Policy, Planning, and Research

WORKING PAPERS

Public Economics

Country Economics
Department
The World Bank
August 1988
WPS 75

Welfare Dominance and the Design of Excise Taxation in Côte d'Ivoire

Shlomo Yitzhaki
and
Wayne Thirsk

The concept of conditional welfare dominance can be used to determine which excise taxes are preferable, both for equity and administrative feasiblity. Applied to Côte d'Ivoire, the technique shows that the most effective excise taxes would be on electricity and telephone services.

Policy, Planning, and Research

WORKING PAPERS

Public Economics

There is a compelling fiscal rationale for encouraging greater reliance on taxing the consumption of electricity and telephone (ET) services.

ET taxes are easy to administer. Enforcement and collection of the tax is relatively inexpensive, since the tax can be added to commercial charges, and the services quickly turned off for nonpayment. It is not difficult to distinguish in most cases between business and personal use of these services. ET taxes avoid the problems of smuggling and evasion commonly associated with taxing the production or use of commodities that can be imported.

On equity grounds, in Côte d'Ivoire at least, ET taxes are clearly the most desirable excise taxes. Ranking alternative commodity taxes with high income elasticity, telephone services clearly dominate — and electricity consumption nearly dominates — the taxation of alcoholic beverages and public transportation.

These conclusions on the distributive impact of alternative indirect tax measures are reached through the application of the relatively new concept of marginal conditional welfare dominance. A commodity tax dominates others on social welfare grounds when a marginal shift in the balance of commodity taxation toward that particular commodity enhances social welfare.

Using household budget data, such dominance can be established statistically and shown graphically without resort to normative considerations. This approach suggests that ET services may be an underexploited tax base in many developing countries.

ET taxes may also meet the test of relatively high efficiency if they can be implemented through a two-part pricing schedule that charges a flat fee for access to service and an additional escalating fee for marginal use.

This paper is a product of the Public Economics Division, Country Economics Department. Copies are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Ann Bhalla, room N10-077, extension 60359.

Welfare Dominance and the Design of Excise Taxation in Côte d'Ivoire

by
Shlomo Yitzhaki
and
Wayne Thirsk

Table of Contents

Governments in developing countries are continuously searching for new and improved tax bases. Existing methods of taxation in these countries frequently fall short of meeting acceptable criteria of efficiency, equity and administrative ease. This paper argues that there is a compelling fiscal rationale for encouraging greater reliance on taxing the consumption of electrical and telephone (ET) services. Greater emphasis on this selective commodity tax base would contribute to the achievement of taxpayer equity and would be administratively easy to impose. In addition, as argued later on, the efficiency characteristics of this form of taxation may also add to the attractiveness of the ET base. These advantages are described below.

This paper makes further use of the notion of marginal conditional welfare dominance in exploring the equity implications of adopting the ET tax base in the Côte d'Ivoire. In an earlier set of papers Yitzhaki and Olkin (1987) and Yitzhaki and Slemrod (1987) have developed this concept and applied it to an investigation of the redistributive impact of commodity taxation in Israel. In this paper, we develop an extension of this methodology by introducing dead-weight loss considerations into the analysis. We also consider some other excise tax bases besides electricity and telephones.

If a commodity tax dominates others on welfare grounds it means that, for a wide class of social welfare functions, social welfare will be

enhanced by a marginal shift in the balance of commodity taxation towards that particular commodity. There is nothing in the methodology that guarantees a complete ranking of alternative commodity tax structures can be obtained but, in the countries examined so far, a partial ranking is feasible and serves to identify some tax bases that are promising on distributional grounds. In the Côte d'Ivoire, and possibly other developing countries as well, the ET base is one of these.

The remainder of this paper is organized as follows. The overall merits of adopting an ET tax are discussed in the section below. After that the concept of marginal conditional welfare dominance criteria is more fully explained, and its application leads to utilizing a well-known tool for analyzing tax incidence, the concentration curve. (See Pfahler, (1987) and the literature cited there). The application of this approach to the ranking of alternative taxes in the Côte d'Ivoire is discussed in the next section. The final part of the paper summarizes the main arguments and examines some of the ways in which they may be extended in future work.

A. The General Case for an ET Tax

Although commonly deployed in developing countries, commodity taxes are felt to have limited appeal and to be tolerated only until superior methods of taxation, usually related to incomes, can be cultivated. Objections to commodity taxes come from several directions. Broad-based commodity taxes on consumption such as a value-added tax (VAT), are viewed as efficient revenue instruments but are frequently objected to

on distribution grounds, i.e. "making the poor even poorer". Efforts to narrow the VAT base and make it more distributionally acceptable normally give rise to problems of administrative complexity and, to the extent exemptions are used to grant relief, create numerous economic distortions that detract from economic efficiency. Moreover, in many developing countries more narrowly based commodity taxes are inappropriately levied on production rather than consumption.1/ Production taxes may be easier to collect but they also lead to tax cascading which seriously distorts economic behavior and generates a haphazard pattern of tax incidence.

In a number of developing countries the challenge facing commodity taxation is to get taxes off of production and onto consumption that is linked to ability to pay and to do so in a way that is administratively feasible. The ET tax base offers one response to this challenge. First, as shown below, a wide range of social welfare functions would approve of its adoption in the Côte d'Ivoire for income distribution reasons and we suspect that the same result would hold in many other developing countries. Secondly, it is relatively easy to distinguish business from residential use of electricity and telephones; the only major difficulty occurs whenever households operate a business from out of their home. Mainly for this reason Cnossen (1978) argues that it is better to tax all usage of telephones. Thirdly, enforcement and collection of the tax is relatively inexpensive since the tax can be easily added on to commercial charges and services can be quickly turned off in the case of noncompliance. Fourth, because it applies to a nontradeable service, the ET tax does not have to grapple with the issue of taxing imports and domestic production in a fair

and consistent manner. Smuggling and evasion, common problems with excise taxes on commodities, will not emerge under an ET tax.

Finally, although there is much less certainty on this score, the ET tax may be a relatively efficient tax instrument because it can effectively burden infra-marginal units of consumption. Significant installation or hook-up charges may be able to capture a sizeable fraction of the consumers' surplus from using these services and allow lower rates to be charged for marginal usage with correspondingly smaller distortions of consumer choice. Charging a fee for access to the service effectively introduces an element of poll taxation into the tax system and this feature of the tax may render it a relatively efficient instrument of taxation.

Of all of the merits addressed in support of the ET tax base, the one that is examined in greater detail below is the claim made for its distributive superiority. As will be seen, the ET tax base dominates other commodity tax bases on income distribution grounds in the Côte d'Ivoire.

B. The Concept of Welfare Dominance

As explained more fully in Yitzhaki and Slemrod (1987), the notion of marginal conditional welfare dominance (hereafter welfare dominance) has its origins in the theory of finance. In the finance literature asset A is said to stochastically dominate asset B in the investor's portfolio if, given the composition of other assets in the portfolio, the investor's expected utility is always enhanced whenever a small amount of asset A is substituted for asset B. The only restriction imposed on the investor's

utility function is that the marginal utility of income be a non-increasing function of income.

In a certain world of commodity taxation the analogous question is whether substituting one commodity tax for another in a revenue-neutral fashion will improve social welfare. Frequently the answer to this type of question has depended on the exact shape of the social welfare function. In the optimum tax literature, for instance, the analysis of desirable commodity tax structures often has been bedevilled by sensitivity to the exact specification of the social welfare function.

The concept of welfare dominance does not suffer from the same defect. It adopts a Utilitarian formulation of the social welfare function which is distributively neutral since each household or income class receives the same ethical weight. The only assumption required is that the marginal utility of income be a non-increasing function of real income. If a particular tax substitution is shown to be welfare dominant under this assumption it will be true <u>a fortiori</u> for all other social welfare functions which exhibit some greater degree of aversion to income inequality.

