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INCOME DISTRIBUTION AND THE STRUCTURE OF INDIRECT TAXATION

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ABSTRACT

Using U.S. data, we examine how optimal indirect taxes and (real) income distribution vary with government revenue needs and society's aversion to inequality. We also show that the more luxurious the good, the higher the optimal tax rate it should bear.

First, the model is introduced, then the data are briefly discussed and finally the results are presented and analyzed. An appendix contains a more detailed account of how the data were obtained.

Income Redistribution and the Structure of Indirect Taxation

1. INTRODUCTION

In the last decade, since the seminal paper of Diamond and Mirrlees (1971) on commodity taxation, numerous authors such as Diamond (1975), Mirrlees (1975, 1976), Atkinson and Stiglitz (1972, 1976), Deaton (1977) and Sandmo (1974, 1976), to name a few, have extended our knowledge on the optimal design of indirect taxation (commodity taxation). Almost none have dealt with measurements of optimal taxes in an economy with many consumers; the most noticeable exception is Deaton's work using a linear expenditure system of consumer demands and a lognormal distribution of income to represent the British economy. Though he explicitly reported the optimal taxes for various levels of government revenues and social inequality aversion, he did not contemplate their impact on the income distribution. True, there have been papers dealing with taxation and distributional neutrality, such as Feldstein (1972), but they tend to limit themselves to interpretative exercises of first order conditions.

In this paper, we examine how optimal indirect taxes and (real) income distribution vary with government revenue needs and society's aversion to inequality, using U.S. data. We also show that the more luxurious the good, the higher the optimal tax rate it should bear (see Deaton, 1977, and Balcer and Sadka, 1980). If there is a large disparity in the degrees of luxuriousness of the various goods, we will get a large disparity in the optimal tax rates. Nevertheless, although these tax rates deviate considerably from a uniform tax structure, they do not redistribute income in a significantly more equal way (as measured by the Gini coefficient and other means). Thus, the social cost of sticking to the uniform tax structure does not seem to be excessively high in the United States.

The paper proceeds as follows: first, the model is introduced, then the data are briefly discussed and finally the results are presented and analyzed. An appendix contains a more detailed account of how the data were obtained.

2. THE MODEL

The theoretical framework to analyze the structure of indirect taxation in this paper is the utilitarian criterion and, in particular, is based on the work of Deaton (1977) and Balcer and Sadka (1980). Specifically, society maximizes an appropriately weighted sum of individuals' utility subject to a government revenue constraint; the weights are determined by the social aversion to inequality as discussed in Atkinson (1970). For the case at hand, the only instruments available to the government for raising revenues while achieving income redistribution efficiently are linear commodity taxes (i.e., taxes which are proportional to the price of the commodity, independent of the level of consumption, and likely to be different for each commodity).

Society

Each individual in society maximizes an identical utility function, $U(x_1,\ldots,x_n) = \prod_{i=1}^{n} (x_i - \gamma_i)^{\beta_i}$, $(\Sigma\ \beta_i = 1)$, subject to a budget constraint

$$(1 + t_1)x_1 + \ldots + (1 + t_n)x_n = I,$$

where x_i is the quantity of commodity i consumed, γ_i is the minimum consumption level of the commodity, below which no utility is derived, t_i is the tax on it, I is income (exogenously given) and, without loss of generality, the producer prices are assumed to be 1. β_i can be shown to be the marginal budget share of good i, or approximately the average budget share of good i for the very rich. Note that the problem is well defined only if income I is greater than or equal to the minimum income necessary for subsistence, that is, $I_S = (1 + t_1)\gamma_1 + \ldots + (1 + t\ )\gamma_n$. Solving the individual's maximization problem, the optimal budget share of each good is derived:

$$\frac{(1+t_i)x_i(1+t_1,\ \ldots,\ 1+t_n,\ I)}{I} = \beta_i\left(1 - \frac{I_S}{I}\right) + \frac{(1+t_i)\gamma_i}{I_S}\left(\frac{I_S}{I}\right) \quad (1)$$

Since β_i is the budget share for commodity i for a person with extremely large income ($I = \infty$) and $(1 + t_i)\gamma_i/I_S$ is the budget share for commodity i for a person with the subsistence income (I_S), then the budget share for commodity i for an individual with income I can be viewed as the weighted sum of the budget share of the richest and the poorest individuals. This will allow a simple classification of each commodity into either a luxury, when the budget share of the rich is greater than that of the poor (equivalently, when the budget share increases with income), or a necessity, when the opposite is true.

In summary, the problem that the government wishes to solve reduces to

$$\underset{t_1,\ldots,t_n}{\text{Max}} \frac{1}{(1-\varepsilon)} \sum_{h=1}^{H} [V(1 + t_1,\ldots,1 + t_n,\ I^h)]^{1-\varepsilon} \quad (2)$$

subject to:

$$\sum_{h=1}^{H} \sum_{j=1}^{n} t_j x_j(1 + t_1, \ldots, 1 + t_n, I^h) \geq R \tag{3}$$

where H, V, R and $\varepsilon \geq 0$ represent, respectively, the number of individuals in the society, the indirect utility (the maximum utility obtainable at given prices and income), the government's revenue needs, and the social aversion to inequality. The H households are representatives of the ten deciles of the U.S. population; household 1 is the poorest and household 10 the richest.

Poorest Individual

The condition that the income of the individual must be sufficient to provide him with the ability to purchase the minimum consumption basket, $\{\gamma_i\}$, at post-tax prices is likely to cause problems for the poorest person in society. In particular, we should add the constraint,

$$I^1 \geq \sum_{i=1}^{n} (1 + t_i)\gamma_i \tag{4}$$

to the maximization problem (2)-(3). At the optimum, (4) may be binding only when $\varepsilon = 0$; when $\varepsilon > 0$, the derivative of $V^{1-\varepsilon}/(1-\varepsilon)$ with respect to V would be infinite if (4) were binding: the marginal impact of the poorest household on social welfare would be infinitely large. It implies that the driving force behind the tax rates is not the maximization of the social welfare function based on the income distribution, but the transferral of income through taxes to the first individual so that he can meet his budget constraint. This is, in our opinion, too narrow a view of the political process taking place.

