Collaborative Research Project —
Poverty, Income Distribution and Labour Market Issues in Sub-Saharan Africa

CR-2-5
Fiscal Incidence in Africa: Microeconomic Evidence

By

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April 17, 1998

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*The authors conducted part of this research while Stephen D. Younger was a visiting Research Fellow at the Free University in Amsterdam. They gratefully acknowledge that University's financial support and hospitality.

1. Introduction

One of the functions people routinely expect governments to perform is to reduce inequality and poverty. This goal sits somewhat uncomfortably beside the more traditional concerns among economists for economic efficiency; including the provision of public goods. But it is important politically and socially, perhaps more so than issues of economic efficiency. Even the most neoclassical policy maker must heed a policy's consequences for the poor.

In Africa, a generation of new, nationally representative household surveys has shown that the distribution of resources is surprisingly unequal. While the Kuznets hypothesis would suggest that Africa's relatively poor economies would have less inequality than middle-income ones, many African economies are in fact among the most unequal in the world (Table 1). At a first glance, then, the need for equalizing policies appears very important on the continent. Conceptually, government could achieve this either with progressive taxation (i.e., taxes that fall disproportionately on the rich) or with progressive expenditures (i.e., programmes or services that go disproportionately to the poor). In this paper, we describe the extent to which different kinds of taxes and expenditures succeed in transferring resources to the poor in Africa. While we consider a broad range of taxes and expenditures, the list is far from comprehensive. On the tax side, because our data come from household surveys, we cannot say anything about taxation of corporations and our results on some important types of taxes, most notably import duties, depend on strong assumptions. For expenditures, we are even more limited. By the very nature of public goods such as defense, public order and the judiciary, it is impossible to identify their beneficiaries, so we cannot comment on large parts of the budget. Further, the transfer payments schemes that account for much of the government's redistributive policies in richer economies are almost nonexistent in Africa.

Many of the benefits of social services, especially health and education, however, accrue directly to individuals and thus are identifiable. Fortunately, these are also the expenditures that people most commonly expect to have a redistributive impact in Africa and they are generally covered in household surveys. Thus, our coverage of expenditure incidence concentrates on benefits of publicly provided health and education services.

2. Methods

In examining the welfare impact of fiscal policy, we limit ourselves to the more easily measured and understood definition of poverty in terms of income (or consumption expenditure as a proxy for permanent income). This not only facilitates comparisons across different types of services, but across countries as well.[1] Likewise, it allows us to compare the progressivity of taxes and expenditures using a common money-metric of utility. Beyond the issue of the choice of welfare indicator used for ranking households (and subsequently measuring inequality), a number of important issues arise in examining the benefits of

[1] The multifaceted nature of poverty and its characterization complicates immensely the analytical requirements of evaluating the distribution and welfare impacts of government spending using indicators other than money-metric notions of utility. For example, non-welfarist indicators, such as nutritional status, have a complex etiology that goes beyond the metric of inadequate consumption expenditures.

spending and the costs of taxation. We discuss these separately below for expenditure and tax policy prior to addressing the statistical issues common to both.

Expenditure incidence

Measuring the incidence of benefits associated with the provision of public services is complex. At a minimum, we want to know which individuals avail themselves of publicly provided services. Answering this most basic question is demanding in terms of detailed micro-level surveys which collect data on visits to public health care facilities and attendance at public school.

The most complex issue in benefit incidence studies is determining the value of the benefits to individuals making use of a service or participating in a program. The simplest approach, which we rely on heavily in this paper, uses a binary indicator of whether or not one accesses a service. Implicit in this method is that all who use a service or participate in a program receive the same benefits. This is obviously not correct, and most likely introduces a systematic bias in the results. Specifically, it is likely that the poor attend lower quality schools and receive lower quality health care, in part because the services they have access to are not financed as well. This commends trying to go beyond the simple yes/no characterization of use, and instead place a differential value on the service received by the individual or sub-group in the population, and thus, the extent to which it improves welfare. This is sometimes based on the unit cost of the subsidy, e.g., the cost incurred by the government of an individual attending school, or visiting the clinic (see for example, Meerman 1979, Selowsky, 1979; Demery, Dayton and Mehra, 1996; Castro-Leal, et al., 1997; Demery 1997). Numerous tenuous assumptions are required in this valuation exercise. Most obvious is the difficulty of measuring the cost of service delivery accurately. Ideally, we would arrive at unit values based on expenditure data from individual schools and health facilities. There is, however, a paucity of such information. We therefore generally rely on government budget data, divided by the estimated number of individuals going to schools or attending a specific health facility in a region or community. The correspondence between budgets and expenditures is often tenuous, however. We are also forced to make strong assumptions about the homogeneity of large clusters of clinics or schools, usually defined by geographical areas for which it is possible to derive the government's cost of delivering the service, usually a province or region. This reflects the reality that unit cost data (on various categories of services) are only available for a few regions of the country. A related problem is that using budget or even accurate government expenditure data inevitably assumes that marginal benefits equal average benefits. This problem is illustrated by the case of governments increasing the expenditure on primary health care clinics. Such increased spending could be primarily on clinics in good neighbourhoods, not in the neighbourhoods where the poor reside. Conversely, the poor may receive most of the benefits of marginal spending on health and education, particularly to the extent that the upper income households are approaching satiation at the margin, or as second round investments in schools and clinics are in more remote areas that were neglected initially.[2] Thus, the information on unit subsidies is inherently inaccurate and limited in terms of the level of disaggregation.

[2] See Piggott and Whalley (1987) for a further discussion of the substantial differences between marginal and average benefits. Also, see Lanjouw and Ravaillion (1997), who show that in India, conventional benefit incidence studies underestimate the extent to which programme expansion benefits the poor.

