On the Distributional Effect of Commodity Tax Reform

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Abstract

Evaluation of the distributional effect of a tax reform is one of the major concerns of a policy planner. The distributional effect manifests itself in the measures of income inequality/poverty/ relative deprivation. This paper considers the feeling of relative deprivation in terms of consumption expenditure and analyzes the impact of marginal changes in commodity taxes on this consumption based measure. An illustration using Indian consumer expenditure data is also provided.

Keywords: Commodity tax reform; Inequality; Relative deprivation

JEL classification: H2

1 Introduction

Due to non-availability of income data in developing and underdeveloped countries, income distribution based studies use total consumer expenditure as a proxy to income. However, examples of studies relating to consumption based measures are not confined to these types of countries only. Slesnick (1993) demonstrated that from a theoretical perspective it is more appropriate to evaluate the level of poverty using a consumption based measure of household welfare. Using data from the U.S. he also showed that the income based measure tends to have an upward bias. Yitzhaki (1994) represented the overall Gini index (G) by

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the sum of components corresponding to individual items of consumption. He examined the distributional effect of a tax reform by analyzing the impact of commodity tax changes on the overall Gini coefficient using data from Israel. Garner (1993) used a similar decomposition of the Gini coefficient and examined the implication of commodity taxation using U.S. data.

This paper examines the impact of marginal changes in commodity taxes on the consumption based measure of relative deprivation (RD) using Indian consumer expenditure data[2]. A measure of RD gives the amount of discontent generated within the society due to differences in the shares of the social cake. It is, therefore, important from the point of view of a policy planner to examine the impact of commodity tax reform on relative deprivation.

The plan of the paper is as follows: section 2 describes the concept of RD, section 3 presents the methodology and data, section 4 discusses the results and finally section 5 makes some concluding remarks.

2 Relative Deprivation

The idea of RD originated with the pioneering study by Runciman (1996). According to Runciman the magnitude of deprivation felt by a person is measured by the difference between the desired situation and that of the person desiring it [see also Kakwani (1984)]. If we consider RD in terms of income, then in view of Runciman's suggestion, the RD felt by person i with respect to person j can be written as

$$\begin{aligned} D(y_i, y_j) &= y_j - y_i \quad \textit{if} \quad y_i < y_j, \\ &= 0 \qquad\quad \textit{if} \quad y_i \geq y_j, \end{aligned} \tag{1}$$

where y_i and y_j are the incomes of persons i and j, respectively. If there are H individuals with incomes arranged in non decreasing order, i.e.,

[2] The impact of commodity tax change on social welfare has been examined in the Indian context by Ahmad and Stern (1984)

$y_1 \leq y_2 \leq y_3 \leq .... \leq y_H$, then the average RD of the society is defined to be

$$RD_y = \sum_{i=1}^{H} \sum_{j=i+1}^{H} \frac{(y_j - y_i)}{H^2}. \quad (2)$$

Hey and Lambert (1980) showed that this index is the product of the Gini index and the mean income of the society. [Yitzhaki (1979) and Kakwani (1984) also derived the Gini coefficient as a measure of RD using alternative formulations.]

Alternatively, one might conceive of the feeling of RD in terms of consumption of particular commodities. If we consider only normal goods, so that consumption of a commodity increases with income, then the consumption RD can be formulated in a manner similar to that in terms of income[3]. We can now define the RD of person i with respect to person j in terms of commodity l as

$$\begin{aligned} D_l(x_i, x_j) &= x_{jl} - x_{il} \quad \textit{if} \quad x_{il} < x_{jl}, \\ &= 0 \quad \textit{if} \quad x_{il} \geq x_{jl}, \end{aligned} \quad (3)$$

where x_{il} and x_{jl} are the quantities consumed of commodity l by persons i and j, respectively. In view of the fact that the commodities are normal goods, we can assume an ordering $x_{1l} \leq x_{2l} \leq x_{3l} \leq ... \leq x_{Hl}$, corresponding to the income ordering. Then the RD of individual i is given by

$$D_{xl}(i) = \sum_{j=i+1}^{H} \frac{x_{jl} - x_{il}}{H}. \quad (4)$$

Here, person i feels most deprived if he does not (cannot) consume commodity l, that is, when $x_{il} = 0$.

The average RD in the society in terms of commodity l is given by

[3] Here we assume that for 'inferior' commodities there is no feeling of deprivation

$$D_{xl} = \sum_{i=1}^{H} \sum_{j=i+1}^{H} \frac{x_{jl} - x_{il}}{H^2}. \tag{5}$$

If we now combine all the normal goods in the society, we can define the average RD in terms of consumption as

$$D_x = \sum_{l=1}^{n} p_l \, D_{xl}, \tag{6}$$

where n is the number of commodities and p_l is the price (faced by all individuals) of commodity l. Note that this is the same as (2) when income is substituted by total expenditure (provided there is no 'inferior' commodity in the consumers' basket). Thus, D_x provides a measure of average RD in the society in case of developing/underdeveloped countries where total expenditure often serves as a proxy to income.

