for some $k^c > \bar{k} > k^w$. This f' is called $\bar{r}$ in the text.

However, none of these results will hold when we have an endogenous supply of labor. In that case, a wage tax will also impose an excess burden – indeed each tax will. The theorem of second best tells us that, a priori, we do not know which tax is associated with higher welfare and simulation or computational techniques have to be resorted to.

8.6 Empirical Studies of Tax Reform

Tax reform is concerned with a movement away from some given *status quo*. So we concentrate on marginal movements.

Suppose we have some vector of tax tools ***t*** in operation, the resulting level of social welfare is $w(\boldsymbol{t})$, and government revenue is $R(\boldsymbol{t})$. We can regard $w(\boldsymbol{t})$ as a Bergson-Samuelson social welfare function. We consider an increase in the *i-th* tax t_i sufficient to raise one dollar of extra revenue. The rate of change with respect to the tax is $\partial R(t)/\partial t_i$. In other words, in order to raise one extra dollar, we must increase the tax by $\left(\partial R(t)/\partial t_i\right)^{-1}$. The rate of change of welfare with respect to the tax is $\partial w/\partial t_i$. We define the fall in welfare, λ_i as the reduction in w consequent upon raising one more dollar by increasing the tax on the *i-th* good.

$$\lambda_i = -\frac{\partial w}{\partial t_i} \Big/ \frac{\partial R}{\partial t_i} \tag{31}$$

We can interpret λ_i as the marginal cost in terms of social welfare of raising one more dollar from the *i-th* tax. If the marginal cost for tax i exceeds that for tax j, then it would be a beneficial reform to switch taxation on the margin from i to j. Thus, if $\lambda_i > \lambda_j$, we have a gain in welfare of $\lambda_i - \lambda_j$ from raising one more dollar *via* tax j and one less dollar *via* tax i.

More generally, of any reform Δt, it is beneficial if $\Delta v > 0$ and $\Delta R \geqq 0$. The statistics λ_i guide us in the selection.

The optimum is the state of affairs where no beneficial reform is possible; thus the theories of optimality and of reform are very close. Optimality requires that all λ_i are equal (λ). That is,

$$\frac{\partial w}{\partial t_i} + \lambda \frac{\partial R}{\partial t_i} = 0 \tag{32}$$

This is precisely the first-order condition for optimality that emerges from the maximization problem of $w(\boldsymbol{t})$ subject to $R(\boldsymbol{t}) \geqq \overline{R}$.

With this framework, we can approach the question of resource mobilization by asking about the marginal cost in social welfare terms of raising revenue by different means.

The data requirements vary according to functional specifications of utility and social welfare, but in general, we need a consumer expenditure survey for demand for each good, knowledge of the tax rate t, the price level of each good, and aggregate demand responses to the tax (price) change (aggregate demand elasticities). To calculate effective tax rates requires some efforts. Note that t_i is a tax levied on final good i. We need to work with actual tax collections and to calculate the effects that taxing of intermediate goods has on taxes effectively levied on final goods. Measuring them involves a specification of the input-output process.

Marginal Reform and Effective Taxes

The expression for the social marginal cost, λ_i, of revenue is,

$$\lambda_i = \frac{\sum_h \beta^h x_i^h}{X_i + \sum_j t_j \dfrac{\partial X_j}{\partial t_i}} \qquad (33)$$

where t_j are taxes on final goods, x_i^h are household demands, X_i are the aggregate demands $\left(\sum_h x_i^h\right)$ and β^h are welfare weights.

To confine data requirements to t_i^e , x_i^h, $\partial X_j / \partial t_i$ and β^h, x_i^h comes from a consumer demand survey, $\partial X_j / \partial t_i$ from aggregate demand responses, and β^h comes from value judgements. A simple reformulation of (33) is,

$$\lambda_i = \frac{\sum_h \beta^h q_i x_i^h}{q_i X_i + \sum_j (t_j^e / q_j) q_j X_j \varepsilon_{ji}} \qquad (34)$$

where ε_{ji} is $q_i \, \partial X_j / \partial q_i \, X_j$, the uncompensated elasticity of good *j* with respect to the *i-th* price. Note that $q_i x_i^h$ represents expenditure by the *h-th* household on the *i-th* good, and that t_j^e / q_j is the effective tax as a proportion of the market price.

$$\beta^h = k(I^h)^{-\varepsilon} \qquad (35)$$

where I^h is the expenditure per capita of the *h-th* group and ε may be considered an index of inequality aversion. The welfare weights in the following have been normalized by choice of *k* such that $\sum_h f^h \beta^h \equiv \overline{\beta} = 1$ for each of ε =0, 0.1, 1, 2 and 5, where f^h is the proportion of households in the *h-th* group.