Given our interest in measuring the extent to which a service improves individual or household utility (or some other nation of welfare), another problem in benefit incidence studies is the dubious notion that the value of a public service is equivalent to the cost incurred by the state in providing the service. In theory, the benefit to the recipient using a health clinic or attending a public school should be equated to the amount that the individual would pay for the service, or similarly, receive for re-selling the service in the open market. In practice, if we could estimate this, the outcome may have little resemblance to the cost incurred by the government in delivering the service. A number of reasons can explain this potential inconsistency. On the cost side, corruption, inefficiency and misallocation of funds can lead to public expenditures far in excess of what actually goes to the intended beneficiaries. On the benefit side, standard economic theory indicates that unless demand is completely inelastic, the value of a transfer in kind is less than the value of a cash transfer with the same cost. On the other hand, there are often quantity constraints associated with the provision of public services that makes their value greater to rationed consumers. Even if we could make an accurate accounting of individual's reservation prices, we still face the possibility that the amount consumed is not discretionary, further complicating its valuation. In addition, there are short-term benefits of using public facilities, such as feeling more fit as a result of treatment at the clinic, which are difficult to value in money metric utility terms.

But perhaps the most important reason that valuing accessed services at the cost of the state subsidy deviates from the true value of the benefit is that government may not provide the "optimal" amount of service, failing to take into account the externalities and the related long-term benefits of spending on health and education. To the extent that the life-long benefits of more education and better health on the enhancement of labour productivity are not factored into the government's decision on social sector spending, the level of expenditure will deviate from the optimum.[3] This is particularly likely given the obvious difficulties of capturing the externalities and non-exclusivities associated with spending on health and education in the measurement of benefits. Likewise, there are also fewer direct longer-term benefits that may result from, for example, investing in technical schools and universities where the entrepreneurial talents of the graduates contribute to future employment possibilities in manufacturing and industry for workers in the lower end of the income distribution.

The reliance on costs as a proxy for benefits to the individual also generally fails to account for the fact that economic agents respond to available subsidies in ways that often render incorrect simple accounting of first round benefits and costs. There are a number of ways in which individuals respond to the provision of public services. Some are in their control, such as adjusting consumption and savings decisions. Important labour market responses in terms of labour–leisure trade-offs are also expected. The benefits of public spending arc also reduced by the changes in level of private transfers that result from public spending. Thus, going beyond such first approximations, and at least taking into account the behavioural response of individuals to changes in the price and availability of publicly provided services, is useful to get a more accurate estimate of the incidence of public expenditures.

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[3] The theory on the optimal pricing of public services is clear—prices should equal the social marginal cost. Determining the optimal price for public services, however, is in practice complicated for most government investments, particularly social services. Markets for social services are incomplete and characterized by acute market failures, in addition to having important externalities that contribute to the impracticality of applying the well established theory to public pricing decisions.

These problems amply illustrate the limitations of benefit incidence studies that use simple indicators of facilities, or disaggregated unit subsidies to value school attendance or health visits. To surmount these limitations, we need to estimate individual valuations of visits to health facilities and attendance at schools via demand function for these services. Armed with these models, we can calculate compensating variations, or the willingness to pay for social services. These types of estimations of individual valuations make it possible not only to examine more accurately who benefits from specific subsidies, but to engage in counterfactual experimentation and simulations of the impact of alternative pricing policy regimes on household welfare and the treasury. For example, the welfare effects of applying user fees to certain classes of social services can be determined on the basis of such models of health and education demand (see for example, Gertler et al., 1987). They can also be used to determine to what extent user fees are viable—that is, whether cost-recovery schemes represent a relatively non-distortionary means of raising revenues that can in turn increase the supply and quality of other services to the poor (Litvack and Bodart, 1993).[4] And most important, perhaps, the price parameters provide policy makers with information on the changes in the welfare of the households affected, willingness to pay.

Despite the value of such models of health and education demand, the comparability of results is quite limited since the prices used are generally imputed from costs of travel, queuing, etc., given that either the services are free or money prices are difficult to measure accurately. A myriad of other econometric problems also plague behavioural response models.[5] So while we encourage further research efforts that go beyond simple benefit incidence analysis, we do so cautiously. Such exercises are demanding in terms of data and analytical capacity. Furthermore, for policy makers who are primarily interested in ranking the progressivity of benefits associated with various categories of public expenditure, or whether a service is progressive, available evidence indicates that little value is added in going beyond the simplest binary approach that assesses who makes use of what service (Younger, 1997).

Tax policy

This section briefly discusses the methodological issues in determining the incidence of taxation. The objective is to determine whose real purchasing power falls when the government imposes different types of taxes. In analysing the economic incidence of taxes in Africa we confront a number of challenges. First, economists have understood that the entities that are legally required to pay a tax are not necessarily those that suffer a reduction in real purchasing power when the tax is imposed. They may successfully shift the tax onto other households. A clear example is a firm. Governments in developing countries collect most taxes from firms, but the firms do not suffer reductions in purchasing power. Either the households that own them do, or the firm shifts the tax to its customers or suppliers through

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[4] The welfare effects of applying user fees are actually determined by both the demand of consumers, and supply responsiveness of providers of services. To date, the preponderance of research in this are has been focused only on the demand side, with the simplifying assumption of constant cost made on the supply side.

[5] One prominent concern is the endogeneity of program placement, and that the use of a public service may be correlated with an unobserved household characteristic, thereby resulting in a biased estimate of the impact of the transfer due to the correlation between the take-up of the service and the regression's error terms. And perhaps of greatest importance is that the behavioural approaches also fail to capture effectively the externalities that are so critical to public expenditure

changes in its prices. For example, it is standard to assume that if an industry is competitive, then a tax on its product will be passed on to consumers via a price increase equal to the tax rate. On the other hand, a tax on firms' profits probably falls mostly on firms' owners. The other common example is the ability to avoid a tax by changing one's consumption or income pattern. For example, households that have high elasticities of demand for gasoline, say, can avoid a tax on gasoline consumption by switching to substitutes with little loss in welfare, while those with an inelastic demand cannot do the same so easily.