3 Methodology and Data

The analysis of tax reform concerns the replacement of an existing tax regime by an alternative and the comparison of one with the other in terms of gains and losses in the society. Here we consider the problem of marginal reform, i.e., a small change away from the existing system, when the relative gain/loss is viewed in terms of the feeling of RD.

We are now in a position to look at how the feeling of RD in the society changes when taxes change. If consumer's price for the *kth* commodity p_k is assumed to be the sum of producer's price and tax rate t_k , then assuming that producer's price remains constant, $dp_k = dt_k$. From (5) and (6), the effect of a change in tax on commodity k on D_k is given by

$$\frac{\partial D_x}{\partial p_k} = \frac{1}{H^2} \sum_{i=1}^{H} \sum_{j=i+1}^{H} \left[(x_{jk} - x_{ik}) + \sum_{l=1}^{n} p_l \left(\frac{\partial x_{jl}}{\partial p_k} - \frac{\partial x_{il}}{\partial p_k} \right) \right]. \tag{7}$$

Thus, the change in average RD in the society due to a change in the tax on commodity k is equal to the contribution of the kth component to overall RD plus the income and substitution effects component due to a change in p_k. Note that D_x is the product of the consumption based Gini coefficient (G_x) and the mean total expenditure.

The revenue effect of the tax change on commodity k can be derived as

$$\frac{\partial T}{\partial t_k} = \sum_{i=1}^{H} x_{ik} + \sum_{i=1}^{H}\sum_{l=1}^{n} t_l \frac{\partial x_{il}}{\partial t_k}, \tag{8}$$

where

$T = \sum_{i=1}^{H}\sum_{l=1}^{n} t_l x_{il}$ is the total revenue. The above expression can alternatively be written as

$$\frac{\partial T}{\partial p_k} = \sum_{i=1}^{H} x_{ik} + \sum_{i=1}^{H}\sum_{l=1}^{n} t_l \frac{\partial x_{il}}{\partial p_k}. \tag{9}$$

Therefore, the effect of an increase in tax on commodity k that raises the revenue by one rupee is given by

$$\frac{dD_x(k)}{dT} = \frac{\frac{\partial D_x}{\partial p_k}}{\frac{\partial T}{\partial p_k}}. \tag{10}$$

In what follows, as an illustrative exercise, we estimate $\frac{dD_x(k)}{dT}$ for $k = 1, 2, ..., n$ using prices and expenditure on nine broad commodity groups, viz., 'cereals and cereals substitutes', 'milk and milk products', 'edible oils', 'meat, fish and egg', 'other food', 'clothing', 'fuel and light' and 'other non food' obtained from the published reports of the National Sample Survey (NSS) Organisation, Government of India, for the 28^th round of their survey period (1973-74) for urban India. Note that in view of the broad classification, these commodities can be assumed to be normal goods. Now, to estimate the price effects one needs to specify a system of demand equations. The own and cross price effects are obtained using a log-quadratic demand system proposed in Majumder

(1992) and the calculations are based on a time series of cross-sectional data covering the period 1953-54 to 1973-74 [see Coondoo and Majumder (1987) for a detailed description of the data].

Three sets of pre-reform tax rates have been used for comparison. These are the (optimal) tax rates based on (i) Ray (1986), who used the Linear Expenditure System (LES) and the Restricted Non Linear Preference System (RNLPS) and (ii) Majumder (1988), who used the Variant 3 system to arrive at these tax rates.[4]

4 Results

Table 1 shows the effect of change in tax of each of the nine commodities, that raises the revenue by one rupee, on D_x. That is, it measures the change in the feeling of RD with respect to each commodity for a marginal change in tax rates. The table also presents the expenditure elasticities from the log-quadratic system to reveal whether the commodity is a necessary or a luxury item[5]. The overall picture that emerges is

(i) generally a tax increases the feeling of RD in the society,

(ii) the effect on RD is not very sensitive to the specification of demand systems at low levels of inequality aversion. This is in conformity with the fact that choice of specification of demand systems is less important for analysis of reform than it is for calculation of optima. [See Ahmad and Stern (1984)].

(iii) Comparing the results over the 9 commodities, the society is more adversely affected (i.e. increase in RD is more) when necessary commodities are taxed rather than when luxury items are taxed. The

[4]Note that these tax retes are 'opimal' with respect to maximisation of welfare and not with respect to minimisation of RD. Therefore, given these tax rates one can think of reform in terms of RD, although welfare reform is not feasible.