Federal and State Taxes

The major element in the taxation of commodities *via* inputs, $\boldsymbol{t}^{diff}$ is the federal taxation of intermediate goods and manufactures $\boldsymbol{t}^{diffc}$ (where *c* denotes the federal tax, and *s* denotes the state tax). Thus $\boldsymbol{t}^{diff}$ is primarily due to the structure of the excise that that is levied mainly on production and in particular on domestic manufacturing activities. In general, $\boldsymbol{t}^{diffc} > \boldsymbol{t}^{diffs}$ for manufacturing and services, $\boldsymbol{t}^{diffs}$ being of the order of 2% on average.

In the case of food items; sugarcane, milk, and animal husbandry as well as processed foods such as sugar, vanaspati, tea and coffee, $\boldsymbol{t}^{diffs} > \boldsymbol{t}^{diffc}$.

The effective taxes associated with excises, the sales tax and the import duty are given by

excises: $$\boldsymbol{t}^{ec'}_{(ex)} = \boldsymbol{t}^{e'}(I - A^d)^{-1} \qquad (36)$$

sales: $$\boldsymbol{t}^{es'}_{(ex)} = \boldsymbol{t}^{s'}(I - A^d)^{-1} + \boldsymbol{t}^{s'} A^m (I - A^d)^{-1} \qquad (37)$$

imports: $$\boldsymbol{t}^{ec'}_{(m)} = \boldsymbol{t}^{m'} A^m (I - A^d)^{-1} \qquad (38)$$

where $\boldsymbol{t}^c$, $\boldsymbol{t}^s$, and $\boldsymbol{t}^m$ represent per unit (nominal) rates of excise duty, sales tax and import duty respectively; A^d is the coefficient matrix for domestic inputs into domestic production; and

A^m is the coefficient matrix for imported inputs into domestic production.

We then calculate $\Delta t^{ec'}_{(ex)}$, Δt^{es}, and $\Delta t^{ec}_{(m)}$, the increases corresponding to a 1% across-the-board increase in excise, sales tax, and import duties, respectively, by considering the changes in (36)-(38).

Let us define the social marginal cost of respective tax change as,

excises: $$\lambda^{\mathrm{ex}} = \frac{\sum_h \sum_i \beta^h x_i^h \Delta t^{ec}_{i(ex)}}{\sum_j \left(\boldsymbol{x}_i + \sum_j t_j^e \frac{\partial \chi_j}{\partial t_t^e} \right) \Delta t^{ec}_{i(ex)}} \quad (39)$$

sales: $$\lambda^{\mathrm{sa}} = \frac{\sum_h \sum_i \beta^h x_i^h \Delta t^{es}_{i}}{\sum_i \left(\boldsymbol{x}_i + \sum_j t_j^e \frac{\partial \chi_j}{\partial t_i^e} \right) \Delta t^{es}_{i}} \quad (40)$$

imports: $$\lambda^{\mathrm{m}} = \frac{\sum_h \sum_i \beta^h x_i^h \Delta t^{ec}_{i(m)}}{\sum_i \left(\boldsymbol{x}_i + \sum_j t_j^e \frac{\partial \chi_j}{\partial t_i^e} \right) \Delta t^{ec}_{i(m)}} \quad (41)$$

The results are given in Table 3 below.

Table 3 Social Marginal Cost of 1% Tax Increase

Change	ε =0	ε =0.1	ε =1	ε =2
λ^{ex}	1.1459	1.1084	0.8497	0.6605
λ^{sa}	1.1204	1.0867	0.8509	0.5867
λ^{m}	1.1722	1.1205	0.7729	0.5375
λ^{PT}	1.1173	1.1173	1.1173	1.1173

Note: ^{PT}=the social marginal cost of raising extra revenue through a poll tax, $\lambda^{PT} = 1/(1-\bar{\delta})$ and $\bar{\delta} = 10.5\%$ where $\bar{\delta}$ the average across households of the marginal propensity to spend on taxes.