In trying to measure the, economic incidence of taxes, we adopt a number of rather strong assumptions. For direct taxes, we assume that the factors that produce the associated incomes pay the taxes. Thus, wage workers pay the withholding tax on wage income. This assumption is equivalent to assuming that households supply the associated factors completely inelastically so that they cannot shift the tax. Selden and Wasylenko (1991) defend this elasticity assumption on the grounds that while restrictive, it often produces results similar to those of more sophisticated models, but at a substantially lower cost in terms of the time and effort required.

For indirect taxes, we assume that households that consume the taxed items pay the associated taxes. Thus, smokers pay taxes on tobacco, households that use kerosene for lamps pay the taxes on kerosene, etc, There are two exceptions to this general rule, however, largely because of the controversy that surrounds two types of taxes. For gasoline taxes, no one doubts that direct consumption of gasoline is highly concentrated in the upper end of the expenditure distribution, yet critics of gasoline taxes argue that the secondary impact of such a tax is regressive because an increase in gasoline prices causes increases in other prices, especially public transport, on which poor people depend more than the rich. To include this effect we assume that the gasoline tax falls both on direct consumers of gasoline and on consumers of public transportation services.[6]

Import duties are the other tax that is difficult to manage. Household surveys do not ask whether goods consumed are imported or not, so we cannot identify import consumers directly. Rather, we assume that the prices of all goods for which imports are a large share of the market go up by the amount of the tariff when it is imposed. Thus, those who pay the tax are consumers of the good, whether it is actually imported or produced domestically. However, not all of this payment goes to the government. A share of the benefits from the import duties goes to protected local producers of the same good who get to charge a higher price for their output. Thus, the costs to consumers that we identify are not equal to the government's revenue.

Finally, for the most part, our analysis uses statutory tax rates rather than any estimates of taxes actually paid. The importance of the informal sector, smuggling and corruption mean that taxes actually collected are far below what perfect compliance with the tax code would yield. We have made some allowances for this, mostly by assuming that certain informal purchases, mostly food and services, and informal incomes escape taxation altogether. But for other products and incomes, we assume that the taxes are paid as per the tax laws.

Dominance testing

[6] This adjustment is only partial, because it does not include the effects through transport as an intermediate product.

We are primarily interested in ranking the progressivity of benefits of categories of social expenditure, and different types of taxation. Furthermore, we want to evaluate the distribution of expenditures and taxes against two benchmarks: whether they are progressive, i.e., inequality reducing relative to our welfare benchmark, and whether they are per capita progressive, implying that those at the lower (upper) end of the income distribution receive (pay) at least an equal level of benefit (taxes) as upper (lower) income individuals. To do so, we use two tests for the progressivity of health and education expenditures, and the revenues that mainly finance that spending. The first involves the statistical comparison of concentration curves for the types of expenditures and taxes. These curves are similar to Lorenz curves in that they plot households from the poorest to the wealthiest on the horizontal axis against the cumulative proportion of benefits received, or taxes paid, for all households. The second uses cardinal measures in the form of the extended Gini coefficients, which provides a middle ground between the normative generality (and consequent indeterminacy) of the welfare dominance approach and the precision (and lack of normative generality) of the Gini coefficient (Yitzhaki, 1983).

To amplify first on the testing of welfare dominance through the comparison of the concentration curves, Yitzhaki and Slemrod (1991) prove that for any social welfare function that is anonymous and favours an equitable distribution of income, changing the structure of expenditures (taxes) by slightly increasing (decreasing) one transfer (tax), *x*, and reducing (increasing) those on another, *y*, by just enough to keep total expenditures constant will improve social welfare when *x's* concentration curve is everywhere above (below) *y's*.[7] The intuition is straightforward. If poorer households tend to receive (pay) more of the benefits (taxes) associated with a particular type of social sector expenditure (revenue measure), say primary education (export taxes), and less of another, say, secondary education (VAT), then reducing (increasing) expenditures (taxes) on the latter to pay for more of the former will improve the distribution of welfare. Yitzhald and Slemrod refer to this as welfare dominance because of the analogy with the concept of second order stochastic dominance in the finance literature.

In addition to comparing the concentration curves for different types of social services and categories of taxes, we also compare each concentration curve to two benchmarks: the Lorenz curve for per capita expenditures and the 45-degree line. We can say that an expenditure (tax) is progressive if it benefits (taxes) poorer households more (less) than wealthy ones, relative to their income, and regressive if it does not. At the same time, public expenditures, especially in the social sectors, are often held to a higher standard than taxes in their being considered well-targeted to the poor only if the benefits go disproportionately to the poor in absolute terms, not relative to income. We will call such transfers "per capita progressive" and note that they have a concentration curve that is above the 45-degree line (concave rather than convex). We will call social services whose concentration curve is above the Lorenz curve but below the 45-degree line simply progressive and those below the Lorenz curve regressive, analogous to the standard tax literature.

[7] Yitzhaki and Slwmrod (1991) actually develop the argument in terms of commodity taxes, but it is equally applicable to transfers, or combinations of taxes and transfers. Technically, the argument also requires that the efficiency consequences of the expenditure/tax change be at least neutral, i.e., that the efficiency of the allocation of resources does not worsen with the change. This condition is more difficult to identify in practice, but we will assume that it is satisfied in our discussion.