See Appendix for a detailed description of the demand systems and tax calculations.

[5]The values of ε given in the table have been used in calculating the optimal (welfare maximising) tax rates as shown in the Appendix (section B). These optimal tax rates have been taken as the pre-reform (existing) tax rate. Given these rates, we are looking at the effect of change in tax rates in terms of feeling of RD.

Table 1: Effect of Tax Reform in Relative Deprivation $\left(\frac{dD_x(k)}{dT}\right)$ and the Expenditure Elasticities.

Commodities	Variant 3		LES		RNLPS		Expenditure
(k)= $1, 2, \cdots, 9$	$\varepsilon = 0.5$	$\varepsilon = 5.0$	$\varepsilon = 0.5$	$\varepsilon = 5.0$	$\varepsilon = 0.5$	$\varepsilon = 5.0$	Elasticity
Creals and cereal substitutes	0.095	0.173	0.103	0.178	0.098	0.146	0.283
Milk and milk products	0.053	0.071	0.073	0.088	0.072	0.089	1.331
Edible oils	0.083	0.131	0.085	0.083	0.085	0.086	0.826
Meat, fish and egg	0.090	0.066	0.090	0.101	0.089	0.100	1.406
Sugar ets.	0.070	0.125	0.082	0.083	0.082	0.086	0.844
Other food	0.077	-0.290	0.081	0.095	0.079	0.088	1.040
Clothing	0.075	-0.044	0.073	0.092	0.072	0.097	1.711
Fuel and light	0.085	0.135	0.092	0.095	0.093	0.100	0.678
Other nonfood	0.046	-0.457	0.056	0.074	0.055	0.074	1.679

society is worst affected when ‘cereals and cereals substitutes’ is taxed followed by ‘fuel and light’. However, ‘meat, fish and egg’, although a luxury item, affects the society more adversely than some other necessary items, when its tax is increased.

(iv) The impact on RD is greater for a higher value of the inequality aversion parameter. An exception is the case of Variant 3 for $\varepsilon = 5.0$, where the RD decreases by increasing tax on ‘other food’ and the nonfood luxury items ‘clothing’ and ‘other nonfood’. If we note that these three are *luxury* items, then the result seems desirable because the highly inequality averse planner is able to actually reduce the feeling of RD by increasing tax on luxury items. Thus, for high values of inequality aversion, the effect on RD is sensitive to the choice of the demand system based on which the initial tax calculations are made.

5 Concluding Observations

Evaluation of the distributional impact of a tax reform is one of the major concerns of a policy planner. One method of measuring the distributional effect is to examine the impact of tax reform on the measure of relative deprivation in a society. In this context we may mention that the optimal (welfare maximising) tax rates need not be optimal in the sense of minimisation of social discontent. However, in this paper we have shown that for urban India, starting from a welfare maximising optimal tax rate, any tax increase is detrimental to the feeling of consumption based relative deprivation in the society. Thus, here the 'optimal' tax rates are 'optimal' in the true sense. But the policy implication is that, if the government is contemplating revenue increase by an increase in the commodity tax rates, at the same time keeping social discontent at a minimum, it should concentrate on *luxury* items. This corroborates the findings of Ahmad and Stern (1984) that a greater concern for the welfare of the poor leads one to be less attracted by raising taxes on the goods they consume.

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Appendix:

A. The Log-Quadratic Demand System

The own and cross price effects have been obtained using the log-quadratic demand system proposed in Majumder (1992). This systems, in budget share form, is given by

$$w_{il} = \frac{\rho_\ell \alpha_\ell(p)}{\sum_{k=1}^{n} p_k \alpha_p(p)} + \beta_l \log \frac{y_i}{\sum_{k=1}^{n} p_k \alpha_k(p)} + \upsilon_\ell(p) \left\{ \log \frac{y_i}{\sum_{k=1}^{n} p_k \alpha_k(p)} \right\} \qquad \text{(A1)}$$

where

$$\begin{aligned} w_{il} &= \frac{p_\ell x_{i\ell}}{y_i}, \\ \alpha_l(p) &= a_\ell + c_\ell \log\left(\frac{p_\ell}{\pi}\right), \sum_{k=1}^{n} p_k \alpha_k(p) > 0 \\ \pi &= \frac{\sum_{\ell=1}^{n} c_\ell p_\ell}{\sum_{\ell=1}^{n} c_\ell}, \quad \upsilon_\ell(p) = \frac{\beta_\ell - d_\ell}{\prod_{k=1}^{n} {p_k}^{d_k}}, \end{aligned}$$

α_ℓ, c_ℓ, β_ℓ, d_ℓ are parameters of the system and $\sum_{l=i}^{n} b_\ell = \sum_{l=1}^{n} d_\ell = 0$ for adding-up restiction, i.e., $\sum_{l=1}^{n} \omega_{il} = 1$ for all i. The expression for $\frac{\partial x_{il}}{\partial p_k}$ can be obtained by writing the *l.h.s.* of (A1) in terms of x_{il} and then differentiating with respect to p_k.