Formally, the argument can be constructed along the following lines with the aid of the notation below:

W = level of social welfare

V^h = level of utility attained by the h'th household,

where

$V^h = (P_1, .. P_n, y_h)$ is the indirect utility function

y_h = money income received by the n'th household

x_j^h = amount of the j'th commodity consumed by the h'th household

P_j = consumer price for the j'th commodity

X_j = total consumption of commodity j ($X_j = \Sigma_h x_j^h$

For a distribution of H households the Utilitarian social welfare function can be expressed as:

$$(1) \qquad W = \Sigma_{h=1}^{H} V^h (P_1 P_2 \ldots, P_n, y_h)$$

and it is assumed that $V_y > 0$ $V_{yy} \leq 0$. For simplicity of presentation we assume that initial producer prices are all equal to one.

Consider next the following hypothetical experiment. For a revenue neutral commodity tax substitution a small increment in the tax rate levied on the i'th commodity must be accompanied by a small decrement in the tax rate on the j'th commodity. The first-order approximation to the change in social welfare is

$$(2) \qquad dW = \Sigma_{h=1}^{H} [V_i^h \, dP_i + V_j^h \, dP_j]$$

where V_i^h is the derivative of the h'th household's utility with respect to the i'th price. Using Roy's identity we can write (2) as

$$(3) \qquad dW = \Sigma_{h=1}^{H} - \lambda^h \ (x_i^h \ dP_i + x_j^h \ dP_j)$$

where λ^h is the marginal utility of income of the h'th household.

Let us turn now to the revenue constraint of the government. Total commodity tax revenue, R, can be expressed as:

$$(4) \qquad R = \Sigma_{k=1}^{K} \ t_k \ X_k$$

where $X_k = \Sigma_{h=1}^{H} \ x_k^h$ and t_k is the ad valorem tax rate applied to the k'th commodity. Revenue neutrality requires that

$$(5) \qquad dR = [X_i + \Sigma_{k=1}^{K} \ t_k \frac{\partial X_k}{\partial P_i}] \ dP_i + [X_j + \Sigma_{k=1}^{K} \ t_k \frac{\partial X_k}{\partial P_j}] \ dP_j = 0$$

and by simple algebraic manipulation we can write equation (5) as

$$(6) \qquad dP_i = - \alpha \frac{X_j}{X_i} \ dP_j$$

where $$\alpha = \frac{1 + (1/X_j) \ \Sigma_{k=1}^{K} \ t_k \ \frac{\partial X_k}{\partial P_j}}{1 + (1/X_i) \ \Sigma_{k=1}^{K} \ t_k \ \frac{\partial X_k}{\partial P_i}} \ .$$

The parameter α determine the rate of substitution between the changes in the two prices and captures the efficiency dimension of the tax substitution. It can be interpreted as the differential welfare cost of raising public funds by taxing the i'th commodity more heavily and using the proceeds to subsidize the j'th commodity. To see this interpretation

more clearly, consider a commodity tax substitution where the initial tax bases, X_i and X_j, are of equal size. In this case, if α exceeds one it requires more than a dollar of extra taxes from the i'th commodity in order to reduce the consumer price of the j'th commodity by one dollar. Of course, careful inspection of the expression for α reveals that it may be just as easily less than one since it measures the interaction of the commodity tax substitution with the initial tax distortions t_k. In the absence of pre-existing commodity taxes, the value of the α parameter would simplify to one.3/

If income were fixed, implying that nontaxable leisure consumption was independent of the design of commodity taxation, it is easy to see that uniform, across-the-board indirect taxes (a general sales tax for example) would be superior on efficiency grounds. With no change in relative prices all of the derivatives in the expression for α would have a value of zero and the value of α would be simply one. Of course the optimal tax literature allows for interactions between the consumption of leisure and commodities or treats leisure as an untaxed commodity and, under these circumstances, non-uniform commodity taxes generally will have the highest efficiency rating. Here, our task is to suppress the efficiency issue and seek to discover instead which excise tax bases are preferable on distribution grounds.

In the special case where all cross-price-elasticities are zero, α reduces to the simpler expression

$$\alpha = \frac{1 + (1/X_j)\, t_j \dfrac{\partial X_j}{\partial P_j}}{1 + (1/X_i)\, t_i \dfrac{\partial X_i}{\partial P_i}} = \frac{1 + t_j \;\; \eta_j \;/\; (1 + tj)}{1 + t_i \;\; \eta_i \;/\; (1 + ti)}$$

where η_j and η_i are uncompensated price elasticities. Note that $\alpha = \alpha_{ij}$; that is, the value of α may be different for each particular commodity tax substitution. As we show later, it is important to know whether α is more or less than unity. In the special case under consideration, since

$$\frac{\partial X_j}{\partial P_j} < 0 \quad \text{and} \quad \frac{\partial X_i}{\partial P_i} < 0 \,,$$

α will be smaller than one if t_i is negative and t_j is positive; that is, if the reform reduces an initial subsidy attached to the i'th commodity. In this situation a lower level of both subsidization and taxation produces a gain in economic efficiency. Conversely, if t_j is negative (an initial subsidy) and t_i is positive, α must be greater than one as the overall level of fiscal distortion is increased. Other alternative reforms are more difficult to sign. Note, however, that α_{ij} can be estimated from a model with a representative consumer which ignores distributional considerations.

Substituting (6) into (3) and rearranging terms we obtain the principal result:

$$(7) \qquad dW = \Sigma_{h=1}^{H} \; -\lambda^h \; [\, x_j^h / X_j \; - \alpha \; x_i^h / X_i] \; X_j \; dP_j$$

If this expression is positive, then social welfare is enhanced by the tax reform. Note that, if the households are ordered according to their income, λ^h is a decreasing function of income and h, the rank in the

income distribution. Also, note once again that dP_j is negative for the experiment that is described.

If household h benefits from the reform, it follows that

$$x_j^h / X_j - \alpha \, x_i^h / X_i \geq 0$$

while if the inequality is reversed that household's welfare is diminished. If households are ordered according to their income, a necessary condition for expression (7) to hold for all admissible social welfare functions is that, for the poorest household consuming x_j^1 and x_i^1,

$$x_j^1 / X_j - \alpha \, x_i^1 / X_i \geq 0.$$

Otherwise, a maxi-min social welfare function that cares only for the welfare of the poorest household would show a decline in social welfare.

In a similar fashiom. the next poorest household, whose consumption pattern is denoted by x_i^2 and x_j^2, experiences an increase in welfare if

$$x_j^2 / X_j - \alpha \, x_i^2 / X_i \geq 0$$

However, aggregate welfare could increase even if the second household were harmed by the reform. With declining marginal utility of income the sum of both welfare changes is positive if

$$\frac{x_j^1 + x_j^2}{X_j} - \alpha \, \frac{x_i^1 + x_i^2}{X_i} \geq 0$$

Generalizing from the preceding argument, the requirement for welfare dominance can be stated as follows. For a revenue neutral commodity tax substitution which shifts tax burdens from the j'th to the i'th commodity, social welfare will increase if the following condition is satisfied:

$$(8) \qquad \sum_{h=1}^{k} \left(x_j^h / X_j \; - \; \alpha x_i^h / X_i \right) \geq 0 \quad \forall \quad k$$

The expression contained in brackets in equation (8) can be interpreted as the vertical difference between the concentration curve of the j'th commodity minus α times the concentration curve of the i'th commodity. A concentration curve is similar to the more familiar Lorenz curve but instead of total income it compares the fraction of total expenditure on a commodity that is attributable to different income groups when they are arranged, starting with the poorest group, according to the size of their income. If the value of α is unity, welfare dominance occurs whenever one concentration cure lies wholly above another throughout the entire range of the cumulative distribution of income. Alternatively, the vertical difference between two concentration curves, hereafter referred to as DCC, must be positive for welfare dominance to occur. If, on the other hand, two concentration curves intersect, taxation of one commodity cannot be said to dominate the other. That is, one can always find two plausible welfare functions which rank the commodities in contradicting orders. For a thorough discussion of the properties of concentration curves see Kakwani (1960), Pfahler (1987), Nygard and Sandstrom (1981) and Yitzhaki and Olkin (1987).