In the United States, the income of the first decile for the most part comes from transfers from the government; it is, therefore, reasonable to argue that the government has established this level of direct income transfers so that the individuals could afford to consume this minimal budget $\Sigma(1 + t_i)\gamma_i$ at the current tax levels. Thus, the level of direct transfers to the first person is adjusted to reflect the changes due to the taxes in the cost of the minimal budget. The government gives, on the one hand, what it takes on the other, so as to maintain the individual at the same level of consumption. Simply said, the government, through direct transfers on I^1, ensures that the poor can afford the misery budget regardless of the commodity tax structure. The consequences are that: (i) constraint (4) is dropped for all reasonable levels of government revenue needs; (ii) tax collections from individual 1 can be dropped from the revenue constraint as they are matched by equal transfers to him so that he can pay the taxes; and (iii) that the utility of individual 1 is constant and can be dropped from the welfare function.

We think that this is a reasonable approach to take, particularly when the incomes in the problem have already been adjusted by the direct taxes and cannot be thought of as earned income independent of government action (see section 3). Our approach uses, thus, a lexicographic welfare function: first, ensuring minimum standards to the poor and then raising revenues from the others subject to a standard welfare maximization procedure.

3. DATA

The information needed for the computation of optimal taxes and the ensuing optimal redistribution of income is: (i) the pretax distribution of income, $\{I^h\}$; (ii) the budget shares of the richest people $\{\beta_i\}$; and (iii) the expenditures by commodity of the poor at producer prices $\{\gamma_i\}$. From the Consumer Expenditure Survey, we obtain the expenditures by commodity of the various deciles. However, these expenditures are given at consumer (i.e., post-current-tax) prices.[1] Hence, in order to calculate the γ's, which are the expenditures of the poor at producer prices, we had to calculate the existing taxes by commodity. A detailed discussion of how the taxes were derived is provided in the appendix. In this section, we only outline how we went from the data to the specific components of our model and to the choice of the commodity groups.

From the Consumer Expenditure Survey, we obtain also a family income distribution by decile, net of income taxes and savings. Income taxes were netted out because we do not intend to examine the replacement of income taxes by commodity taxes, and the leisure-consumption trade-off is ignored. Savings are netted out to keep the model simple and tractable. To handle savings appropriately would have necessitated a multi-period utility function and expectations about future taxes and income that are beyond the scope of this paper. The net incomes for the ten deciles are reported in Table 1. For each commodity consumed by the poorest decile, the expenditures reported at consumer prices (col. 3, Table 2) are inflated or deflated by the subsidies received or the taxes paid by these consumers (col.

Table 1

Net Income (income after direct tax minus savings) by decile, 1972

Decile	Net Income (dollars per yr)
1	$2,825
2	3,771
3	4,827
4	5,912
5	6,971
6	7,838
7	8,918
8	10,066
9	11,501
10	14,936
TOTAL	77,565

Source: 1972 Consumer Expenditure Survey.

Table 2

Budget Shares and Tax Rates, 1972

(1) Commodity	(2) Budget Rich	(3) Budget Poor	(4) Tax Rate Poor	(5) γ_i (Producer Prices)	(6) $\beta_i'^{a}$	(7) $\gamma_i'^{b}$	(8) β_i/γ_i'
Housing	$1,512.48	$656.61	-7.207%	$707.61	.0707	.2532	.2792
Public transportation	87.97	33.10	-9.695	36.65	.0045	.0131	.3435
Home energy	644.37	206.71	2.823	201.04	.0361	.0720	.5014
Food (at home)	2,086.12	536.22	-6.144	571.32	.1280	.2045	.6529
Other	4,843.07	734.28	8.121	679.13	.3395	.2430	1.3971
Gasoline	625.37	102.94	39.4	73.85	.0431	.0264	1.6326
Clothing	1,431.35	177.85	4.676	169.91	.1035	.0608	1.7023
Vehicle purchases	1,412.01	181.55	13.547	159.89	.1016	.0572	1.7762
Recreation	2,293.75	195.95	5.005	186.63	.1732	.0668	2.5928
TOTAL	14,936.49	2,825.21	-	2,794.25	1.000	1.000	-

Source of data: 1972 Consumer Expenditure Survey.

[a] $$\beta_i = \frac{(\text{Budget}^i_{rich} - \text{Budget}^i_{poor})}{\sum_j (\text{Budget}^j_{rich} - \text{Budget}^j_{poor})}.$$

[b] $$\gamma_i' = \frac{\gamma_i}{\sum_j \gamma_j}.$$

4, Table 2) to obtain the expenditures at producer prices (col. 5, Table 2). The latter are also equal to the quantities consumed by the poor given the producer price normalization at 1. These quantities are the γ's. For each commodity consumed by the richest decile (col. 2, Table 2), we subtract the expenditure of the poor from the expenditure of the rich, both at consumer prices, and normalize by the sum of these adjusted expenditures over all commodities to obtain the β's (col. 6, Table 2). Column 7 presents the budget shares of the poor (i.e., $\gamma_i' = \gamma_i/\Sigma\gamma_j$) and column 8 presents the poor/rich budget shares (i.e., β_i/γ_i'). The goods in Table 2 were arranged in an increasing order of the ratio β_i/γ_i'. The reason for this will be discussed later.

The definition and the choice of the nine commodities used in this paper is to a large extent arbitrary. One may see this as a serious objection to the results yet to be derived, since those results depend on the dispersion of the ratios of the budget shares of the rich to those of the poor across commodities. Using the Consumer Expenditure Survey, the expenditures were examined at a level of disaggregation of 30-odd commodities. Only the groups that represented both a reasonable share of the budget and had a ratio sufficiently different from 1 were retained, and became the eight commodities specified in Table 2. The remaining commodities were grouped in a single category, other goods. In addition, the chosen commodity groups are sufficiently broad and different from one another to justify the Stone-Geary representation for the preferences, given the rather small cross-elasticities of the implied demand system.

4. RESULTS

The welfare model, as described by the optimization problem (2)-(3), was solved for many levels of government revenue needs (ranging from -5% to +30% of total disposable income) and various levels of inequality aversion (ranging from 0.0 to 2.0). The results are divided into two categories: results for the commodity taxes themselves, and results regarding the ensuing income redistribution.