B. The Optimal Tax Rates

Assuming (i) the optimization is carried out in two stages, viz. each of H. individuals maximizing its utility function $u_i\ (x_{il},\ \ldots,\ x_{in})$ subject to the budget constraint $\sum_{\ell=1}^{n} p_l x_{i\ell} \leq y_i$, and the government maximizing the social welfare function $\Psi\{v_1\ (p, y_1),\ v_2\ (p, y_2),\ \cdots,\ v_H\ (p, y_H)\}$ subject to the revenue constraint $\sum_{\ell=1}^{n} t_\ell \sum_{i=1}^{H} x_{i\ell} \leq R_0, \Psi$ being the Bergson-Samuelson social welfare function and v_i ( )'s the indirect utility functions corresponding to u_i ( )'s, and (ii) constant producer price, the optimization leads to the following first order conditions:

$$\sum_{i=1}^{H}\gamma_i x_{i\ell} = \lambda\left(H\bar{x}_l + \sum_{k=1}^{n} t_k p_k \frac{\partial x_k}{\partial p_\ell}\right);\ l = 1, 2, \cdots, n$$

where t_l : tax on item l per unit of consumer price p_l.

$x_\ell \ = \ \sum_{i=1}^{H} x_{i\ell},\ \ \bar{x}_l = x_l/H,$

λ : welfare loss,

γ_i : social marginal utility of income of i-th individual measured from Atkinson's (1970) utility function

$$W_i(y_i) = \begin{cases} \frac{ky_i^{1-\varepsilon}}{1-\varepsilon}, & \varepsilon \neq 1 \\ k \log y_i, & \varepsilon = 1 \end{cases} \text{ whereby } \gamma_i = \frac{\partial W_i}{\partial y_i} = ky_i^{-\varepsilon},$$

and assuming social marginal utility on income for the poorest person (say, person 1) to be unity (i.e.,$\gamma_1 = 1$),

$\gamma_i = (y_l/y_i)^{\varepsilon}$.

ε : planner's equality aversion parameter with a higher value of ε denoting greater aversion.

Assuming apriori values of ε, the parameters λ and t_l $(l = 1, 2, \ldots, n)$ can be solved from the above equation system and the revenue constraint

$$R_0 = \sum_{l=1}^{n} t_\ell p_\ell x_\ell.$$

C. The Systems Used for Obtaining the Tax Rates:

The (optimal) tax rates, according to the calculations above, have been taken from the following three sources:

(i) Majumder, (1988):

Variant 3:

$$w_{il} = \frac{p_l \alpha_l(p)}{\sum_{k=1}^{n} p_k \alpha_k(p)} + \beta_l(p) \log \frac{y_i}{\sum_{k=1}^{n} p_k \alpha_k(p)},$$

where

$$\begin{aligned} \alpha_l(p) &= a_l + c_l \log \frac{p_l}{\pi_1} \;\; ; \;\; \pi_1 = \frac{\sum_{k=1}^{n} c_k p_k}{\sum_{k=1}^{n} c_k} \\ \beta_l(p) &= b_l + d_l \log \frac{p_l}{\pi_2} \;\; ; \;\; \log \pi_2 = \frac{\sum_{k=1}^{n} d_k \log p_k}{\sum_{k=1}^{n} d_k}. \end{aligned}$$

with a_l, b_l, c_l and d_l as parameters and $\sum_{l=1}^{n} b_l = 0$.

(ii) Ray (1986):

(a) Linear Expenditure System : (LES)

$$p_l x_{il} = p_l c_l + b_l \left(y_i - \sum_{k=1}^{n} p_k c_k \right),$$

where $\sum_{l=1}^{n} b_l = 1, \;\; 0 < b_l < 1, \;\;$ and $\;\; y_i > \sum_{k=1}^{n} p_k c_k$

(b) Restricted Non Linear Preference System (RNLPS):

$$w_{il} = \left(\frac{p_l}{y_i} \right)^{\alpha} c_l + b_l \left[1 - \sum_{k=1}^{n} \left(\frac{p_k}{y_i} \right)^{\alpha} c_k \right].$$

where $\sum_{k=1}^{n} b_k = 1, \;\; 0 < \alpha \leq 1$.
The system reduces to **LES** when $\alpha = 1$.