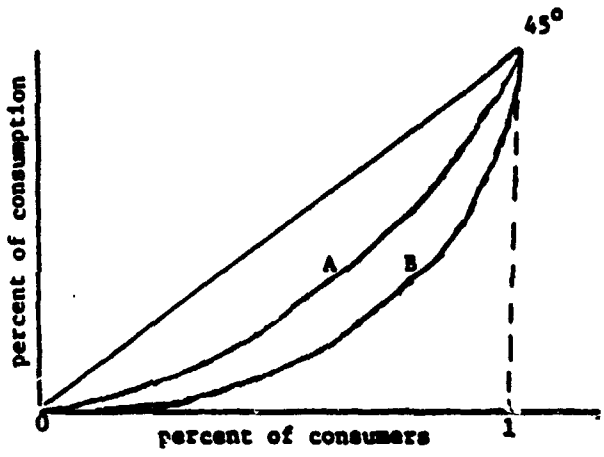
The left hand panel of Figure I portrays a situation in which a revenue neutral tax substitution from commodity A to commodity B is welfare dominant. The absence of welfare dominance is indicated in the right hand panel of Figure I where the two concentration curves cross. Welfare dominance is also impossible to achieve whenever α exceeds unity. To see this note that whenever α is unity the graph for the concentration curve starts at coordinates (0,0) and ends up at (1,1). If α exceeds unity, however, at least for the richest household, the difference between the concentration curve of commodity A minus α times the concentration curve for commodity B must be negative. The reason for this outcome is simple. With an increase in deadweight loss, any welfare function with constant marginal utility which does not care for redistribution will indicate a deterioration in social welfare.

In Panel C of Figure I α is assumed to be larger than one and, since the DCC curve ends up at the coordinates [1 - α, 1], the DCC curve either crosses the horizontal axis at least once or never rises above it. Welfare dominance is ruled out when this happens. If, however, α is less than one, the DCC will end up in the positive orthant as shown in Panel D of Figure I. In this case an overall efficiency gain is indicated but welfare dominance still requires that the DCC curve remain above the horizontal axis.

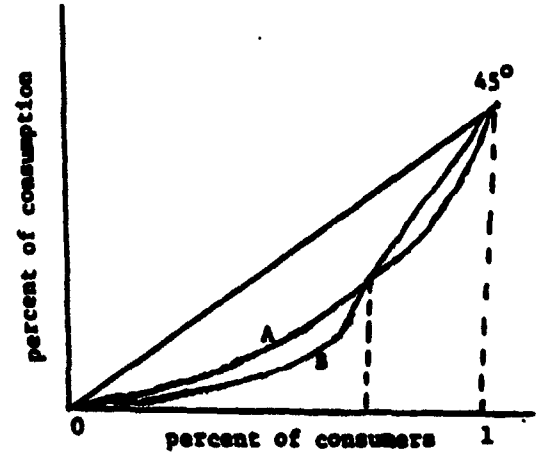
In a separate appendix we explore some additional features of the DCC curve. Assuming that α has a value of unity, we show that the curvature of the DCC curve has an interesting welfare interpretation. Specifically, the slope of the DCC curve at a particular income level

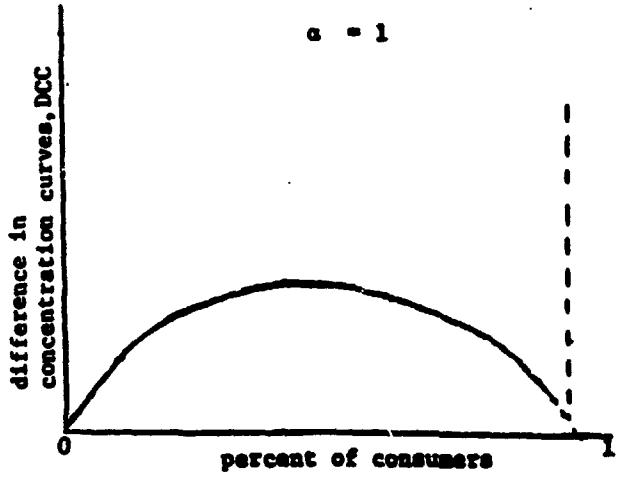
Figure 1: THE GEOMETRY OF WELFARE DOMINANCE

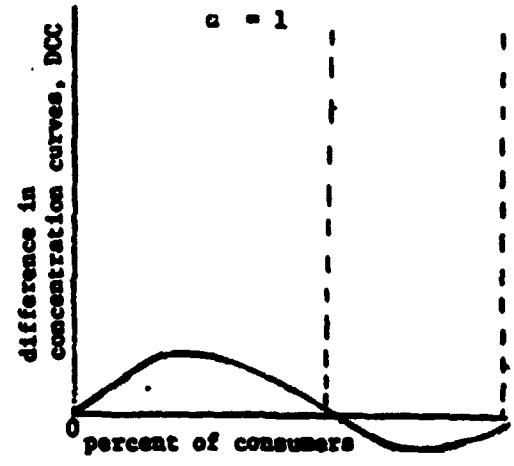
A. Welfare dominance of commodity B over A

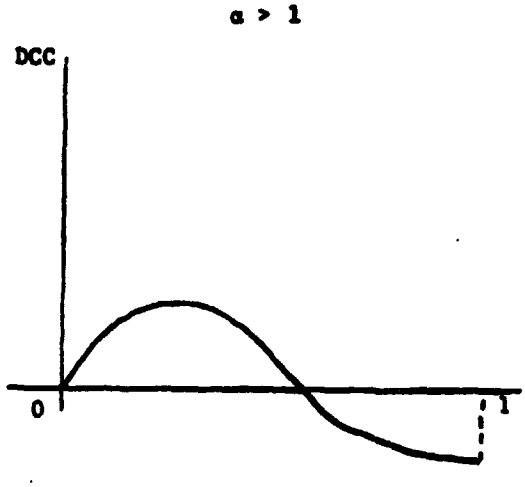


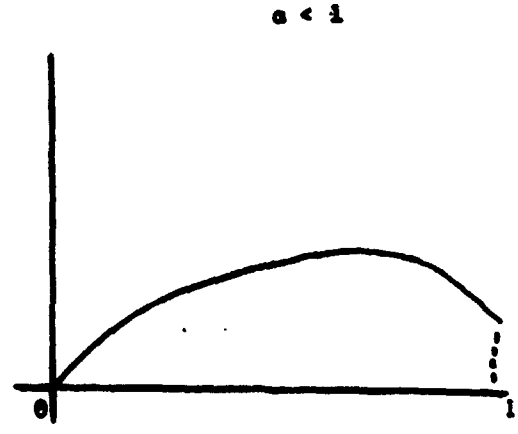
B. No welfare dominance











representing the poorest F families in the cumulative distribution measures the gain in real income experienced by the family at that income level. Similarly, the size of the DCC curve itself indicates the cumulative gain of the poorest F families over the range of incomes when the DCC curve is increasing. Losses, on the other hand, occur whenever the DCC curve is decreasing and, over the entire range of the DCC curve, there is no net gain or loss as long as α is one.

Since the value of α is unknown and difficult to determine empirically, we concentrate in the rest of the paper on the special case where α is one. For simplicity of exposition below we will also assume that the income distribution is a continuous distribution.

Since household surveys of consumer expenditure normally include thousands of obeservations it would be extremely cumbersome to calculate the DCC for more than a few commodities. Clearly, some sort of screening mechanism would be desirable to distinguish promising candidates for welfare dominance. However, Yitzhaki (1987) has provided a fairly straightforward procedure for reducing the number of possibilities to a manageable total. In an earlier paper that author has established the following result:

$$(8) \qquad \int_0^1 DCC_{ji}(F)\, dF = -(b_j/S_j - b_i/S_i)\, G_y$$

where F is the cumulative distribution of income, G_y is the Gini coefficient of income, S_i is the share of the expenditure on X_i and

$$(9) \qquad b_i = \text{cov}(X_i, F(y))/\text{cov}(y, F(y))$$

is Sievers (1983) non-parametric estimator of the slope of the regression line of X_i on Y. In our context b_i can be interpreted in two ways. On one hand b_i is equal to the area between the 45° line and the concentration curve if the i_{th} commodity divided by the area between the 45° line and the Lorenz curve (see Yitzhaki and Olkin, 1987). Alternatively, b_i is a weighted mean of the marginal propensity to spend on commodity i. As argued in Yitzhaki (1987), b_i/S_i can be interpreted as the weighted average income elasticity of commodity i. Hence equation (9) indicates that the sign of the area below the DCC_{ji} curve is determined by the difference between the weighted average income elasticities of the commodities. Since, if commodity i is to dominate commodity j, DCC_{ji} must be positive, it is clear that a necessary (but, of course, not sufficient) condition for welfare dominance is that the weighted income elasticity of commodity j be lower than that for commodity i.

