RATIONING, DUAL PRICING AND RAMSEY COMMODITY TAXATION : THEORY AND AN ILLUSTRATION USING INDIAN BUDGET DATA

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I. Introduction

It has been usual to treat rationing as a method to assure minimum supplies to all consumers of a commodity in short supply. In almost all countries of the world, critical situations, like wars, have necessitated rationing. In India, however, rationing and the elaborate public distribution system that goes with it, have often been viewed as a method to provide essential items at a low cost. Thus rationing has been used as a redistributive device as well. The available literature on rationing in India takes the existing arrangement as a datum, i.e., there are fixed quotas of rationed commodities that people (both rich and poor) can purchase at "fair price shops" and demands of people over and above these fixed quotas have to be met at free market prices.

This rationing arrangement has, perhaps, not been able to achieve its professed aim of redistribution. Supplies of essential commodities to the rural poor through "fair price shops" are often meagre and uncertain, and of poor quality, too, whereas richer people mainly rely on the free market supplies of these commodities. It would perhaps be appropriate to say that it is primarily the urban middle class that has benefited from rationing.

In this paper we undertake an exploratory exercise. We conceive of rationing as a purely redistributive measure[1] and, thereby, formally introduce dual pricing. We use the nine-commodity classification studied by Murty and Ray (1987a, 1987b). The producer prices of all nine commodities are fixed. There are two decision-making authorities who, in coordination with each other, attempt to maximise social welfare. One of these authorities- call it the Food Department (FD)- set the prices of food to be paid by the poor and rich. The other - call it the Tax Department (TD)- is responsible for setting commodity tax rates. We now proceed to describe the activities of these departments in some detail.

The producer price of foodgrains is fixed and the entire amount of the harvest is available to the government at this fixed price. Foodgrains are the most important consumption item for the poor. For humanitarian reasons or, perhaps because the price of foodgrains is a very visible political consideration, the FD fixes the nominal subsidy on foodgrains consumed by the poor. They can buy any amount of foodgrains at this subsidised price. This price is, however, not available to the rich. Additionally, the FD sets the price of foodgrains to be paid by the rich. To do this, however, it has to act in concert with the TD.

The TD sets Ramsey Optimal commodity tax rates for the other eight commodities by solving a standard many-person Ramsey problem. Apart from the usual revenue constraint associated with these problems, the TD faces two additional constraints. First, the price of foodgrains to be paid by the poor is parametrically given to it. Secondly, the price of foodgrains (set by FD) to be paid by the rich is such that the market for foodgrains clears in the sense that foodgrain demand by poor (at the price fixed for them) plus foodgrain demand by rich (at the price determined for them) is exactly equal to the available supply of foodgrains. Moreover, the price of foodgrains for the rich is such that the surplus earned from them exactly pays for the subsidy given to the poor. Thus FD balances its budget and TD meets the stipulated revenue condition. Apart from this price, the algorithm used in this paper computes optimal consumption of all nine commodities by rich and poor, the Ramsey Optimal commodity effective tax/subsidy rates (common to rich and poor) for the other eight commodities, the marginal social value of the expenditures by rich and poor and the marginal social values of a rupee earned from alternative revenue instruments for different values of the subsidy on foodgrains to the poor and alternative values for the inequality aversion parameter of Atkinson's (1970) social welfare function.

The plan of the rest of the paper is as follows. In section II we detail the rationing scheme advocated by us. In section III we work out in detail the rationing/dual pricing structure and the associated Ramsey rule for commodity taxation when one of the commodities is subject to rationing. Section IV reports results of an empirical illustration using Indian budget data. Section V offers some concluding comments.

II. A Redistributive Role for Rationing

Consider an economy with n commodities. n_1 of these commodities are subject to rationing/dual pricing whereas $n_2(=n-n_1)$ are not. There are two classes of people: poor (A) and rich (B). The supplies of rationed commodities are fixed at $\bar{X}_i$ $(i=1,2,\ldots,n_1)$ and all commodities are supplied at constant producer prices in the economy. Let q_i and P_i, $i=1,\ldots,n$ represent respectively the producer and consumer prices of commodities. Assuming that the difference between consumer and producer prices of non-rationed commodities is only due to commodity taxes, we have