Because the concentration curves are constricted from sample data, comparisons between them are, or should be, statistical.[8] Beach and Davidson (1983) first derived distribution-free standard errors for comparison of independent Lorenz curves. However, while such standard errors are adequate for comparing distributions across independent populations, a problem arises in the case of testing dominance of social services and taxes that may be correlated with income, as well as each other. In a recent paper, Davidson and Duclos (1996) derive distribution-free standard errors for the difference between two concentration curves that may be dependent. We use the Davidson and Duclos' estimator to establish a confidence interval around the estimated concentration curves and then test for significant differences between them. (See Appendix A for details on the estimator.)

In addition to accounting for the possible dependence between concentration curves, our tests differ from most of the literature in the way that we use the covariance matrix for the ordinate estimates. Typically, researchers who apply statistical tests use t-tests for the difference between the ordinates of two concentration curves at several abscissa (usually 0.1 to 0.9). Then they reject the null hypothesis of non-dominance when one of the ordinates differs statistically in the direction of dominance, as long as none of the other pairs indicates a statistically significant result in the opposite direction.[9] Howes (1996a) shows that we can only be sure that the probability of type I error is no more than the critical value if we reject the null hypothesis in the case that the difference in the ordinates of the two curves is non-zero for every ordinate tested and, obviously, that the difference is of the same sign. This decision rule is clearly less likely than the more common one to reject the null in favour of dominance. In practice, we find that it leads us to accept the null quite often leaving us with little to conclude about the relative progressivity of categories of expenditures or taxes. However, bounding the size of the test at the risk of low power is consistent with standard econometric practice, and we follow it here. Of course, as indicated above, failure to reject the null leaves us with an indeterminate results unless we can establish that the two concentration curves cross, something shown by two significant differences in ordinates of opposite signs.

In another paper, Howes (1996b) criticizes the use of (rather wide) quantiles for dominance testing. In theory, we can establish welfare dominance only if one concentration curve is above another at every point. In practice, when we determine dominance by relying on t-statistics that test for the difference of ordinates in two concentration curves, it is almost always the, case that as we approach the extremes of the distribution (0 and 1), t-statistics go to zero. Statistical testing of very small quantiles is also limited by the sample size. As a result, establishing dominance at each point on the concentration curve is not feasible, and instead, we rely on what Howes refers to as "restricted" dominance. This involves excluding the extreme tails so that we reject the null of non-dominance even if the curves cross or are not significantly different in that range, e.g., the ninety-ninth percentile. Choosing how restrictive to be is difficult and arbitrary. Most papers use ordinates at the deciles (0.1 to 0.9), which ignores fairly large sections of the income distribution and thus weakens the economic significance of any conclusion that one transfer dominates another. On the other hand, choosing very small quantiles reduces the power of the test as standard errors become based

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[8] It is not unusual that findings regarding dominance are not based on statistical tests of differences in concentration curves. See, for example, Jerkins and Lambert (1993).

[9] See for example the recent paper by Gouveia and Tavares (1995).

on very few observations per quantile. Based on relatively small sample sizes in our surveys, and the even smaller number of individuals who, for example, are enrolled in post-secondary education, we will extend the range of values over which we test dominance only to the fifth percentile of the income distribution at the bottom and the ninety-fifth percentile at the top.[10] In sum, our decision rule is this: using 20 equally spaced ordinates from 0.05 to 0.95, we reject the null in favour of dominance if all the t-statistics are greater than the critical value and of the same sign; or, we reject the null in favour of crossing if there are at least two significant t-statistics with opposite signs. Rejecting the null of non-dominance using these procedure implies that one distribution is preferred over the other under any social welfare function that favours progressivity. This is indeed a demanding criterion, especially in light of the low power of the test.

When the dominance tests fail to reject the null we are left with inconclusive results in terms of providing information on the relative progressivity of different types of public expenditures or taxes. In these cases, we resort to a second approach to draw conclusions about welfare evaluation and incidence analysis, the use of cardinal measures of welfare.[11] The most common is the Gini coefficient, though any of the several options for inequality indexes are also plausible. Yitzhaki (1983) shows that an extended Gini coefficient can adjust the weight given to each point on a Lorenz curve and thus give a clearer notion of how more progressive social welfare functions would rank distributions. The coefficient is defined as:

$$G(v) = -v * \mathrm{Cov}\{e,[1-F(y)](v-l)\} / \bar{e} \quad v>l$$

where *e* measures households' receipt of the benefits associated with a particular category of social service or payment of a particular tax; *F(y)* is the cumulative density function of the welfare ordering; $\bar{e}$ is mean receipt (payment) of the social service (tax); and *v* is a parameter that affects the weighting of each point on the Lorenz curve. *G*(2) yields the traditional Gini coefficient, while values of *v* greater than 2 yield measures that give even greater weight to poorer households. Thus, by calculating the extended Gini coefficient for increasing values of *v*, we can gain a sense of how a more, progresive (yet still cardinal) social welfare function ranks the value of a given public service. To draw conclusions similar to the dominance tests, we calculate Ginis for *v* values from 1.01 to 10 in steps of 0.5 for income and for all the transfers. If all 20 pairs of extended Ginis (from *v* = 1.01 to 10) are significantly less (more) for one of the social services (taxes), we conclude that it "dominates" the other. Our use of this term clearly does not have the same rigorous foundation in welfare analysis as the ordinal measure. We choose it only because the implied policy conclusion is similar, even if it is based on cardinal measures.

3. Results

In this section we present the results of the expenditure and tax incidence. In the case of the former, we report on seven African countries: Côte d'Ivoire, Ghana, Guinea, Madagascar, South Africa, Tanzania and Uganda. Our choice of countries is determined by one major

[10] Practically, this decision has important consequences: examination of the difference in ordinates in the top and bottom 5% of the income distribution often reverses a decision based on the deciles alone.

[11] Our research testing for the progressivity of social insurance and assistance in Romania shows that using cardinal measures allows us to draw more inferences about the progressivity of public expenditures.

criterion: that there are reasonably high quality survey data available to us, with the appropriate types of information that allow us to determine who benefits from the provision of health and education services. In addition, all the surveys followed roughly the same design, helping ensure comparability across countries. Appendix B presents the names of the surveys used and their basic parameters.