The same argument can be repeated using the extended Gini. The extended Gini is a weighted integral of the area between the forty-five degree line and the Lorenz curve (see Yitzhaki 1983). The formula for the extended Gini is:

$$(10) \qquad G_y(v) = -v \operatorname{cov}(y, [1-F(y)]^{v-1}) / \mu_y \; ; \; v > 1.$$

Here v is an inequality-aversion parameter chosen by the investigator and μ_y is the mean value of the distribution. The extended Gini is similar to the Gini coefficient except that it uses a different weighting scheme. The standard Gini is a special case of the extended Gini where v is 2. The

higher is v, the greater is the importance attached to the bottom of the income distribution.5/

The preceding analysis based on the Gini can be replicated in terms of the extended Gini.

$$(11) \qquad (v-1) \int [DCC_{ji}(F)\,(1-F)^{v-2}\,df = -[b_j(v)/S_j - b_i(v)/S_i)]\,G_y(v)$$

where

$$(12) \qquad b_i(v) = \frac{\text{cov}(Xi, [1 - F(y)]^{v-1})}{\text{cov}(y, [1 - F(y)]^{v-1})}$$

is the estimator of the (extended) Gini marginal propensity to spend on commodity i. The difference in the b_i (v) is attributable to the choice of weighting schemes. Each weighting scheme is increasing with income up to a certain quantile and then it declines. Table 1 presents the quantile with the highest weight for various values of v.

Equation (11) provides additional necessary conditions for welfare dominance. If commodity i dominates commidity j, a shift from taxing commodity j to commodity i would decrease the extended Gini inequality index for all v, including the standard Gini case where v = 2. These necessary conditions are useful in empirical investigation of welfare dominance because they are fairly easy to calculate and can be used to identify the pair of commodities for which welfare dominance is possible.

Not surprisingly, the notion of welfare dominance is linked to the conventional wisdom of imposing luxury excises on items of consumption

having a relatively high income elasticity of demand. However, important differences between the two approaches still exist. Conventional measurements of income elasticity use the mean of the income distribution as a reference point and are indifferent to income inequality. The partial test for welfare dominance, on the other hand, measures the income elasticity at each point along the concentration curve and is sensitive to the income position of the spender.6/ Moreover, the usual argument for luxury excises cannot easily distinguish on welfare grounds which of two income-elastic commodities would be the most suitable target for excise taxation.

In the analysis of the expenditure data for the Côte d'Ivoire that follows, weighted income elasticities are compared for different pairs of commodities. The weights employed are those associated with the calculation of the extended Gini coefficient. Values for these weights are permitted to vary between 1.5 and 5 and some of the welfare implications of this range of values are depicted in Table 1. Higher values for these weights attach more importance to the lower end of the income distribution. A weight of unity implies complete indifference to inequality while an infinitely large value would assign zero weights to everyone except the household with the lowest income. Thus a range of values between 1.5 and 5 encompasses a reasonable diversity of views about the importance of income inequality.

C. Welfare Dominance and ET taxes in the Côte d'Ivoire

Data for the Côte d'Ivoire originate from a random sample of 1,600 households who were surveyed over a period of a year starting in

Table 1: WELFARE WEIGHTS (v) AND THE DISTRIBUTIVE PERCENTILE (P_i) WITH THE LARGEST WEIGHT

V	1.5	2	3	6
P_i	.56	.5	.42	.3

1985. The design of that survey and its implementation is thoroughly described in Ainsworth and Munoz (1986). The survey attempted to collect information on household income sources, consumption patterns, employment activities, housing conditions and several other subjects. On the expenditure side data were collected on regularly purchased nonfood items (fuel, cigarettes for example), on irregularly purchased clothing, household goods and maintenance, food expenditures, durable goods ownership, housing rents and the value of home produced and consumed food.

In Table 2 one can see the expenditure shares of different consumption categories and the range of values for the weighted income elasticities. Most food items and, as well, tobacco products, are income-inelastic but as the welfare weights attach more importance to low-income consumption the income elasticity approaches unity for rice, millet, bread, casava and a casava derivative called attieke. Income elasticities for public transportation, education expenses and alcoholic beverages hover slightly above unity. Consumption of gasoline, telephone-telegraph and electricity, on the other hand, all exhibit income elasticities substantially larger than one.

On the basis of the income elasticity information contained in Table 2 numerous pairwise tax comparisons can be made to identify instances of welfare dominance. It would appear, for example, that, as alternative commodity tax bases, telephones dominate electricity and gasoline, electricity dominates public transportation and gasoline dominates alcoholic beverages. Figures 2-5, which exhibit the form of the empirical DCC curve for each comparison, confirm these suspicions.

Table 2: INCOME ELASTICITIES OF CONSUMPTION FOR CÔTE D'IVOIRE a/

Consumption category	Expenditure share	Weighted income elasticity: v = 1.5	2	3	4	5
Total expenditure (Gini)	1	.32	.45	.57	.64	.67
Casava	.036	.46	.54	.64	.7	.74
Rice	.04	.78	.87	.95	.98	.99
Maize	.05	.42	.58	.69	.75	.77
Millet	.001	.88	1.0	1.1	1.12	1.12
Bread	.016	.82	.88	.95	.98	1.0
Attieke	.018	.93	.99	1.05	1.07	1.09
Sugar	.007	.59	.68	.77	.82	.85
Cigarettes, tobacco, cola nuts	.011	.63	.65	.68	.70	.72
Gasoline	.04	1.71	1.58	1.41	1.33	1.29
Public transportation	.03	1.13	1.12	1.11	1.10	1.10
Telegraph-telephone	.003	2.25	1.96	1.67	1.54	1.47
Alcoholic beverages	.017	1.17	1.14	1.11	1.10	1.09
Electricity	.02	1.64	1.52	1.41	1.36	1.32
Education expenses	.042	1.24	1.20	1.16	1.14	1.13
Rent and dividends	.05	1.61	1.54	1.45	1.39	1.35
Wages	.30	1.54	1.52	1.42	1.37	1.34

a/ Income is defined as total expenditure plus consumption of home produced goods per capita.

Source: Côte d'Ivoire Living Standards Survey, World Bank, 1986.

Rather than present a large, and potentially confusing, array of DCC curves for the Côte d'Ivoire, Table 3 summarises our efforts to establish a welfare ordering of alternative commodity taxes using the criterion of marginal welfare dominance. Of the five promising excise tax candidates consisting of telephones, electricity, gasoline, alcoholic beverages and public transportation, we concluded that the taxation of telephone services dominates all of the other items in this group. Taxing electricity consumption, on the other hand, dominates the taxation of alcoholic beverages and public transportation but does not quite manage to dominate the taxation of gasoline. Gasoline taxation, by the same token, dominates a tax on either alcoholic beverages or public transportation. Finally, a tax on alcoholic beverages fails to dominate a tax on public transportation. It would be possible to extend this welfare ordering to include other items shown in Table 2 but the ranking shown in Table 3 are perhaps the most interesting ones for policy purposes and it is clear from Table 2 that taxes on food and cigarettes would be dominated by taxes on any of the five candidates already examined.

An interesting extension of the analysis is to consider the welfare implications of adjusting the mix of direct and indirect taxes in the Côte d'Ivoire. This welfare comparison can be achieved by viewing a tax on wages or rents and dividends as a tax on all of the expenditure made by workers or capitalists respectively. From Table 2 it appears that the weighted income elasticities for capital and labor incomes are relatively large and extremely close to one another in size. Moreover, while telephone consumption dominates either income component as a tax base, it is also apparent that neither electricity nor gasoline consumption does the

Table 3: THE WELFARE ORDERING OF COMMODITY TAXES IN THE COTE D'IVOIRE

Commodity/Tax Base				
1. Telephone	dominates a/	dominates a/	dominates	dominates
2. Electricity		does not dominate	dominates	dominates
3. Gasoline			dominates	dominates
4. Alcoholic beverages				does not dominate
5. Public transportation				

a/ A close examination of the individual observations for bread and water reveals that the curve intersects the X-axis for the very last observation. If this sample exactly portrayed the population, a social welfare function that is linear over the whole range of the distribution and concave between the second richest family and the richest one would show that subsidizing bread at the expense of water would be welfare decreasing. However, we suspect that this is a result of the sampling error. Where we take the average of two consecutive observations this anomaly disappears.