$$P_i = q_i+t_i, \quad i = (n_1+1), (n_1+2), \ldots\ldots n$$

In the case of rationed commodities government procures them from producers at fixed producer prices (q_i, $i=i,\ldots\ldots,n_1$). The nominal subsidies (s_i) given on these items for consumers of type A are also predetermined by government. Hence if P_i^A is the price paid by type A consumers for the ith rationed commodity, we have

$$P_i^A = q_i-s_i, \quad i=1,\ldots,n_1$$

The prices of rationed commodities (P_i^B) for type B consumers is set such that

i. the demand for each rationed good is exactly equal to the supply, and

ii. the total subsidy to the poor on each item is entirely met by payments made by the rich through a higher price so that these subsidies have no budgetary implications for setting taxes/subsidies for non-rationed commodities.

Thus we have

$$P_i^A \; x_i^A + P_i^B \; (\bar{X}_i-x^A{}_i) = q_i\bar{X}_I \qquad (1)$$

$$i=1,\ldots\ldots,n_1$$

where x_i^A , x_i^B $(= \bar{X}_i-x_i^A)$ $i=1,\ldots,n_1$

are consumptions of ith rationed commodity by rich and poor respectively.

Consumers of type A have the direct utility function

$$u^A(x_1^A, x_2^A, \ldots, x_{n_1}^A, x_{n_{1+1}}^A, \ldots, x_n^A, y^A \qquad (2)$$

and a budget constraint

$$\sum_{i=1}^{n_1} P_i^A x_i^A + \sum_{j=n_{1+1}}^{n} P_j x_j^A = y^A \qquad (3)$$

where y^A is income of type A consumer. Maximising (2) subject to (3), we obtain the following demand functions for the rationed goods:

$$x_i^A = x_i^A (P_1^A, \ldots, P_{n_1}^A ; P_{n_{1+1}}, \ldots, P_n, y^A) \qquad (4)$$

$$i = 1, \ldots\ldots n_1$$

Let the demand function for the ith rationed good by consumers of type B be:

$$x_i^B = x_i^B (P_1^B, \ldots, P_{n_1}^B, P_{n_{1+1}}, \ldots\ldots, P_n, y^B) \qquad (5)$$

where y^B is income of type B consumer.

We now consider the problem of determining x_i^A, x_i^B, $i=1, 2, \ldots, n_1$, the optimal tax/subsidies on n_2 non-rationed commodities and prices charged by government to consumers of type B (P_i^B) for rationed commodities in the many-person Ramsey rule framework for optimal commodity taxes. Let $V^A(P_1^A, P_n^A, P_{n_1}^A, \ldots\ldots P_n, y^A)$ and $V^B(P_1^B, \ldots P_{n_1}^B, P_{n_{1+1}}, \ldots, P_n, y^B)$ be indirect utility functions of individuals of types A and B. Aggregate social welfare function is given by

$$W(V^A, V^B) \qquad (6)$$

We assume that W is concave. The government revenue constraint is given as

$$\sum_{j=n_1+1}^{n} t_j x_j = R \qquad (7)$$

where $x_j = x_j^A + x_j^B$ and R is exogenously fixed government revenue requirement. As mentioned above, there is no surplus or deficit in government budget on account of n_1 rationed commodities. For given t_j and hence P_j, $j=(n_1+1), (n_1+2), \ldots, n$ and exogenously fixed P_j^A, $j=1,\ldots n_1, P_j^B$, $j=1,2,\ldots n_1$, x_i^A and x_i^B are automatically determined from equations (1), (4) and (5). The many-person Ramsey problem is, therefore, to

$$\max_{t_{n_1+1},\, t_{n_1+2},\ldots,\, t_n} W(V^A, V^B) \qquad (8)$$

subject to constraints given by equations in (1) and (7).