Commodity Taxes

It was shown by Deaton (1977) that the goods whose budget shares are greater for the rich than for the poor are taxed more heavily than those whose budget shares are greater for the poor than for the rich. However, the budget shares of the poor depend on the tax rates, so it is impossible to derive a positive rule from his result. Balcer and Sadka (1980) proved that the tax rate increases across commodities when they are ranked by the ratio of the budget shares of the rich to those of the poor at producer prices (β_i/γ_i'). This theoretical rule is confirmed in Table 3 and Figures 1 and 2.

In Figure 1, the tax rates as a function of the pretax ratio of the budget shares of the rich to those of the poor are reported for various levels of inequality aversion when the government revenue needs are 10% of disposable income. As expected, when society is neutral towards inequality ($\varepsilon = 0$), the tax rates are uniform across commodities. As inequality aversion increases, the tax rates increase for the commodities favored by the rich while they decline for those favored by the poor. For example, when $\varepsilon = .25$, the tax rates vary

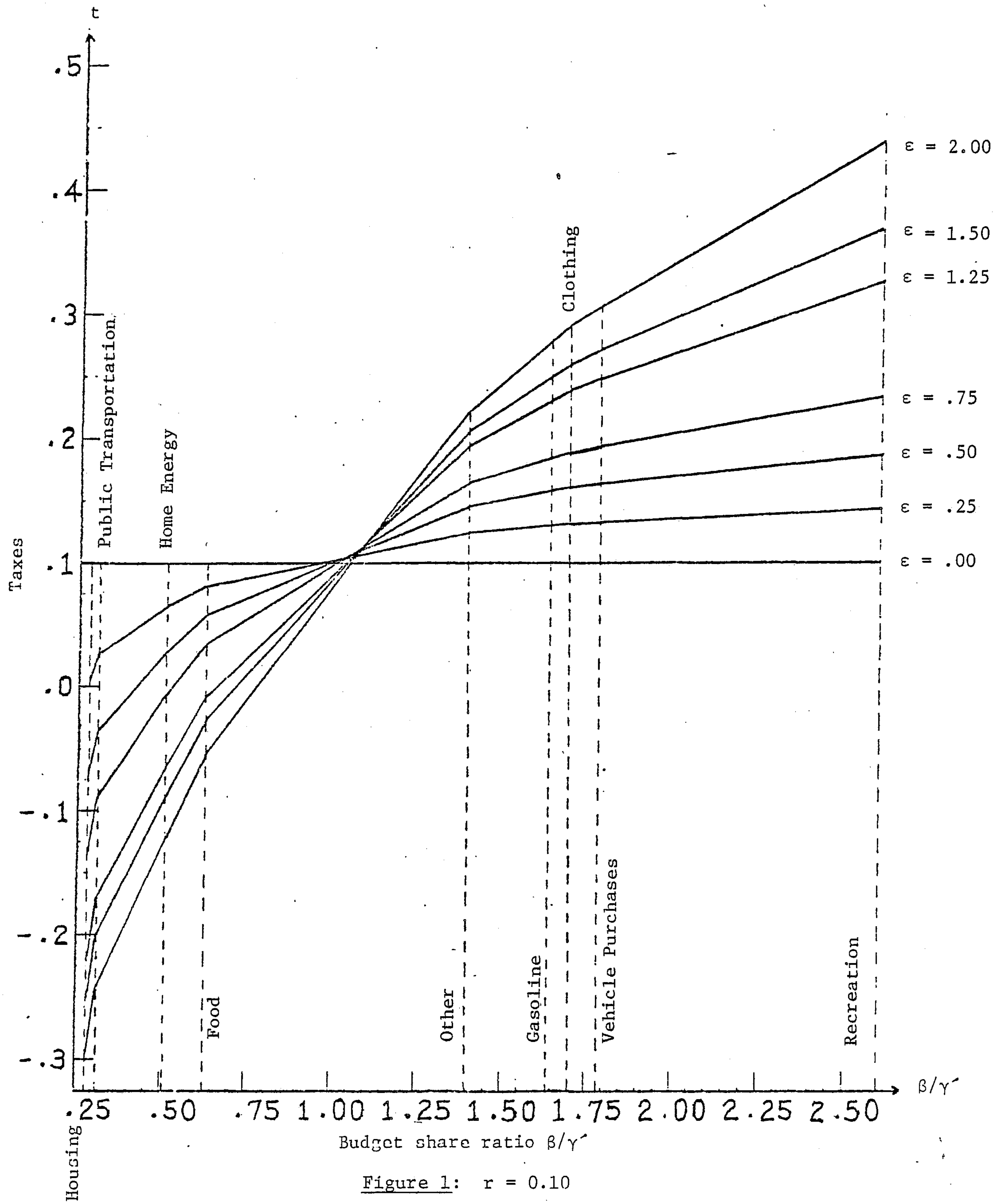


Figure 1: r = 0.10

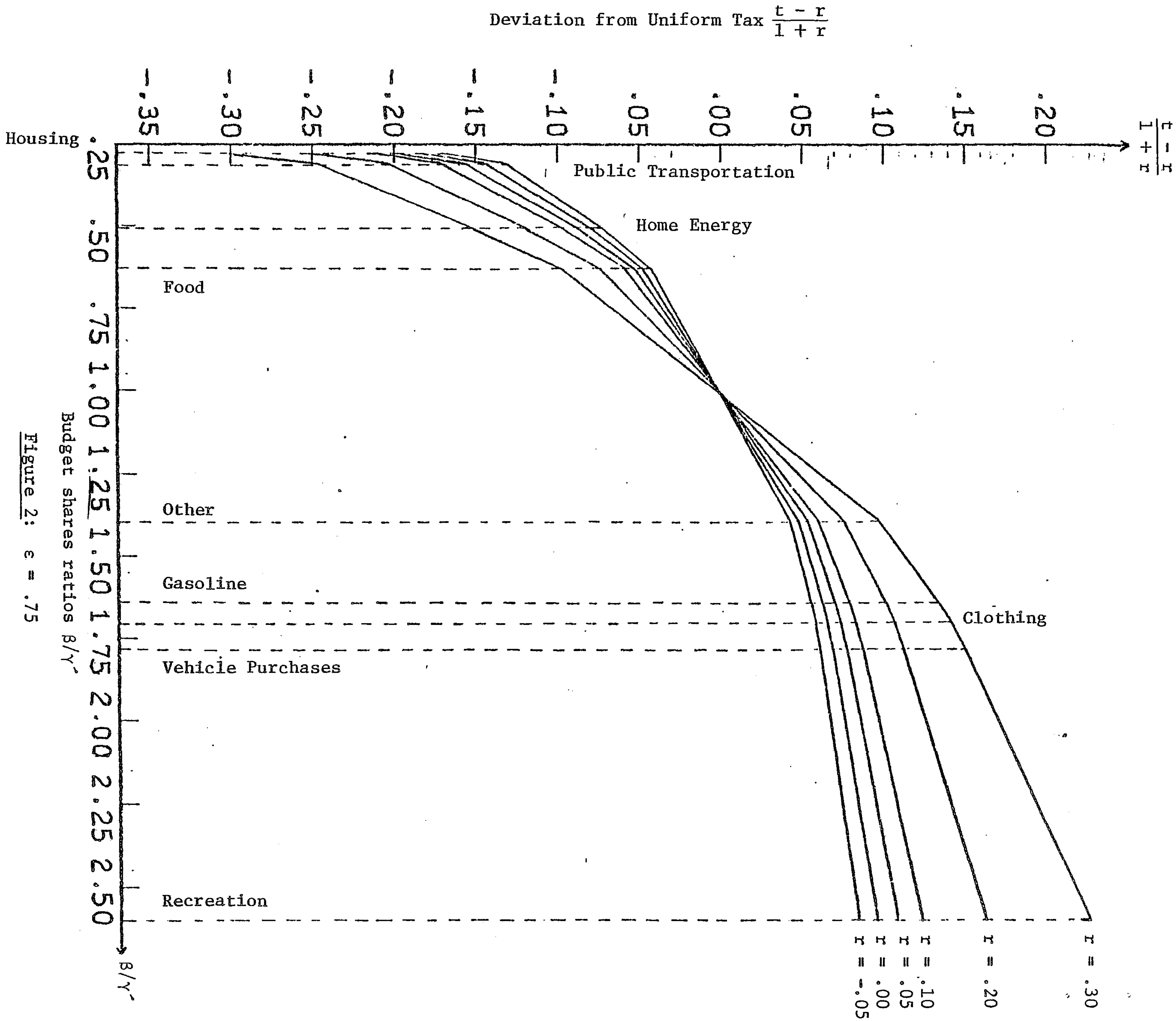


Figure 2: ε = .75

from 0.2% to 14.2%, while they vary from -30.2% to 43.4% when $\varepsilon = 2$. This figure, as well as all the other figures and tables, illustrates Balcer and Sadka's theoretical finding mentioned above: the tax rate on a good i is higher than the tax rate on good j if, and only if, the pretax rich/poor budget share of good i [i.e., β_i/γ_i'] is higher than that of good j [β_j/γ_j']. Roughly speaking, the reason for this result is that a higher β_i/γ_i' means also a higher "degree" of luxuriousness which calls for a higher tax.