Figure 2

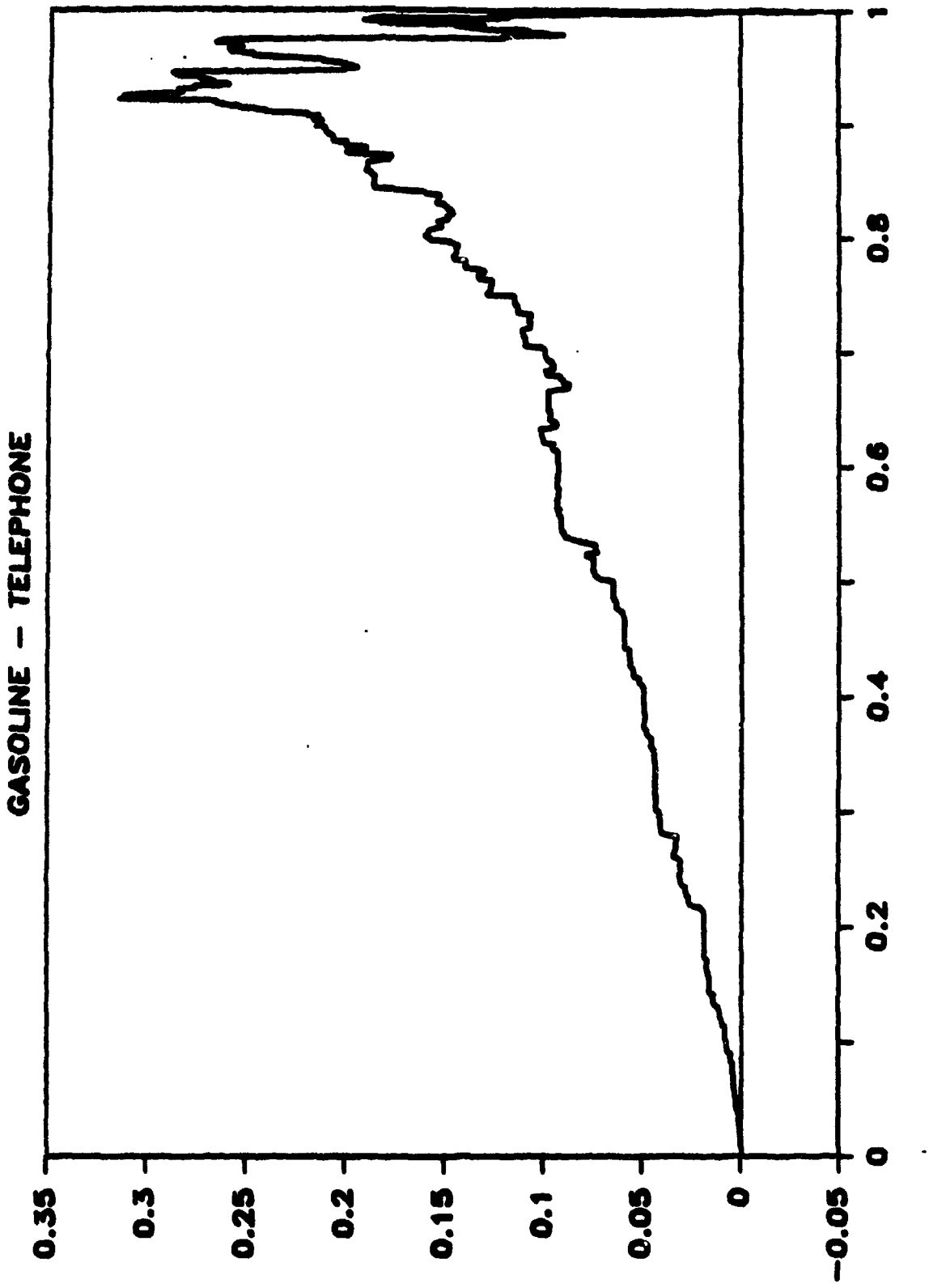


Figure 3

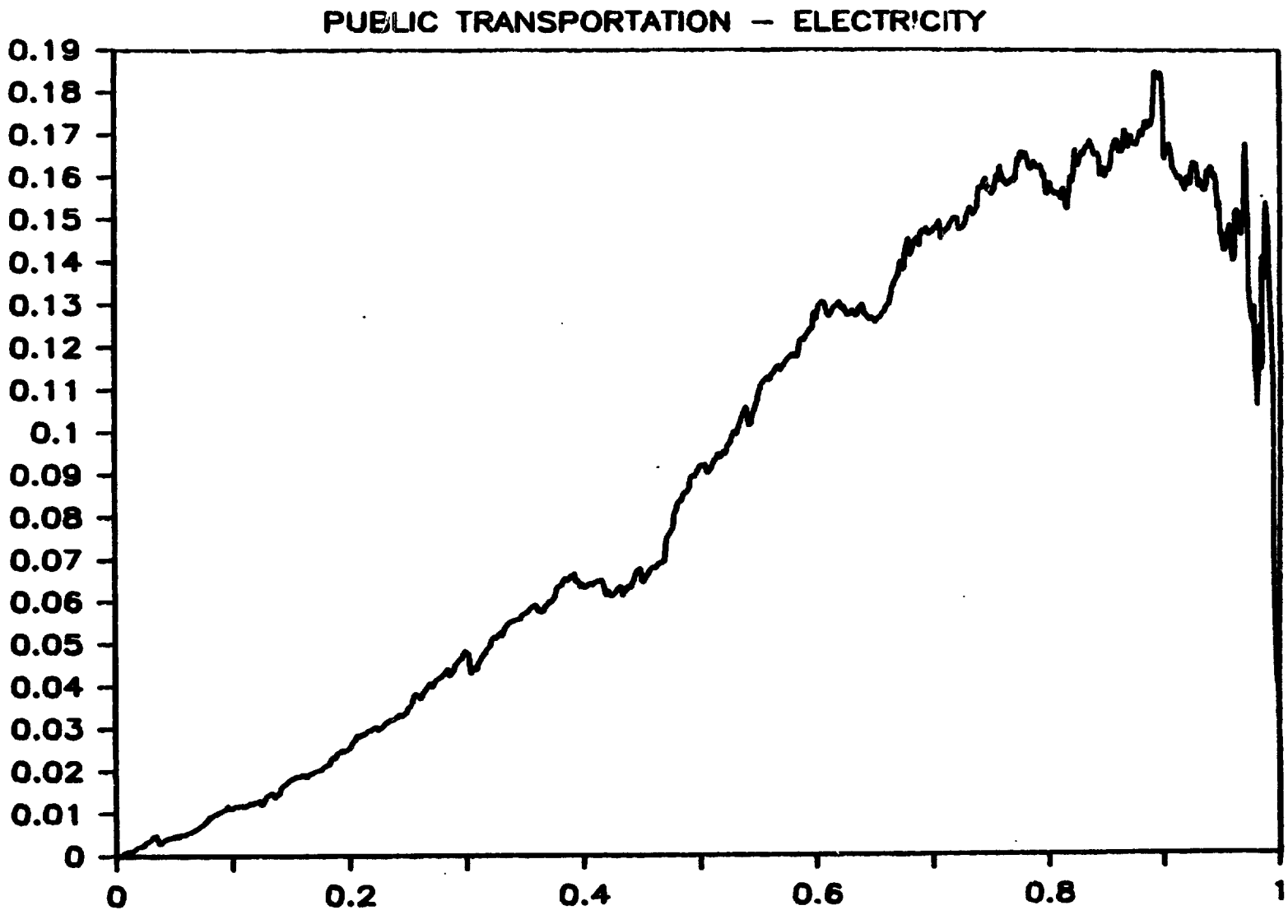

PUBLIC TRANSPORTATION – ELECTRICITY
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.2
0.4
0.6
0.8
1