III. Rationing of Foodgrains: An Illustration Using Indian Consumer Budget Data

In the empirical analysis we use a nine-commodity framework for consumer goods with foodgrains as one of the commodity groups. We suppose that only one commodity - foodgrains - is sold through fair price shops. We assume that both poor and rich have Stone-Geary utility functions

$$u = \sum_{i=1}^{9} \beta_i \ln (x_i - \gamma_i) \qquad (9)$$

with $\sum_{i=1}^{9} \beta_i = 1$ and γ_i as the minimum quantity of the ith commodity. The indirect utility functions for consumers of type A and B are given as

$$V^A = \frac{y^A - \gamma_1 P^A_1 - \sum_{i=2}^{9} \gamma_i P_i}{(P_1^A)^{\beta_1} \prod_{k=2}^{9} (P_k)^{\beta_k}} \qquad (10)$$

$$V^B = \frac{y^B - \gamma_1 P_1^B - \sum_{i=2}^{9} \gamma_i P_i}{(P_1^B)^{\beta_1} \prod_{k=2}^{9} (P_k)^{\beta_k}} \tag{11}$$

where $y^A = P_1^A \quad x_1^A + \sum_{k=2}^{9} P_k \; x_k^A$

$$y^B = P_1^B \; x_1^B + \sum_{k=2}^{9} \; P_k x_k^B$$

Demand for x_1 by a consumer of type A is given by

$$x_1^A = \gamma_1 + \frac{\beta_1}{P_1^A} \left[y^A - \gamma_1 P_1^A - \sum_{k=2}^{9} \gamma_k P_k \right] \tag{12}$$

Correspondingly

$$x_1^B = \gamma_1 + \frac{\beta_1}{P_1^B} \left[y^B - \gamma_1 P_1^B - \sum_{k=2}^{9} \gamma_k P_k \right] \tag{13}$$

The amount of foodgrains available is fixed exogenously at $\bar{X}_1$, say by the harvest. Hence

$$x^A{}_1 + x^B{}_1 = \bar{X}_1 \tag{14}$$

The subsidy on food for the poor is entirely and exactly met by the payments made by the rich, i.e.,

$$P_1^A x_1^A + P_1^B x_1^B = q_1 \bar{X}_1 \tag{15}$$

whence

$$P_1^B = \frac{q_1 \bar{X}_1 - P_1^A x_1^A}{(\bar{X}_1 - x_1^A)} \tag{16}$$

Now the Ramsey problem can be written as

$$\max_{t_2,\ldots,t_9} W(V^A, V^B) \text{ subject to}$$

$$\sum_{k=2}^{9} t_k x_k = R \qquad (17)$$

and (16)

Recently Murty and Ray (1987a, 1987b) have developed a method of calculating Ramsey optimal commodity tax rates. We proceed to briefly describe this method.

Following Ahmad and Stern (1984), we define λ_i as the marginal social cost of raising a rupee of government revenue with a tax on the ith commodity:

$$\lambda_i = -\frac{\delta W/\delta t_i}{\delta R/\delta t_i} \qquad (18)$$

$$i = 2,\ldots\ldots,9$$

Now $$\frac{\delta W}{\delta t_i} = \frac{\delta W}{\delta V^A} \cdot \frac{\delta V^A}{\delta t_i} + \frac{\delta W}{\delta V^B} \cdot \frac{\delta V^B}{\delta t_i} + \frac{\delta W}{\delta V^B} \cdot \frac{\delta V^B}{\delta P_1^B} \frac{\delta P_1^B}{\delta t_i}$$

$$= -\left(b^A x_i^A + b^B\left(x_1^B \frac{\delta P_1^B}{\delta t_i} + x_i^B\right)\right).$$

$$= -\left(b^A x_i^A + b^B\left(x_1^B\left\{\frac{e_{1i} \cdot x_1^A}{t_i}(q_1\bar{X}_1 - P_1^A x_1^A)\right.\right.\right.$$

$$\left.\left.\left. - P_1^A \frac{x_1^A}{t_i} e_{1i} (\bar{X}_1 - x_1^A)\right\}(\bar{X}_1 - x_1^A)^{-1} + x_i^B\right)\right) \qquad (19)$$

where e_{1i} is the cross-elasticity of demand for commodity 1 with respect to the ith price ($i = 2,\ldots\ldots,9$).

Similarly,

$$\frac{\delta R}{\delta t_i} = x_i + \sum_{k=2}^{9} \left(t_k \; e_{ki} \; \frac{x_k}{t_i} \right) \qquad (20)$$

where e_{ki} is the price-elasticity of demand for the kth commodity with respect to the ith price.

From (19) and (20) we can then define the λ_i's for the ith commodity.