Our country coverage for tax incidence is less comprehensive than in the benefit incidence section. To do this analysis, we need both survey information and in-depth information about tax codes, collection practices, etc. In practical terms, this requires a visit to the tax authorities of each country, and we have only been able to do that in four: Côte d'Ivoire, Guinea, Madagascar and Tanzania. In Tanzania, the Human Resource Development (HRD) survey that we use throughout this paper lacks information on export production and wage earnings, important areas for tax policy research, so we have analysed another survey, carried out by the Economic Research Bureau (ERB) at the University of Dar es Salaam and Cornell University, as well. This survey has a relatively small number of households, about 1000, but in areas where the two surveys cross, they are roughly consistent, so we have some confidence in the reliability and comparability of the results, despite the small sample.

3.1 Benefits for social spending

The concentration curves for social sector benefits are presented, by country, in Figures 1 through 7. Some general patterns are clear. First, the concentration curves for post-secondary education are usually most convex, and often fall below the Lorenz curve for Household expenditures. This implies that the benefits associated with post-secondary schools are regressive, being more concentrated among the rich than consumption in general, itself already highly concentrated. At the other extreme, the most progressive of the social expenditures is primary education. In fact, the concentration curves for primary education are concave in the cases of Ghana and South Africa, and possibly Uganda. Most of the concentration curves for health services and secondary education fall between the Lorenz curve and the 45-degree line so that they are progressive, but not per capita progressive. We also observe that the concentration curves for non-hospital based health care are generally above those for hospital care. Many of the concentration curves for the social services cross each other, as well as the 45-degree line and the expenditure Lorenz curve, suggesting that at least in these cases, we cannot establish a clear dominance ordering.

We next examine the country specific dominance tests results outlined in the previous section (Appendix C, Table C1 through C7). We are interested in determining whether social services (1) are per capita progressive (i.e., where the concentration curve is above the 45-degree line implying that the poor receive more benefits than the rich in absolute terms), (2) are progressive (i.e., where the concentration curve is above the expenditure distribution, implying that the poor benefit more in relative terms), and (3) can be ranked or ordered by their degree of progressivity. Based on a statistical comparison (t-tests) for the difference between ordinates of two concentration curves at 20 abscissa, we find that with the exception of primary education in South Africa, no services are per capita progressive, i.e., we cannot reject the null that their concentration curves are equal to or below the 45-degree line. Conversely, there are many examples of the 45-degree line statistically dominating services—that is, where the poor receive less benefit from the service in per capita terms than individuals at the upper end of the expenditure distribution. We reject the null in favour of the dominance of the 45-degree line for post-secondary school in all countries except Ghana and Tanzania, secondary school in Guinea, Madagascar and Tanzania, and Uganda, as well as

hospital care in Guinea and Tanzania. In those cases where we fail to reject the null we can further test to see whether in fact the concentration curve actually crosses the 45-degree line. When observed, crossing assures us that a failure to reject the null of non-dominance is not due to large standard errors, but genuine ambiguity in welfare terms. We find a number of cases where, while we do not reject the null of non-dominance, we do find statistically significant crossings with the 45-degree line. This applies to primary education in Côte d'Ivoire, Guinea, Madagascar and Tanzania, middle school in Ghana, secondary school in South Africa, and hospital care in South Africa and Uganda.

Comparisons between the expenditure Lorenz curve for Household expenditures and various categories of social services reveal a number of cases where the latter dominate, i.e., where the services are progressive. Foremost, we can reject the null of non-dominance between public primary schools, and the expenditure Lorenz curve in all countries. The same is true for non-hospital health care. That is, the benefits of primary school and health care outside hospitals are more progressive than the distribution of expenditures in African countries. This general pattern, however, does not apply to the benefits of secondary and post-secondary education and hospital care. Specifically, public secondary schools are only progressive relative to the expenditure distribution in the cases of Ghana and South Africa. The only other case of expenditure progressivity are hospitals in South Africa.[12]

Pair-wise comparisons of social services across countries also reveal some common patterns. Primary education dominates secondary education in all cases except Ghana and South Africa, although only in the case of South Africa can we statistically prove that secondary schooling is more progressive than post-secondary schooling.[13] We can only statistically show that hospital care is less progressive than other facilities (e.g., clinics) in the case of Guinea despite comparison with the Lorenz curves that suggests that the latter are more progressive. When we compare primary education with non-hospital based health services we cannot reject the null of non-dominance in any of the within-country comparisons, indicating no general ordering in terms of the progressivity of the two types of benefits.

In light of the low power of the dominance test in general and the limited number of conclusions we are able to reach based on these tests, especially when it comes to the ordering of services, we next turn to the results of the cardinal measures. Our statistical tests for whether the entire range of extended Gini coefficients for any given pair of curves differs from each other enable us to reach far more conclusions (see Appendix C, Tables C1b through C7b).[14] Most important, the extended Gini comparisons allow us to reach two additional general conclusions: that hospital services are less progressive than other health services and that public secondary schools are more progressive than post-secondary schools. When relying on the dominance results, only in South Africa were secondary education and public hospitals more progressive than the per capita expenditure distribution. When using the extended Ginis we find that secondary education is more progressive than the expenditure

[12] There are also few cases of confirmed crossing of the concentration curves with the Lorenz curve: hospital care in Guinea, secondary school in Madagascar and post-secondary school in Tanzania.

[13] The high standard errors on post-secondary education, because of small number of observations, explains why we cannot show that it is dominated by secondary education.