Figure 4

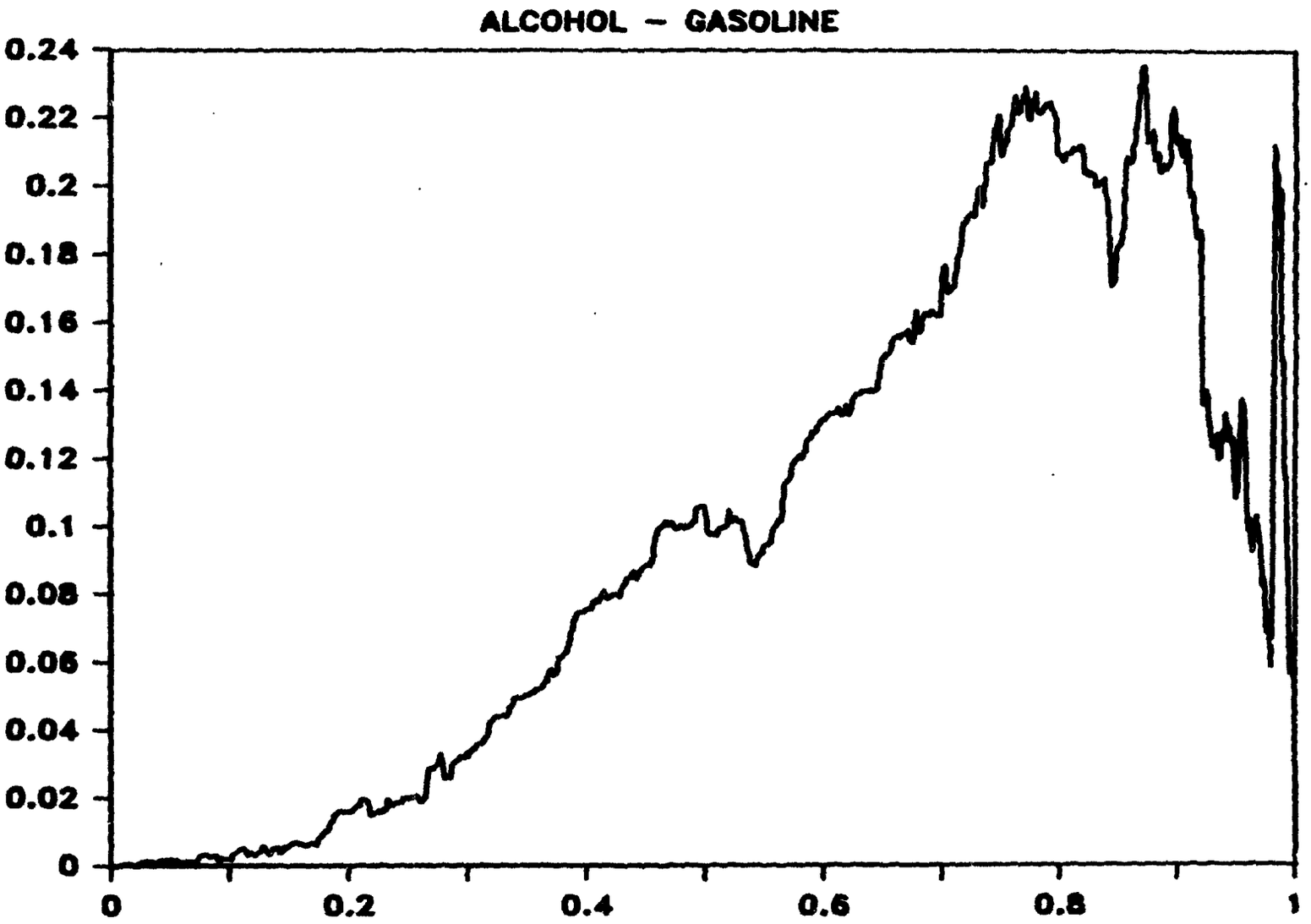
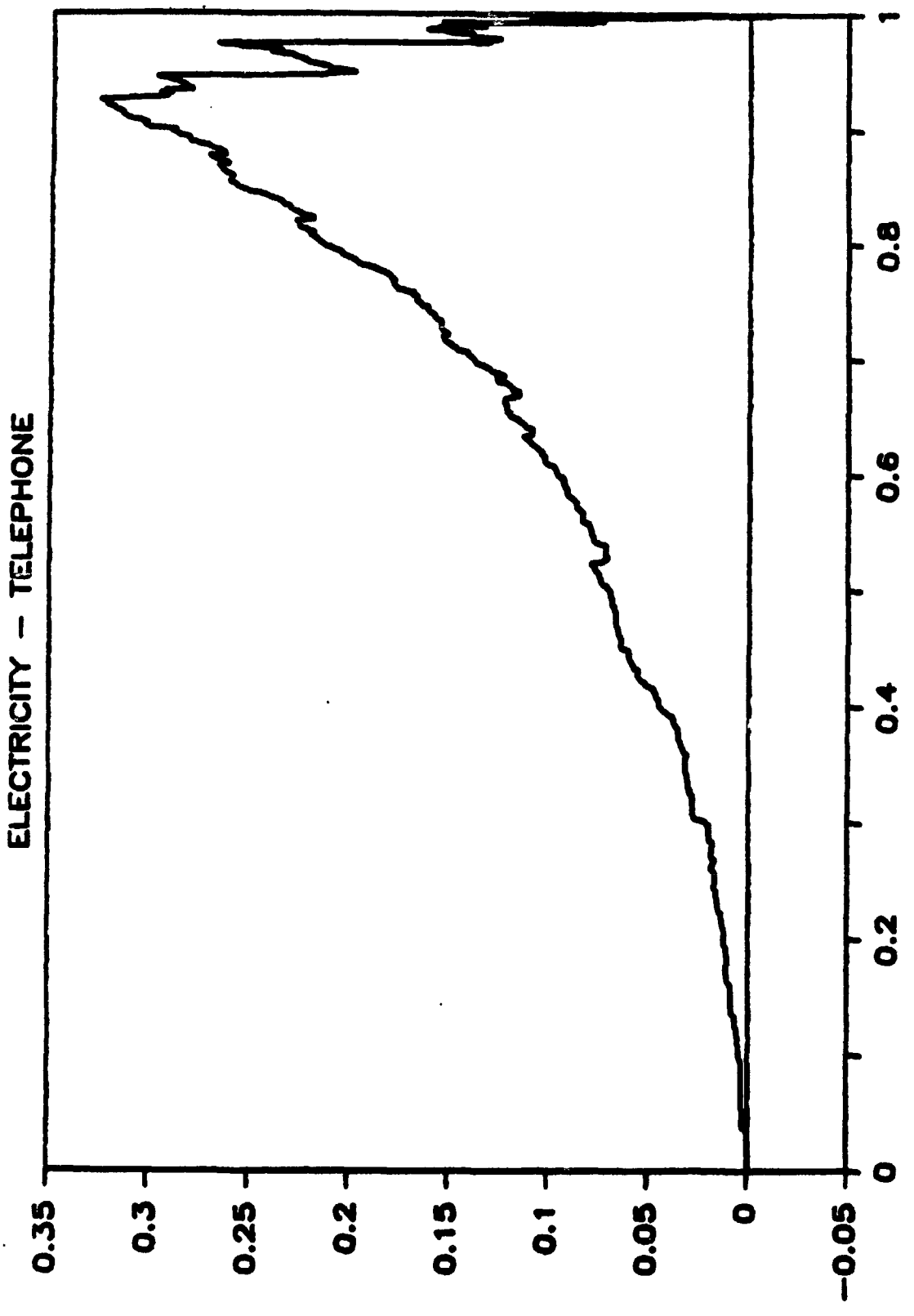

ALCOHOL – GASOLINE
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1

Figure 5


ELECTRICITY — TELEPHONE
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
0.2
0.4
0.6
0.8
1

same. On balance, income taxes and ET taxes have surprisingly similar consequences for income distribution.