We assume that the social welfare function, W, is additive in individual utilities:

$$W = \frac{1}{1-\varepsilon} \left[(V^A)^{1-\varepsilon} + (V^B)^{1-\varepsilon} \right] \qquad (21)$$

Normalising $b^A = 1$ for type A individuals, the social marginal utility of income to type B individual is given as

$$b^B = \left\{ \frac{V^A}{V^B} \right\}^{\varepsilon} \left\{ \frac{\delta V^A / \delta y^A}{\delta V^B / \delta y^B} \right\} \qquad (22)$$

where $\delta V / \delta y$ represents private marginal utility of individuals.

Equation (22) implies that the b's depend via V's on both prices and income. The iterative procedure developed by Murty and Ray computes the optimum Ramsey taxes with respect to which

$$\lambda_i = \lambda_j = \bar{\lambda} \quad \text{for } i,j = 2,\dots\dots,9 \qquad (23)$$

This procedure enables us to compute the value of the b's, the market clearing price of commodity 1, taxes on the remaining eight commodities, amounts of consumption of the nine commodities by rich and poor, and the matrix of cross and own price elasticities of demand at optimum.

IV. Empirical Estimates

The commodity disaggregation used in this study is identical to that used in earlier studies by Ahmad and Stern (1984), Murty and Ray (1987a, 1987b): 1. Foodgrains, 2. Milk and Milk Products, 3. Edible Oils, 4. Meat, Fish and Eggs, 5. Sugar and Tea, 6. Other Food, 7. Clothing, 8. Fuel and Light, 9. Other non-Food.

The data set used here is taken from the table of consumer expenditure for the 32nd Round of the National Sample Survey (1977-78) available in Government of India (1984). We have used urban data sets and corresponding urban demand parameter estimates reported in Ray (1986a) for linear expenditure system. The initial tax rates for eight non-rationed commodities are the effective rates of taxes[2] calculated by Ahmad and Stern (1984) for the year 1978-79. Since tax estimates and consumer budget data used in this study represent two different years with a gap of only one year, we assume that consumer budget shares for the year 1977-78 may approximately represent budget shares for the year 1978-79. We have aggregated 14 NSS monthly per-capita expenditure classes for urban sector into groups A and B poor and rich with the assumption that all the households with per capita consumption less/more than the urban poverty line are treated as poor/rich.

The computations were made with three different values of subsidised price of foodgrains to poor (P_1^A = 0.75, 0.9, 0.5) and two different values of inequality aversion (ε = 2.0, 25). The iterative procedure is continued until the algorithm converges, i.e., the coefficient of variation of λ_i becomes arbitrarily low.

Tables 1 and 2 present initial and calculated prices of foodgrains for rich and poor, initial and final consumption of all nine commodities by the two groups and the effective tax rates on the eight commodities.

In Table 3 we summarise our results on the λ_i's and the b^B. Since the algorithm converges we know that the effective tax/subsidy and P_1^B calculated are "optimal" in the sense of Ahmad and Stern (1984) and Murty and Ray (1987a, 1987b).

In Table 4 we summarise the relationship between P_1^B and P_1^A for various values of the inequality aversion parameter ε.

V. Conclusions

In this paper we have underscored the redistributive role of rationing. Since full scale non-linear commodity taxation is a non-feasible proposition, we posed our problem in a way that is consistent with existing administrative arrangements for the supply of foodgrains.

By fixing the nominal subsidy on foodgrains to the poor, we introduced a dual pricing structure and further calculated Ramsey optimal commodity tax rates that are consistent with the administrative arrangements stipulated with the market for foodgrains.

An obvious limitation of the analysis ~~is that~~ we do not consider resale of foodgrains by the poor. However, ours is an exploratory analysis designed to introduce non-linear prices in a simple and welfare improving manner. Such refinements, as allowing for resale by poor, should obviously be important constituents of any agenda for further research in this area.