Denote by r the uniform tax rate necessary to meet the government's needs.[2] Such a tax is usually not an optimal tax. It is interesting to consider how the deviation between the optimal tax structure and the uniform tax structure changes with the size of the government's budget. In Figure 2, the optimal tax rates[3] translated by r and normalized by 1 + r [i.e., $(t_i - r)/(1 + r)$] are plotted against the pretax ratios of the budget shares of the rich to those of the poor. The parameter ε of the social aversion to inequality is 0.75 and various government revenue needs are considered. As the government revenue needs increase, differences in the tax rates across commodities become larger. This could be explained as follows: when the revenue needs of the government increase, all taxes must generally become higher; this puts a relatively heavier burden on the lower income class than on the richer class, as taxes are paid on all consumption, but utility is derived only on consumption above a minimum level. To correct this, the tax burden is shifted more onto the rich, by taxing incrementally their preferred consumption and reducing the (adjusted) taxes on the items preferred by the poor. Of course,

Table 3

Actual and Optimal Taxes by Commodity

Commodity	Actual Average Tax Rates	Optimal Tax Rates			
		ε = .25	ε = .5	ε = .75	ε = 2.00
Housing	-11.8%	-4.2%	-10.8%	-16.2%	-31.9%
Public Transportation	-9.7	-2.1	- 7.5	-12.1	-26.6
Home Energy	2.5	1.0	- 2.1	-5.8	-15.8
Food (at home)	-1.4	2.5	.6	-1.4	-9.4
Other	7.3	6.0	7.8	9.4	14.5
Gasoline	39.6	6.5	8.8	11.0	19.0
Clothing	4.7	6.6	9.0	11.4	20.2
Vehicle Purchases	14.9	6.7	9.3	11.8	21.4
Recreation	5.4	7.5	11.1	14.8	31.8

Source of data: 1972 Consumer Expenditure Survey.