Currently, the Côte d'Ivoire functions with a value-added tax on manufacturing activity and a cascaded tax on most services provided in urban areas. Both taxes are described in Heian and Monson (1987). There are also traditional excise tax levies on tobacco products, alcoholic beverages and fuel. Our results suggest that it would be worthwhile to extend the excise tax network to include electricity and telephones.

D. Summing Up

This paper has had two major goals. Introducing a relatively new technique for evaluating alternative excise tax bases has been one of them. Examining differences in the concentration curves between various pairs of commodities can be used as a tool for identifying desirable excise tax options. Concentration curves have been used previously to illuminate the distributive impact of alternative direct tax measures. In this paper the concept has been adapted to study the structure of indirect taxes and to explore the welfare consequences of a variety of indirect tax reforms.

In particular, concentration curves have been used to obtain conditions under which a wide range of social welfare functions would approve of a particular commodity tax substitution. Where imposing a tax on one commodity and using the proceeds to reduce taxes on another receives the approval of nearly all plausible social welfare functions, the first commodity is said to dominate the other. More precisely, the requirements

for marginal conditional welfare dominance are satisfied. Part of the attraction of the concept of welfare dominance is that it allows at least some excise tax policies to rest on weak and reasonably nonrestrictive normative considerations. Using household budget data at least a partial welfare ordering of alternative excise taxes can be achieved. Besides being virtually value-free, the approach of searching for welfare dominance is to a large extent model free in that in its simpliest form no knowledge of consumer price behavior is required. More sophisticated application of the methodology would, however, have to consider the efficiency as well as the equity implications of changes in excise taxes and to take into account the reactions of consumers to tax reforms.

The welfare framework utilized in this paper is closely related to that found in the literature on optimum taxation. Ahmad and Stern (1984), for example, measure the marginal social cost of raising extra indirect tax revenue from different sources using explicit welfare weights and empirical estimates of consumer price elasticities. However, their objective is to describe the optimum commodity structure that would emerge from equalizing the marginal social cost of revenue from different sources. Our task of identifying welfare-improving tax reforms is less ambitious and requires significantly less information about the economy.

The other goal of this paper has been to apply the dominance approach to the Côte d'Ivoire and to extract some policy conclusions about the design of excise taxation in that country. What emerged from that effort was the clear dominance of telephones as a tax base and the near dominance of electricity consumption.[7] Further reflection on ET (electricity-telephone)

taxation suggests that it may be a relatively under-exploited tax base in a number of developing countries.

Greater reliance on the ET tax base has much to recommend it. In addition to their appeal on income distribution grounds, ET taxes may be relatively efficient revenue sources if they can be implemented through two-part pricing schemes. Moreover, they are relatively easy to administer, they lend themselves readily to the destination principle of commodity taxation and they can distinguish between business and household use without great difficulty.

Despite these advantages, the basic argument favoring higher ET taxes in the Côte d'Ivoire, and perhaps elsewhere, relies on acceptable income distribution effects. In an earlier paper, McLure and Thirsk (1978) proposed the removal of excise taxes on beer and cigarettes for essentially the same reasons, that they were income and price inelastic in consumption and therefore had a harmful impact on welfare. Here, we make the opposite claim, that the imposition of ET taxes would enhance economic welfare. Many countries appear to act perversely by taxing beer consumption heavily and subsidizing the consumption of electricity. Another way of looking at this equity claim is to note that in most developing countries the consumption of a wide range of consumer durables such as TVs, VCRs and fridges is income elastic. However, in most cases it is difficult to tax either the services provided by these durables or their initial purchase. It may be much easier instead to tax a close complement, electricity consumption, in this situation.

Our enthusiasm for ET taxes may have to be tempered by a consideration of external effects in consumption. At least in the case of telephones consumers' enjoyment from phoning may depend on who else has access to a phone. Up to a point, the utility of owning a telephone may be a function of the number of subscribers, in which case an efficiency argument can be made for subsidizing rather than taxing telephone use. Once more, efficiency and equity concerns clash in the design of an appropriate tax policy.

Future work in this area can profitably proceed in several areas. First, it would be useful to disaggregate large expenditure aggregates such as public transportation, alcoholic beverages and telephones in order to see if some components have different distributive characteristics and are not close substitutes in consumption. For example, differential excise taxes on beer versus fine wine, or long distance versus local phone calls, may be used to fine-tune the system of excise taxes. Secondly, more work on the efficiency dimensions of excise taxation would be desirable. Finally, a useful extension to the analysis would incorporate the horizontal equity aspects of excise taxation.

ENDNOTES

1. This unhappy situation, and the recommendation to shift more towards consumption taxation, is discussed in an African context by Z. Shalizi and L. Squire, "Tax Policy for Sub-Saharan Africa", World Bank, June 2986.

2. More generally, the change in a Bergson-Samuelson social welfare function, $W = W(U_1 \ldots U_H)$ can be written as

   $dW = \sum_1^H \partial W/\partial Ui \cdot \partial Ui/\partial yi \cdot yi$ where $\partial W/\partial U_i$ is the ethical weight attached to the i'th household's change in utility and the product $\partial W/\partial U_i \cdot \partial U_i/\partial y_i$ can be interpreted as the marginal social utility of income. In the utilitarian framework the ethical weights are all normalized around unity and the marginal social utility of income declines with higher incomes.

3. It is worth emphasizing that the value of α is unique to each particular commodity tax substitution and that it is the single part of our methodology that compels resort to some kind of modelling exercise. The purpose of our analysis is to see what welfare implications can be extracted from the limited household survey information on consumer behavior that is typically available in developing countries. If more information on consumer behavior were available it would also be possible to incorporate second-order excess burden effects into the analysis.

4. Nonetheless, the welfare rankings are transitive so that if a tax on commodity B dominates one on commodity C, a tax on commodity A also dominates one levied on C.

5. See Yitzhaki (1983) for a complete discussion of the properties of the extended Gini.

6. Formally we can write

$$b_i(v) = \int w(F(y), v)\, x_i'(y)\, dy$$

where $w(F(y), v)$ is the weight attached to the marginal propensity of spending on the i_{th} commodity, $x_i'(y)$. In the case of the Gini $v = 2$ then

$$w(F(y), 2) = \frac{F(y)\,[1 - F(y)]}{\int F(z)\,[1 - F(z)\,dz}$$

which means that the highest weight is given to the marginal propensity of the median individual. The higher v, the higher the weight attached to low income groups. See Yitzhaki (1987).

7. The results for the Côte d'Ivoire also indicate the desirability of taxing gasoline. We have resisted the temptation to recommend ETG (electricity-telephone-gasoline) excises because gasoline taxes in most countries serve as crude user fees for the consumption of road services and therefore have an efficiency rationale that is quite different from the equity considerations which distinguish ET taxes.

APPENDIX

Additional Properties of the DCC curves

In the main part of the paper we have used the concentration curve (hereafter CC) and the difference in concentration curve (hereafter DCC) in order to see whether one can order tax bases according to the criterion of marginal conditional welfare dominance. In this appendix we intend to derive several properties of those curves that will provide further intuition behind the ordering. Our task is to show that there is an interesting relationship between the concavity (convexity of these curves) and the income elasticity of the tax bases. For simplicity of presentation continuous functions are used here.

Let $C_j(Y)$ be the Engel curve for commodity j.

$$C_j(Y) = E_j(C_j \mid Y).$$

The expectation operator reflects the fact that families with income Y may consume different quantities of commodity j.

The concentration curve of commodity j with respect to income Y is defined implicitly by:

$$(13) \qquad \Phi_j (F) = (1/\mu_j) \int_o^q C_j (y) f (y) dy$$

where

$$(14) \qquad F(q) = \int_o^q f (y) dy$$

f (y) and F (y) are, respectively, the density function and the cumulative distribution of income and μ_j is the mean expenditure on commodity j in the population. The DCC_{ij} curve is the vertical difference between the concentration curves of commodity i and commodity j.

Formally,

$$(15) \qquad \begin{aligned} DCC_{ij}(F) &= \Phi_i (F) - \Phi_j (F) = \\ &= (1/\mu_i) \int_o^q C_i (y) f (y) dy \\ &- (1/\mu_j) \int_o^q C_j (y) f (y) dy \end{aligned}$$

The curve describes the difference in the shares of expenditures on commodity i and j, that is spent by the poorest F families. The DCC curve begins at coordinates (0,0) and ends up at (0,1) since the difference in shares is zero in the bottom and the top of the income distribution.