[14] There are 18 cases where we find that according to the extended Ginis, the 45-degree line was more progressive than the service, as opposed to only 11 cases when we are able to reject the null in favour of the 45-degree line dominating the services. And, whereas using the dominance tests we find 17 cases of services being expenditure progressive, there are 24 such cases when using the extended Ginis.

distribution in the cases of Côte d'Ivoire, Ghana and Uganda, and hospital care is more progressive than the expenditure distribution in the cases of Côte d'Ivoire, Tanzania and Uganda. In addition, when we test for statistical differences in the extended Ginis we also find that public primary education in Guinea and Uganda, as well as combined private and public primary education in South Africa, are per capita progressive.

3.1.1 Comparing methods for service valuation: Binary indicators vs. disaggregated unit costs

In this section we compare the results of analysing benefit incidence based on a simple dichotomous variable of whether or not an individual uses a service (e.g., goes to a clinic or attends school), with the unit subsidy valuation derived from dividing government budget data by government estimates of the number of individuals who use a service.[15] Our interest in this comparison is to explore, the extent to which the two methods differ, and thereafter understand why.

We are able to compare unit subsidies to the binary approach for health and education services in Guinea, Madagascar and, to a lesser extent, South Africa. In Guinea, our unit subsidies are disaggregated on the basis of the five regions of the country (see Appendix D, Tables D1 and D2). In Figures 8 and 9, we see that the concentration curve for non-hospital care shifts down significantly when using unit values, while both education curves shift up. In each case, this is due to a large difference in the per unit subsidies in Conakry versus other regions. For other health services, the Conakry value is much higher than in other regions, which increases the estimated concentration because households in Conakry are generally better off than others. Exactly the converse is true of the education values, where at least one rural area has substantially higher unit values than Conakry. In terms of dominance testing, there are only two departures from the results that rely on the binary variable (Appendix C, Tables C8 and C9): the 45-degree line no longer dominates the value of primary school, and the 45-degree line now dominates non-hospital health care. There are no differences with respect to the Lorenz curve or the ordering of services.

Before presenting the dominance results from Madagascar, we once again refer to the unit subsidy figures in Appendix D, Tables D3 and D4. We are particularly sceptical about what we find to be somewhat implausible figures from Madagascar: that the unit subsidy for basic health care facilities in Antananarivo is far less than that in four of the other five regions. Conversely, the unit value of hospital visits is substantially more in Antananarivo than other regions, as we would expect, being more than four times greater in two instances. The reason for our scepticism is that we can think of no a priori reason non-hospital care in is so much less expensive in the capital city, while hospital care is much more so. With this qualification, we first examine the concentration curves for the unit value versus the binary approach (Figures 10 and 11). The only perceptible change is a downward shift in the hospital curve. In terms of more formal dominance tests, as with Guinea, there are no changes relative to the Lorenz curve (Appendix C, Table C9). There are also no differences in the results in terms of comparing the concentration curves with the 45-degree line. Where things do differ, however, is in the ordering of the progressivity of services. Using the unit

[15] The unit subsidy data comes from Castrol-Leal 1996a, Castro-Leal 1996b; World Bank 1996a; World Bank 1996b.

subsidy approach, primary education is now more progressive then hospital care. This is explained by the fact that there is a preponderance of high income individuals in Antananarivo, and that since the unit value assigned to their use is higher than the rest of the country, the benefit associated with these services appears less progressive than with the dichotomous variable approach. No changes in the ordering of progressivity of services is found when using the extended Ginis (Appendix C, Table C9b).

In the case of South Africa, we have unit subsidy information, by region, only for health services. More specifically, we can distinguish among nine regions of the country, in terms of the unit costs of a visit to hospitals and health centers/clinics. These are shown in Appendix D, Table D5, where extremely large regional differences are noted. To no surprise, the unit subsidies are highest in the Northern Cape, and lowest in Eastern Transvaal. For health clinics, the difference is more than seven times, and for hospital benefits, the difference is almost fivefold. Despite these dramatic regional differences in unit subsidies, and the fact that an examination of the concentration curves indicates that over most of the range of values the binary approach makes services appear more progressive (Figure 12), we find no differences from the binary approach in the ordering of health care or in the comparisons relative to the 45-degree line or Lorenz curve (Appendix C, Tables C10a and C10b).

In addition to this regional disaggregation, we also have disaggregation of unit subsidies, by race, for education. As shown in Appendix D, Table D6, the spending per student is dramatically higher for whites than for Africans, with that for coloureds in between. Also noteworthy is that the spending in the Homelands on Africans is far lower than the non-Homelands. When examining the concentration curves (Figure 13) and dominance results for the binary approach versus unit subsidies that take into account these dramatic racial differences, we find that the 45-degree line now dominates primary education, while just the opposite was true based on the binary approach (Appendix C, Table C10a). This same phenomenon occurs with the extended Ginis (Appendix C, Table C10b). Likewise, the 45-degree line now dominates secondary education, while we observed crossing when using the binary approach. However, as with all the other cases, using unit subsidies does not alter the finding that primary and secondary education are expenditure progressive, and university education is not. Another difference is that when the binary approach is used we find that secondary school is more progressive than university education. This is not the case when unit subsidies are used. Thus, when there is a high correlation between income and the benefits of a service received by different segments of the population, the use of unit values can have an important impact on the findings.

The data on unit subsidies have the additional advantage of allowing us to aggregate benefits across different types of services for which we have unit values. We can compare the sum of the benefits with the 45-degree line and the Lorenz curve. As suggested by Figures 8 and 9 for Guinea, and Figures 10 and 11 for Madagascar, the sum of the values of the health and education benefits one more progressive than the income distribution based on the tests of Lorenz dominance, as well as the comparison of extended Gini coefficients. With respect to our test for per capita progressivity, we find that in Guinea, the 45-degree line dominates the sum of the benefits, on the basis of both the dominance tests and the Gini comparisons. For Madagascar, we cannot reject the null of non-dominance between the 45-degree line and the sum of health and education (excluding post-secondary) benefits in Madagascar. Based on our Gini criterion, however, we do show that the sum of benefits is not per capita neutral, reflecting that according to this criteria, hospital health care and secondary education are less progressive than the 45-degree line. And in South Africa, the

aggregation of the value across the two categories of health care for which we have unit subsidies (Figure 12) reveals that the sum of benefits are progressive, but not per capita progressive. We also sum up the benefits of education spending from Figure 13, using the unit subsidies based on racial differences. This presumably captures a large degree of the implicit discrimination against poor African households at the lower end of the income distribution. We still find that the education benefits, overall, are expenditure, albeit, not per capita progressive.