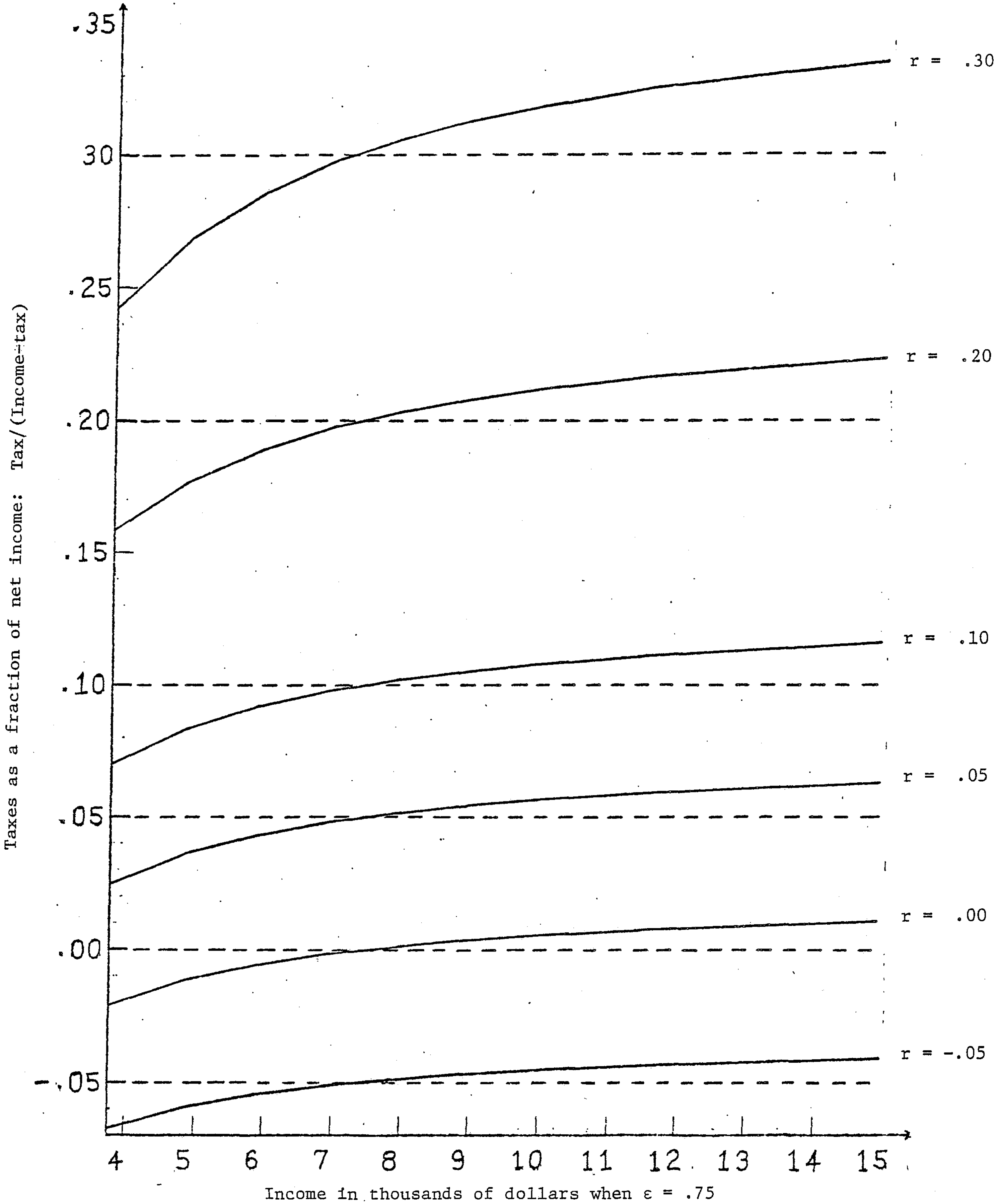
the unadjusted tax rates, the t's, increase for all goods with an increase in government revenue needs.

Table 3 reports the actual taxes in 1972 and compares them with the optimal ones which raise the same amount of revenue (4.0675% of disposable income). The optimal rates vary from about -4.2% to about 7.5% for $\varepsilon = .25$ and from -31.9% to 31.8% for $\varepsilon = 2$. The narrower range represents substantially smaller variations than is currently observed in the United States, while the wider range exhibits somewhat larger variations, particularly on the subsidy side.[4] One may, therefore, say that the government's ε is somewhere between .25 and .75, most likely in the neighborhood of .5, which is in line with Blinder's (1978) figure.

Income Distribution

So far we have examined the instruments of inequality reduction, namely the commodity tax rates; but their variations of -30% to 43% from one commodity to the other may mislead us in believing in their great redistributive ability. Three measures of the redistributive action of the taxes are considered here.

The first two are very similar and we will describe them first: (i) we can look at the percentage of total commodity taxes paid by each decile [i.e., $\sum_i t_i x_i(1+t, I^h)$] from the disposable income of that decile; (ii) we can calculate the lump-sum tax for each decile that would have led to the same utility level as obtained under commodity taxation and then look at the percentage of the lump-sum tax from the after lump-sum tax income of each decile.[5] The advantage of the second method is that it takes into account the excess burden or dead-weight loss inflicted by distortionary commodity taxation.[6] It can be shown that the lump-sum tax on each decile which is calculated in (ii) above is higher than the total commodity taxes paid by that decile as calculated in (i). Figure 3 illustrates the burden of taxation (ratio of lump-sum taxes to after lump-sum taxes income) for various government revenue needs when the social inequality aversion is .75. The dashed lines in Figure 3 are the ratios of the government's revenue needs from total disposable income. They are also equal to the uniform tax rate which will meet these needs. As seen from the graphs, the impacts on the various income groups are almost uniform, in spite of the huge variations in the optimal tax rates reported earlier in Figure 2 (recall that the tax rates reported in that figure are adjusted and should therefore be multiplied by 1 + r and then added to r in order to get the t's). Figure 4 replicates Figure 3, for various levels of inequality aversion, when the revenue needs are 10% of disposable income. Even for the unrealistically high level of inequality aversion of 2.0 (Blinder, 1978), the burden varies from 5.6% of (poor) income to 13.8% of (rich) income. It varies only from 7.0% (poor) to 11.6% (rich) at an inequality aversion level of .75. For the various combinations of social inequality aversion and revenue needs, we also computed the Gini coefficients for the income distribution, after the above lump-sum taxes are netted out, and compared them to the Gini coefficient of the pretax income distribution as reported in Table 1. From Table 4, we see that the Gini coefficient is reduced very slightly. For example, for $\varepsilon = .75$ and the current r of .040675, the Gini coefficient is reduced by only 1.46%.