The derivative of DCC curve with respect to F is equal to:

$$(16) \qquad \begin{aligned} \partial DCC_{ij} (F) / \partial F &= C_i (q) / \mu_i - C_j (q) / \mu_j \\ &= [C_j (q) / \mu_i] [C_i (q) / C_j (q) - \mu_i / \mu_j] \end{aligned}$$

Thus the curve is increasing if the ratio of expenditure on commodity i relative to commodity j is higher than the overall ratio of the shares in

expenditure in the population. Given our assumption of a unitary value for α the ratio of the overall shares is the slope of the public sector budget constraint. Formally,

$$(17) \qquad [\, - dP_j/dP_i] = \mu_i/\mu_j,$$

That is the second term in equation (16) is the change in prices that will keep the revenue constant. Let us consider the required change in income that will enable the individual with income q to continue to purchase the same bundle as before:

$$(18) \qquad \Delta\,(q) = dP_j C_j\,(q) + dP_i\, C_i\,(q) =$$

$$= C_j\,(q)\; dP_i\; [\; dP_j\,/dP_i + \frac{C_i\,(q)}{C_j\,(q)}\;]$$

Using (17) and the fact that we are dealing with a dollar increase in taxes (that is $dP_j = 1/\mu_j$) we get equation (16). Therefore the slope of the DCC curve measures the gain in dollars to families with income q and the DCC curve itself indicates the cumulative gain (in dollars) of the poorest F individuals. Thus whenever the DCC is increasing (decreasing) it means that the income group which is represented on the horizontal axis is gaining (losing) from the change in taxes. This also explains why the DCC curves start at zero and end up at zero. Because the budget of the government is constant and no efficiency gain or loss is taken into account, the total gain in dollars for the society is zero.

The second derivative of the DCC curve is equal to:

$$(1/\ f(q))\ [c'_i\ /\ \mu_i\ -\ c'_j/\mu_j]$$

That is the second derivative is positive or negative depending on whether the ratio of the average propensities to spend in the population. Alternatively, by dividing and multiplying each term by the ratio c (q)/q we write the second derivative of the DCC as:

$$\frac{1}{q\ (q)}\ \left[\ \eta_i\ \frac{C_i\ (q)}{\mu_i}\ -\ \eta_j\ \frac{C_i\ (q)}{\mu_j}\ \right]$$

where η_i is the income elasticity of of the i'th commodity and C(q)/q is the ratio of household consumption to mean consumption.

REFERENCES

Ahmad, E. and N.H. Stern. 1984. "The Theory of Tax Reform and Indian Indirect Taxes". Journal of Public Economics, vol. 25, no. 3 (December).

Ainsworth, M. and J. Munoz. "The Côte d'Ivoire Living Standards Survey: Design and Implementation". Living Standards Measurement Study, Working Paper No. 26. World Bank.

Cnossen, Sijbren. 1978. Excise Systems: A Global Study of the Selective Taxation of Goods and Services. Baltimore: Johns Hopkins Press.

Heian, B.C. and T. Monson. 1987. "The Value-Added Tax in the Côte d'Ivoire". Development Research Department Discussion Paper No. DRD227. World Bank.

Kakwani, N.C. (1980). Income Inequality and Poverty. Oxford University Press.

McLure, C.E. Jr. and W.R. Thirsk. 1978. "The Inequity of Taxing Inequity: A Plea for Reduced Use of Sumptuary Taxes in Developing Countries." Economic Development and Cultural Change, vol. 26 (April).

Nygard F. and A. Sandstrom (1981). Measuring Income Inequality. Almqvist and Wiksell International.

Pfahler, Wilhelm. 1987. "Redistributive Effects of Tax Progressivity: Evaluating a General Class of Aggregate Measures". Public Finance, no. 1, pp. 1-31.

Shalizi, Zmarak and Lyn Squire. 1986. "Tax Policy for Sub-Saharan Africa". World Bank (June).

Sievers, G.L. (1983). "A Weighted Dispersion Function for Estimation in Linear Models". Communication in Statistics, Theory and Methods, vol. 12, no. 10, pp. 1161-1179.

Yitzhaki, Shlomo. (1987). "On rhw Progressivity of Commodity Taxation". DRD Discussion Paper No. 289, World Bank 1987.

_____. (1983) "An Extension of the Gini Inequality Index". International Economic Review, vol. 94, no. 3 (October).

_____ and Joel Slemrod. (1987). "Welfare Dominance: An Application to Commodity Taxation". DRD Discussion Paper No. 269, World Bank.

_____ and Ingram Olkin. (1987) "Concentration Curves". Technical Report No. 230, Department of Statistics, Stanford University (April).

PPR Working Paper Series

	Title	Author	Date	Contact
WPS37	Black Market Premia, Exchange Rate Unification and Inflation in Sub-Saharan Africa	Brian Pinto	July 1988	R. Blade-Charest 33754
WPS38	Intergovernmental Grants in Developing Countries	Larry Schroeder		
WPS39	Fiscal Policy in Low-Income Africa	Stephen A. O'Connell	July 1988	R. Blade-Charest 33754
WPS40	Financial Deregulation and the Globalization of Capital Markets	Eugene L. Versluysen	August 1988	R. Blade-Charest 33754
WPS41	Urban Property Tax Reform in Developing Countries	William Dillinger		
WPS42	Government Pay and Employment Policies and Government Performance in Developing Economies	David L. Lindauer	August 1988	R. Blade-Charest 33754
WPS43	Tax Administration in Developing Countries: Strategies and Tools of Implementation	Tax Administration Division		
WPS44-WPS60	Assigned to WDR			
WPS61	Student Performance and Schools Costs in Private and Public High Schools in the Philippines	Emmanuel Jimenez Vicente Paqueo Ma. Lourdes de Vera		
WPS62	Status of Universities in the Arab Countries of the Middle East and North Africa	George I. Za'rour		
WPS63	Does Japan Import Less Than It Should? A Review of the Econometric Literature	Kenji Takeuchi	July 1988	J. Epps 33710
WPS64	Cocoa and Coffee Pricing Policies in Cote d'Ivoire	Takamasa Akiyama	August 1988	D. Gustafson 33714

PPR Working Paper Series

	Title	Author	Date	Contact
WPS65	Interaction of Infant Mortality and Fertility and the Effectiveness of Health and Family Planning Programs	Howard Barnum		
WPS66	Slowing the Stork: Better Health for Women through Family Planning	Anthony R. Measham Roger W. Rochat		
WPS67	Price and Tax Policy for Semi-Subsistence Agriculture in Ethiopia	Robert D. Weaver Saad Ali Shire	August 1988	D. Gustafson 33714
WPS68	A Comparison of Lamps for Domestic Lighting in Developing Countries	Robert van der Plas		
WPS69	Does Local Financing Make Public Primary Schools More Efficient? The Philippine Case	Emmanual Jimenez Vicente Paqueo Ma. Lourdes de Vera	August 1988	T. Hawkins 33678
WPS70	Vocational Education and the Economic Environment: Conflict or Convergence?	Arvil V. Adams Antoine Schwartz		
WPS71	School Effects on Student Achievement in Nigeria and Swaziland	Marlaine Lockheed Andre Komenan	August 1988	T. Hawkins 33678
WPS72	The Relative Efficiency of Public Schools in Developing Countries	Emmanuel Jimenez Marlaine Lockheed Vicente Paqueo	August 1988	T. Hawkins 33678
WPS73	Taxation and Output Growth: Evidence from African Countries	Jonathan Skinner		
WPS74	Fiscal Stabilization and Exchange Rate Instability: A Theoretical Approach and Some Policy Conclusions Using Mexican Data	Andrew Feltenstein Stephen Morris	August 1988	A. Bhalla 60359
WPS75	Welfare Dominance and the Design of Excise Taxation in the Cote d'Ivoire	Shlomo Yitzhaki Wayne Thirsk	August 1988	A. Bhalla 60359