It is clear that, at low levels of inequality aversion ε, say 0 or 0.1, $\lambda^m > \lambda^{ex} > \lambda^{sa}$. An increase in sales tax causes the least social loss per marginal revenue. For 0.1< ε <1, the ranking of the welfare loss associated with excises and import duties changes to $\lambda^{ex} > \lambda^m > \lambda^{sa}$. The initial ranking is completely reversed at moderate levels of inequality aversion, say, ε =1, $\lambda^{sa} > \lambda^{ex} > \lambda^m$, with relative differences widening at higher levels of ε.

This result reflects the relative pattern of Indian state and central (federal) taxes, with sales taxes bearing rather heavily on final consumption goods consumed by the lower-income groups, and excises and import duties falling relatively more on intermediate goods and ultimately on manufactures.

At moderate levels of inequality aversion, 1% increase in sales taxes leads to a greater welfare loss per revenue than a similar increase in excise duties and import tariffs, which are the main sources of taxation on intermediate goods. A selection of particular goods for sales tax increases rather than across-the-board changes could avoid this apparent conflict.

The welfare loss from poll tax is higher than any other tax for $\varepsilon > 0.1$.

A unifying feature of tax reform evaluation is based on the calculation of the loss in social welfare (λ) from the marginal revenue from each source: λ_i for the taxatiuon of good *i*, λ^T for various reforms of the income tax, λ^C for central (federal) taxes, λ^S for state taxes.

A comparison between taxes on the basis of λ would in general involve the suggestion that, other things being equal, we would shift from sources with high λ to that with low λ. If λ_i for good *i* is greater than λ_j, then we want to shift on the margin from good *i* to good *j*. If λ^T is lower than all the λ_i, we want to shift from indirect to direct taxation. If λ^C is bigger than λ^S, then the marginal revenue from state taxes cause less social loss than that from the central (federal) taxes.

Furthermore, a consideration of major reform, for example, a uniform VAT suggests that *uniformity* is not desirable if there is positive inequality aversion. This is not an argument against the VAT, however, which avoids the distortionary effects of the taxation of inputs. It is possible to have a system of nonuniform VAT so as to equate the cost of raising a unit of revenue across final goods. For administrative reasons, the “appropriate differentiation” might be best achieved with a combination of two or three bands for the VAT, supplemented by specific taxes or subsidies on certain goods.

Exercises

1. Optimal tax reform is different from optimal tax (design) theory on the ground that the latter is constructed on a "clean sheet of paper", while the former is concerned with the issue how to improve or depart from the existing tax system. Could you elaborate in detail how these differences matter in a concrete situation? Could you also discuss how there two approaches can be used in a practical tax policy making?

2. In a model with n goods and (untaxed) labor, derive the conditions under which a small revenue-neutral departure from uniform taxation increases welfare if all commodities whose prices are lowered are better substitutes for the numeraire than all those whose prices are raised.

3. There are three commodities (L=3), of which the third is a humeraire (p_3=1). The market demand function $x(p,w)$ has

   $$x_1(p,w) = a + bp_1 + cp_2$$

   $$x_2(p,w) = d + ep_1 + gp_2$$

   (a) Give the parameter restrictions implied by utility maximization.

   (b) Estimate the equivalent variation for a change of prices from $(p_1, p_2) = (1,1)$ to $(\tilde{p}_1, \tilde{p}_2) = (2, 2)$. Verify that without appropriate symmetry, there is no path independence. Assume symmetry for the rest of the exercise.

   (c) Let EV_1, EV_2, and EV be the equivalent variations for a change of prices from $(p_1, p_2) = (1,1)$ to, respectively, (2, 1), (1, 2) and (2, 2). Compare EV with EV_1+ EV_2 as a function of the parameters of the problem. Interpret.

   (d) Suppose the initial tax situation has prices $(p_1, p_2) = (1,1)$. The government wants to raise a fixed (small) amount of revenue R through commodity taxes. Call t and t_2 the tax rates for the two commodities. Determine the optimal tax rates as a function of the parameters of demand if the optimality criterion is the minimization of deadweight loss.

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