3.1.2 Cross-country comparisons

In this section we explore inter-country comparisons of the progressivity of certain categories of social sector expenditure. Prior to doing so, however, we admonish caution in drawing inferences from these results. While all surveys in this study are quite similar in terms of the questionnaire design, the surveys undoubtedly differ in terms of sampling and non-sampling errors. These types of errors are not expected to significantly affect intra-country comparisons of the progressivity of expenditure, as presented above. However, they will detract from the quality of inter-country comparisons, as this study is not immune from the limitations of all similar exercises that examine inequality across different countries.

As our point of departure, we present the per capita expenditure Lorenz curves and extended Gini coefficients for our seven-country sample (Figure 14 and Table 2). Inequality appears to be lowest in Ghana and highest in South Africa. Uganda's extended Ginis are also noticeably lower than those in Tanzania, Guinea, Madagascar and Côte d'Ivoire. Statistical tests of dominance of the country Lorenz curves reveal that South Africa's expenditure inequality is significantly worse than other countries' (Table 2). Likewise, Ghana's inequality is less. Expenditure inequality, based on a statistical comparison of the 20 pairs of ordinates, is also found to be less in Uganda than Guinea, Madagascar and Côte d'Ivoire. These findings from dominance testing are consistent with our use of cardinal measures, with the exception of the additional finding from the Gini comparisons indicating that equality is greater in Uganda than Tanzania.

In Figures 15 through 18, we present a cross-country comparison of concentration curves for each category of social service. Comparisons of the progressivity of primary education reveal that the concentration curve for South Africa (which unlike the other countries includes private as well as public schools) dominates those in Tanzania and Guinea (Table 3a). When the extended Gini criteria are used, the progressivity of benefits in South Africa exceeds all other countries (Table 3b). The findings about the relative progressivity in South Africa are particularly interesting in light of the extremely unequal expenditure distribution in South Africa. Also, in regard to education, the distribution of benefits associated with primary schools in Ghana, Tanzania and Uganda is more progressive than in Côte d'Ivoire and Guinea based on the extended Ginis, although this only applies to Ghana when comparing ordinate pairs.

Secondary school benefits in South Africa are also more progressively distributed than in all the other countries (Table 4a). The secondary school concentration curve for Ghana and Côte d'Ivoire also lies everywhere above the curve for Madagascar. When relying on extended Gini comparisons, we find that secondary school benefits in Ghana and Côte, d'Ivoire are also more progressive than Guinea and Tanzania, and that secondary school benefits in Uganda are more progressive than in Madagascar (Table 4b). Post-secondary schools in Uganda and South Africa dominate Madagascar. Using the Gini criteria, we find that the benefits of post-secondary schooling are also more progressively distributed in all the

other countries than Madagascar, in Ghana more than in Guinea and Côte d'Ivoire, in South Africa more than in Guinea, and in Uganda more than in Côte d'Ivoire.

No dominance is found in cross-country comparisons of non-hospital based health care (Table 5b). The only statistically significant result of the extended Ginis is that the benefits of other public health services are less progressive in Ghana than in South Africa, Uganda and Tanzania (Table 5b). When it comes to the distribution of benefits associated with hospital care, once again the dominance results indicate that South Africa does better than other countries, as we reject the null of non-dominance in comparisons with Côte d'Ivoire, Ghana and Guinea. Tests based on the extended Ginis add Tanzania and Madagascar to the list of countries in which hospital based care is more progressive than in South Africa (Table 6a). Two additional findings are noted when we use the extended Gini comparisons: hospital benefits are more progressive in Uganda than all countries, with the exception of South Africa, and hospital care is less progressive in Guinea than in Ghana, Côte d'Ivoire and Tanzania (in addition to South Africa and Uganda as discussed above) (Table 6b).

Finally, in the cases of Guinea and Madagascar, where we have unit value information on health and education, we sum up the benefits across types of social services and across all social services. Of the four services we compare (hospitals, other health care, primary education and secondary education), only one is significantly different: primary education subsidies in Madagascar are more progressive than those in Guinea. Further, because primary education is a large share of all subsidies, the sum of all subsidies for these four services is more progressive in Madagascar than in Guinea.

3.2 Tax incidence

In this section, we examine the impact of the other side of the budget on inequality in Africa. Not all taxes apply in all countries, and not all surveys include information on the same taxable expenditures or incomes, so the results are not as uniform here as they are in the expenditures section. We have aggregated all taxes on imports into one tax, "import duties", except sales or value-added taxes on imports, which we group with those taxes. Similarly, we have aggregated all non-petroleum excise duties into one group, "excises", in the graphs, though not in the tables. Many countries have eliminated export duties, including Guinea and Tanzania. In these cases, we use a hypothetical 1% tax on products that the country exports, applied to reported production.