.35
30
.25
.20
.15
.10
.05
.00
-.05
r = .30
r = .20
r = .10
r = .05
r = .00
r = -.05
4
5
6
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12
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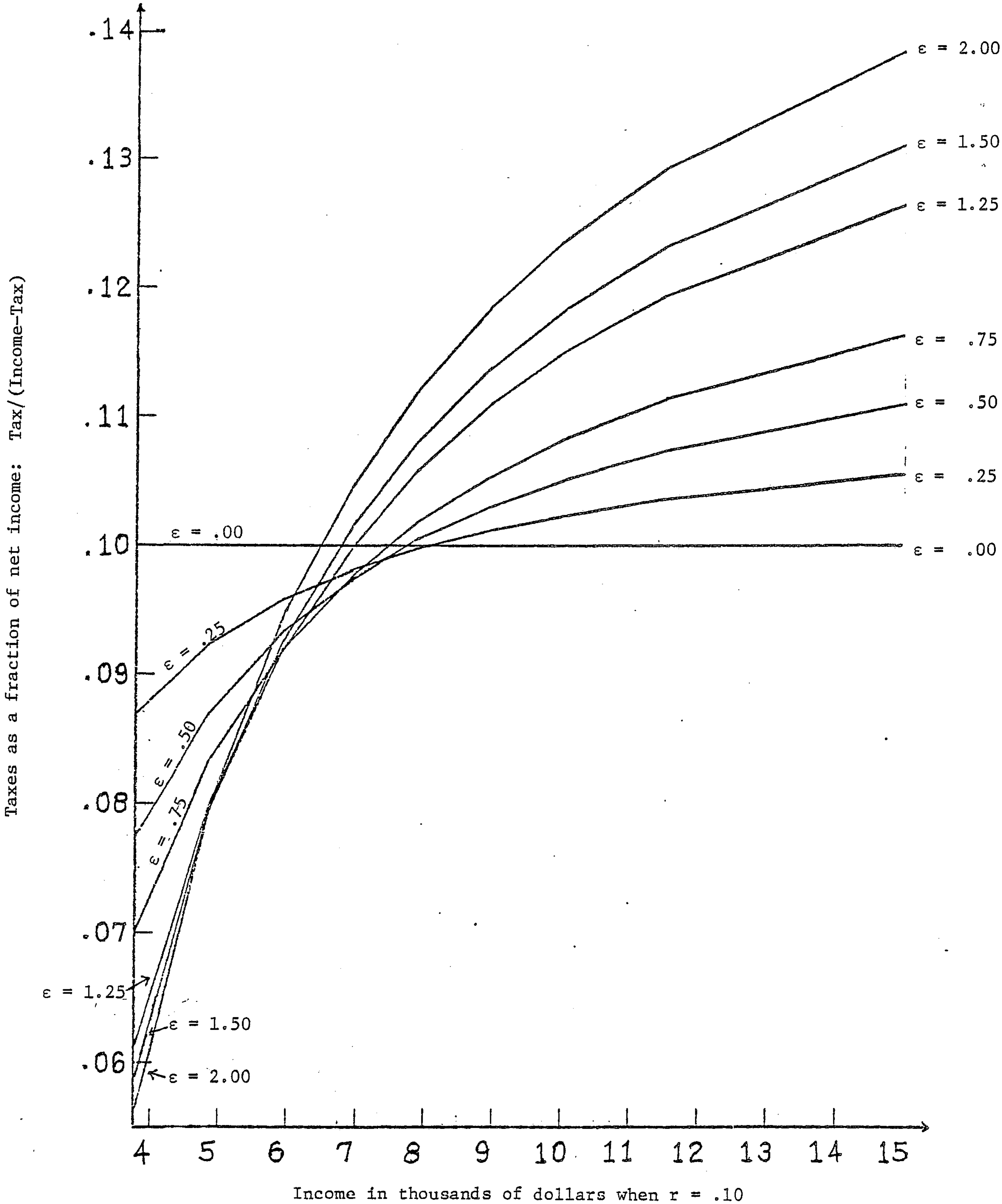
Taxes as a fraction of net income: Tax/(Income-tax)
Income in thousands of dollars when ε = .75

Figure 3



Taxes as a fraction of net income: Tax/(Income-Tax)
.14
.13
.12
.11
.10
.09
.08
.07
.06
4
5
6
7
8
9
10
11
12
13
14
15
ε = 2.00
ε = 1.50
ε = 1.25
ε = .75
ε = .50
ε = .25
ε = .00
ε = .00
ε = .25
ε = .50
ε = .75
ε = 1.25
ε = 1.50
ε = 2.00
Income in thousands of dollars when r = .10

Figure 4

Table 4

The Effect of Indirect Taxation on the Gini Coefficient of the Distribution of Income

ε[b]	Revenue Rate (r)	Gini Coefficient[a]: After Tax	Gini Coefficient[a]: Percentage Change
0	.1	.301	0
.25	.1	.298	- .68
.50	.1	.297	-1.24
.75	.1	.295	-1.71
1.25	.1	.293	-2.43
1.50	.1	.292	-2.69
2.00	.1	.291	-3.06
.75	-.05	.297	-1.14
.75	0	.297	-1.30
.75	.040675	.296	-1.46
.75	.05	.296	-1.50
.75	.1	.295	-1.71
.75	.2	.294	-2.24
.75	.3	.292	-2.96

[a]The Gini coefficient before tax is .301.

[b]ε = level of inequality aversion.

This reduction is very small when contrasted with the reduction obtained by other researchers who examined the impact of income taxation. For instance, Okner (1966) shows that abolishing the income tax would increase the Gini measure by 17%, Danziger and Haveman (1977) point out that a tax-welfare simplification plan (tax credit adjusted for family size and linear income tax) reduces the Gini of disposable income by 10%, and Betson, Greenberg and Kasten (1980) obtain that, compared with the current system, the Gini is reduced by 12.5% under a credit income tax and 10.3% under a negative income tax.

A third way to examine the redistributive power of commodity taxation is to consider the welfare loss of restricting the tax to a uniform imposition. The welfare loss is defined as the amount by which government is forced to lower its revenue if it wants to hold social welfare at the same level as under optimal commodity taxation; this methodology is discussed in Sadka, Garfinkel, and Moreland (1979). These losses are reported in Table 5 for the various levels of revenue needs and social aversion to inequality used in Figures 1 and 2. If we compare these losses with the disposable national income of $77,565 (sum of the income of the 10 deciles in Table 1), they are very insignificant. For instance, for $\varepsilon = .75$ and the current r of .040675, the welfare loss is only .32% of disposable national income. Table 5 shows that the welfare cost of uniform taxation increases in either ε or r, confirming our earlier results that the variations in the optimal tax rates increase in either the inequality aversion level (ε) or the government's revenue rate (r).