Table 1

$\varepsilon = 25$

Item	INITIAL			FINAL $P^A_{1\cdot} = 0.57$			FINAL $P^A_{1\cdot} = 0.9$			FINAL $P^A_{1\cdot} = 0.5$		
	Consumption by A	Consumption by B	Effective tax rate	Consumption by A	Consumption by B	Effective tax rate	Consumption by A	Consumption by B	Effective tax rate	Consumption by A	Consumption by B	Effective tax rate
Foodgrains	18.18	22.32		10.996	29.503		9.807	30.692		14.559	25.940	
Milk & Milk Products	4.17	16.74	0.009	6.961	21.897	-0.074	7.098	22.638	-0.102	7.011	21.495	-0.061
Edible Oils	2.55	6.19	0.083	1.404	3.941	0.484	1.296	3.661	0.606	1.478	4.068	0.428
Meat, Fish & Eggs	1.95	5.48	0.014	1.977	5.960	0.0441	1.937	5.919	0.052	2.023	5.949	0.407
Sugar & Tea	1.56	3.46	0.069	2.358	6.921	-0.359	2.812	8.427	-0.479	2.208	6.305	-0.296
Other Food	10.93	29.90	0.114	8.701	25.666	0.234	8.346	24.924	0.275	8.988	25.896	0.218
Clothing	1.61	14.89	0.242	4.550	14.771	0.164	4.626	15.224	0.138	4.559	14.540	0.174
Fuel & Light	4.17	8.57	0.247	3.453	9.448	0.031	3.640	10.154	-0.028	3.392	9.045	0.066
Other Non-Food	8.76	51.31	0.133	16.526	53.120	0.124	16.346	53.335	0.121	16.895	52.869	0.123
	Final Value of P^B_1			1.093182			1.0319			1.2806		

Table 2

$\varepsilon = 2$

Item	FINAL P_1^A=0.75			FINAL, P_1^A=0.9			FINAL, P_1^A=0.5		
	Consumption by A	Consumption by B	Effective tax rates	Consumption by A	Consumption by B	Effective tax rates	Consumption by A	Consumption by B	Effective tax rates
Foodgrains	10.934	29.565		9.776	30.722		14.556	25.943	
Milk and Milk Products	8.175	25.774	-0.212	7.300	23.350	-0.130	7.134	21.866	-0.077
Edible Oils	1.045	2.862	1.074	1.219	3.434	0.714	1.417	3.887	0.497
Meat, Fish and Eggs	1.804	5.464	0.134	1.860	5.702	0.090	2.011	5.914	0.046
Sugar and Tea	3.560	10.663	-0.596	2.412	7.210	-0.386	2.411	6.911	-0.361
Other Food	7.282	21.459	0.458	7.900	23.625	0.334	8.823	25.407	0.240
Clothing	6.015	19.378	-0.063	5.101	16.759	0.052	4.683	14.794	0.158
Fuel and Light	3.180	8.664	0.108	3.040	8.323	0.150	3.490	9.340	0.037
Other non-Food	18.396	59.221	0.014	17.359	56.692	0.058	16.946	53.030	0.120
Final Value of P_1^B	1.0924			1.031826			1.28055		

Table 3

	ε = 25			ε = 2		
	$P_1A=0.75$	$P_1A=0.9$	$P_1A=0.5$	$P_1A=0.75$	$P_1^A=0.9$	$P_1^A=0.5$
Initial Mean of λ_i	0.356	0.356	0.356	0.529	0.507	0.566
Final Mean of λ_i	0.448	0.442	0.457	0.607	0.5901	0.6567
Initial value of $b._B(b^A=1)$	$0.258x10^{-10}$	$0.849x10^{-12}$	$0.199x10^{-10}$	0.123	0.109	0.152
Final value of $b._B(b^A=1)$	$0.187x10^{-11}$	$0.730x10^{-12}$	$0.143x10^{-10}$	0.1176	0.107	0.146

Table 4

$\varepsilon \mid P_1^A$	0.75	0.9	0.5
2	1.0924	1.0318	1.28055
25	1.093182	1.0319	1.2806

NOTES

1. Since income and other direct taxes are relatively unimportant in India, one has to turn toward indirect taxes for revenue as well as redistribution (See Jha, 1987). It is in this context that several authors have expressed their agnosticism about the degree of redistribution possible through simply linear indirect taxes. The arrangement described in this paper improves upon a purely linear indirect tax structure.

2. An effective rate of tax represents tax revenue for a rupee's producer price worth of final consumer good.

3. It is because the subsidy on foodgrains to poor is defined in this paper as a fraction of constant producer price ($q_1 = 1$) that it cannot be compared with effective taxes/subsidies on non-rationed commodities that are given in Tables 1 and 2.

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