Table 5

Welfare Cost of Uniform Taxation as Percentage of Total Net Income ($77,565)

Inequality Aversion ε	Revenue Rate r	Welfare Cost
.0	.10	.00%
.25	.10	.05
0.5	.10	.17
.75	.10	.40
1.25	.10	1.10
1.5	.10	1.51
2.0	.10	2.28
.75	-.05	.24
.75	.00	.28
.75	.040675	.32
.75	.05	.33
.75	.10	.40
.75	.20	.60
.75	.30	1.01

5. CONCLUSION

On a normative basis, the model indicates that commodity taxes are expected to vary widely across commodities; these variations increase with either an increase in inequality aversion, an increase in government revenue needs, or an increase in the range of the budget shares ratios. Their redistributional ability is, however, somewhat limited.

On a positive basis, the model indicates that the current commodity tax-subsidy rates in the United States are not imposed on the appropriate commodities at the desired levels. At the level of inequality aversion of .5 as approximated from the data, the major deviation between optimal and actual tax rates is that taxes on gasoline are substantially higher taxes than are desired. This may be justified on externalities grounds (neglected here), or on the more likely ground that gasoline taxes are simply a practical mechanism to collect users' fees for the road network. This explanation is the most plausible since, in most instances, tax revenues from gasoline sales are earmarked for highway construction and/or maintenance. Also, for a greater level of inequality aversion, .75, and for a greater level of revenues, 10%, than implied by the data, the model showed that a deviation from optimal tax-subsidy rates to uniform rates neither results in a great welfare loss, nor leads to greater redistribution. Since the actual rates do not deviate substantially (with one exception), the model implies that for a more realistic inequality aversion of .5 and revenue needs of 4%, very little could be gained by changing the actual rates to optimal ones.

Finally, in this paper, the analysis was done with a welfare maximization subject to the requirement of a minimal consumption level imbedded in the utility function. This emphasizes inequality, while the emphasis in political discourse, in the United States at least, has been on assuring minimum standards of living, although there is debate over how high to set the minimum standards. Within the context of our model, an increase in the γ's is not only an increase in society's minimum standard, but also a change in preferences. So we cannot study the effect of increasing the society's minimum standards by simply employing higher γ's. Nevertheless, we can consider the effect of raising the income of the poorest decile by, say, $100 at producer (pretax) prices. This will cost the government $100 which will have to be raised from all the other deciles. In our model, this is equivalent to raising the government's budget by $100. Thus, the effect on optimal tax rates of raising the poverty line is the same as the effect of raising the size of the budget. The latter effect has already been reported in our results.

6. APPENDIX: DATA

We calculated the expenditures and budget shares for each income class from the published results of the Consumer Expenditure Survey undertaken by the Bureau of Labor Statistics in 1972 and 1973. These published results include a set of tables for the expenditures of each pretax income decile. Expenditures were then calculated for nine commodity groups for each decile. With two exceptions, housing and food at home, reported expenditures reflect expenditures on these commodities at consumer prices. An income measure was also calculated for each decile; this was equal to the total of expenditures at consumer prices for all goods. This is approximately equal to gross income minus income taxes and saving; these income measures are reported in Table 1.

The nine commodity groups are: (1) housing, (2) public transportation, (3) home energy, (4) food at home, (5) gasoline, (6) clothing, (7) vehicle purchases, (8) recreation and (9) other goods and services. The group of expenditures implied by public transportation, food at home, gasoline and clothing are self-explanatory. Home energy expenditures consist of all expenditures on heating, water, gas, electricity and sewerage. We should note that expenditure for durables refers only to current outlays on durables. These expenditures are not based on a rental value concept, nor do they necessarily reflect full purchase price. For example, vehicle purchase expenditure refers to net current outlay on the vehicle, plus any interest payments. Housing includes all mortgage and interest payments and other housing maintenance expenditures. Recreation includes expenditures on transportation, lodging, food in restaurants, and other recreational goods. The category of other expenditures is quite diverse. It includes expenditures on alcohol, tobacco, services, health care, and purchases of all other goods.

The analysis requires knowledge of both consumer and producer prices. As we noted above, the reported expenditures are equivalent to expenditures at consumer prices except for two goods, food at home and housing. In the case of food at home, reported expenditures are equal to the total rung up at the checkout counter. However, this total is not the cost to the consumer when food stamps are used. Therefore, to calculate food expenditures at consumer prices, the difference between the value of food stamps purchased and their cost must be subtracted from reported expenditures on food at home. Similarly, the housing subsidy implicit in the income tax structure requires that reported expenditures on housing be corrected by the amount of this subsidy in order to reflect consumer cost. The consumer expenditures are reported in Table 2.

Expenditures at producer prices must also be determined. Under the assumption that the only distortions between producer and consumer prices are consumption taxes and subsidies, we subtracted the net tax payments from consumer expenditures to derive producer costs. This involved calculating the average net tax rate for all commodities. We defined this average net tax rate as the sum of all applicable sales tax, excise tax, and subsidy rates. Average tax rates are reported in Table 3 for the entire population and in Table 2 for the lowest decile. These different tax rates were determined in the following manner.

Sales Tax

The average sales tax was applied to all commodities unless they were specifically excepted. The commodities for which there were exceptions were services, food, medicine, gas/electric, water, telephone, food in restaurants, lodging, vehicles and transportation. Average sales taxes for 1972 were found for each state (ACIR, 1972, pp. 178-90). In those states where local sales taxes were not uniformly collected, the state sales tax rate was inflated by the ratio of total sales tax ratios (S+L) and state sale tax revenues (s). Population-weighted averages for all the commodity groups were calculated for four geographical regions--North Central, Northeast, South and West. These regional averages were then weighted by average expenditure for each of the commodities by each decile within each region. (Total expenditure weights were used for the average sales tax.) In this manner, we were able to define sales taxes for each commodity group by income decile. These sales tax rates, even though uniform within a state, vary over the reported income distribution, which is a national distribution, because the composition of rich and poor varies geographically.

Excise Tax

Excise taxes exist on the local, state and federal level for tobacco products, alcoholic beverages, gasoline, motor vehicles, telephone service and transportation of persons. Excise taxes are usually defined per unit purchased. This creates some difficulties, since we have no quantity information. Thus, we must have the excise taxes in the form of tax rates to enable us to determine producer costs from consumer expenditures. For tobacco products, alcoholic beverages, telephone services and transportation of persons, the excise tax rate was calculated by dividing total excise tax revenues for each commodity by personal consumption expenditures on that commodity. For motor vehicles, the tax revenues were divided by the sum of personal consumption expenditures, producer capital expenses and government purchases of motor vehicles.[8]

Gasoline excise taxes were calculated from the excise taxes for each state (ACIR, 1972, p. 291). Population-weighted averages were calculated within each region. Then the average state gasoline excise tax was defined as a weighted average of the regional excise taxes using average gasoline expenditures for each income decile as weights. In 1972, there was also a 4 cents a gallon federal excise tax.[9] Thus, adding the average state and federal excise taxes, we have an average gasoline excise tax. If we assume the average price of a gallon of gasoline was 40.5 cents in 1972,[10] we can then calculate the average gasoline excise tax rate for each income decile.

Consumption Subsidy

Consumption subsidies were considered for food, public transportation and housing. The bonus value of food stamps is available from the Consumer Expenditure Survey. Since food expenditures are reported by the actual cost of food, not the actual level of expenditures when food stamps are used, the producer cost of food is the expenditure corrected for sales taxes only. For public transportation, total operating revenues and expenditures were determined for the sample of transit systems represented by the American Transit Association. The difference between revenues and expenses, net revenue, was calculated.[11] The subsidy rate was then defined as the ratio of net revenue to operating expenses, implying a subsidy rate of 18.8%.

Housing subsidies are more complicated, since they involve two types: (1) direct subsidies that lower the cost of rental housing; and (2) indirect subsidies available to homeowners through federal income tax deductions. The direct subsidies involve subsidized public housing and rental allowances from AFDC and OAA. Since the median income of the recipients of these benefits was only $1,990, the correction for direct housing subsidies is only made for the two lowest deciles. The public housing subsidy was determined by comparing the total expenses for low rent housing and the rental income.[12] The implied subsidy was $16.57 per month. We also found the average rental allowance for the AFDC and OAA programs of each state in 1972 (HUD, 1973, p. 2013). A population-weighted average was then calculated. In 1972, the national average rental allowance was $80.65 per month. Given these two subsidies, we then calculated the proportion of the poverty population that receive these benefits. Of those who are renters, 15% receive the public housing subsidy and 3% receive rental allowances (CPS, Ser. P-60, No. 110, p. 12). This implies that the average monthly subsidy to renters below the poverty line is $4.91. Thus, by multiplying by the percentage of renters, the average direct housing subsidy can be calculated for the first and second deciles.

Finally, we calculated the implicit subsidy to homeowners within the federal income tax structure. Homeowners are able to deduct mortgage and interest payments and property taxes from their taxable income. Hence, the implicit subsidy is equal to these payments multiplied by the marginal income tax rate. By first calculating the mean taxable income for each income decile and then looking these up in the tax tables for 1972, we were able to find the marginal tax rates. Mean taxable income was defined as mean gross income minus the mean personal deduction (family size mean multiplied by $750). Also, for incomes above $10,000, another allowance of 15% of income, not exceeding $2,000, was deducted in 1972. We should also note that property taxes were viewed as part of the cost for housing services.

The other datum required by the analysis was the government revenue constraint, which was assumed to be the then current level of revenues. This was quite simply computed. For each income decile, consumer expenditures were then compared with the producer costs implied by our corrections for consumption taxes. The difference is the tax revenues accruing from each decile. These were then summed across all ten deciles to form the level of total government revenues.

NOTES

[1]Food and housing are some exceptions, as some of the subsidies in these two cases are paid directly to the consumers (for instance, via the itemized deduction in the case of housing).

[2]This r is related to R of the RHS of (3) by $r/(1 + r) = R/\Sigma I^h$.

[3]The justification for this normalization is that a uniform commodity tax at a rate r is equivalent to a proportional income tax at a rate of $r/(1 + r)$ which leaves an aftertax income of $I/(1 + r)$. Formally, since demand is homogeneous of degree 0 in prices and income, then $x_i[1 + t_1,\ldots,1 + t_n;I] = x_i[(1 + t_1)/(1 + r),\ldots,(1 + t_n)/(1 + r); I/(1 + r)]$. Hence, the tax rates t_i are equivalent to the tax rates $(1 + t_i)/(1 + r) - 1 = (t_i - r)/(1 + r)$ after a proportional income tax at a rate $r/(1 +r)$ is raised. Figure 2 is plotted with the normalization because we believe it shows more clearly the effect of changing the revenue needs on the deviation of the optimal tax rates from the (nonoptimal) uniform tax rate.

[4]One should be cautious in interpreting the results as certain heavily subidized commodities have been omitted--for instance, education and health services. The reason for their omission is that in the United States these commodities are provided in kind and in fixed amount, so that we cannot assess the value of γ for them, as it is not revealed by the preferences of the poor.

[5]The reason that we consider the percentage of tax from aftertax income (namely, income minus tax) rather than from pretax income is for purposes of comparison with commodity tax rates, which are based on producer prices (namely, consumer prices minus taxes).

[6]This is the reason we report here only the second measure. Also, the numerical difference between the two measures was not found to be meaningful.

[7]For tobacco and alcoholic beverages, see U.S. Dept. of Commerce, 1977, pp. 248, 431; for telephone services, see ibid., 1975, pp. 232, 514; for transportation, see ibid, pp. 383, 514. Tax revenues come from ibid, pp. 514, and the sum of the last three items from Survey of Current Business, January 1976, Vol. 56, No. 2, p. 33.

[8]U.S. Dept. of Commerce, 1977, p. 642.

[9]Ibid, p. 641.

[10]American Transit Association, 1974, p. 1.

[11]Both figures from HUD, 1972, pp. 118, 133.

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