Figures 19 through 28 present the concentration curves for major taxes for our four countries (and five surveys). Five broad generalizations are evident: taxes on exports and kerosene (also called paraffin or petrol) are the least concentrated, which is to say the most regressive,[16] in all countries. At the other extreme, taxes associated with automobile ownership, either license fees or direct purchase of gasoline or diesel fuel, are highly concentrated among the rich, which is not surprising. Perhaps more surprising is the fact that the concentration curves that depict who pays the taxes on gasoline via transportation services are also more concentrated, or more convex, than expenditures in all countries. This

[16] Because we are now dealing with taxes rather than benefits, we have to reverse our normative judgements. Concave, or less convex, concentration curves are the least progressive, because they distribute the taxes most evenly rather than concentrating them among the rich. Similarly, in the tables, a D now indicates that the column variable dominates the row.

probably reflects the urban bias of transport expenditures. Taxes on wage income, which we assume are limited to wages earned in the formal sector, are also progressive in all countries. Finally, import duties, sales taxes, the VAT and excise duties have concentration curves below the Lorenz curve (except for import duties and excises in Côte d'Ivoire), though they are less progressive than taxes on wages and automobile-related taxes.

A careful statistical analysis does not bear all of these observations out, however. Appendix E presents the dominance tests for different taxes, by country. Using Howes' criterion, we often cannot reject the null that other taxes dominate (are more progressive than) export duties, nor can we reject the null of neutrality[17] despite the wide differences in the concentration curve. In part, this is due to the small number of exporters found in each sample, which leads to large standard errors. But it is also true that the concentration curves for exports are sinusoidal, indicating that neither the very poor nor the very rich tend to pay much of this tax. That is consistent with the notion that export farmers are better off than other farmers, but that farmers as a group are worse off than non-farmers. This implies that the concentration curve for exports will be close to or cross most other curves: the progressive, ones near zero and the regressive ones near one. Using the extended Gini criterion allows somewhat more definitive results, though Household expenditures still do not dominate export duties in Madagascar and Tanzania, i.e., we cannot conclude that they are regressive.

In contrast the results for taxes on petroleum products are generally statistically significant as well as consistent across countries. Gasoline excises are progressive in all four surveys that record gasoline expenditures. Somewhat more surprisingly, use of public transport which pays gasoline taxes indirectly through the cost of fuel, is either neutral or progressive in all the surveys, so that when we combine gasoline taxes paid both directly and indirectly through public transport, the result is also progressive.

Using Howes' criterion, kerosene duties are regressive in three of five surveys and neutral in the others (Côte d'Ivoire and Tanzania/HRD). Using the Gini criterion, they are regressive in Côte dlvoire as well.[18]

The conclusion that wage taxes are progressive is also statistically significant in three of four surveys, with the Tanzania/ERB survey being the exception. It is worth noting, however, that the concentration curve for wages in that survey is quite convex. Only the crossings near zero and one prevent a rejection of the null of neutrality.

Broad-based taxes on imports and sales or value-added are significantly more concentrated than expenditures in Guinea, Madagascar and Tanzania/HRD, while we cannot reject the null of non-dominance for Côte d'Ivoire and Tanzania/ERB. Comparison of the extended Ginis changes these conclusions only slightly: import duties become regressive in Côte d'Ivoire (the only such case for consumption taxes) and progressive in Tanzania/ERB, while import duties in Tanzania/ERB become progressive as well. Thus, even though the concentration curves for these broad-based taxes tend to be closer to the Lorenz curve, we can usually reject the null in favour of progressivity because the standard errors are small. This reflects the large number of households that pay these taxes.

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[17] A tax is neutral if its incidence is the same as expenditures in general, i.e., the concentration curve is the same as the Lorenz curve.

[18] The HRD survey in Tanzania did not include a question about gasoline consumption so it is possible that some gasoline consumption was recorded as kerosene, thus making it appear less regressive than is actually the case.

Finally, excise duties on tobacco, alcohol and non-alcoholic beverages are progressive in Madagascar and the two Tanzania surveys, but either neutral (by the dominance criterion) or regressive (by extended Ginis) in Côte d'Ivoire. We should note that because of the social stigma attached to consumption of alcohol and tobacco, reporting of expenditures for these products is often unreliable, which affects the reliability of these results. Further, the degree of misreporting may well vary by consumption level and by socio-cultural environment, making comparisons particularly difficult.

3.2.1 Inter-country comparisons

Figures 29 to 36 and Appendix F present cross-country comparisons of concentration curves for each particular type of tax along with statistical tests of their differences. Unlike the expenditures comparisons, there are no clear patterns here. The vast majority of the statistical tests accept the null of non-dominance. The only possible conclusion might be that excises duties and taxes on gasoline appear to be somewhat more regressive in Côte d'Ivoire than in other countries. This may reflect Côte d'Ivoire's relative wealth compared with the other economics, and a high income elasticity of demand for these products. It is also worth noting that there is only one statistically significant difference for the two different Tanzania surveys, for non-petroleum excises.[19] Consistency between the two surveys lends credibility to the methods and to our simultaneous use of both.

4. Summary and Conclusions

To conclude, we will both summarize our results and comment on methodology issues that we feel are particularly important for future research.

4.1 Summary of results

An important initial observation is that expenditure inequality is high in Africa. In several countries, it is much higher than one might expect based on the Kuznets hypothesis. Thus, inequality is a problem that merits policy makers' attention. Among the taxes and expenditures that we review, many are progressive and thus will mitigate the existing inequality somewhat, but the effect is often small and inadequate. African governments would do well to consider how to better target both their taxes and expenditures.

Most of the benefits of public services in the social sector are progressive, but only primary schooling in South Africa is per capita progressive, and only when using the binary approach. This implies that even the most progressive social services go disproportionately to wealthy people, rather than to the poor, a cause for serious concern. While we recognize that active means testing is administratively and politically difficult, probably impossible, in the African context, our results suggest that general provision of social services as carried out today in Africa is a poor substitute for well-targeted transfer payments to the poor. Of course, there are other arguments in favour of social spending, based on externalities associated with them, but hopes that such spending will have a substantial impact on Africa's skewed expenditure distribution are misplaced.

[19] This conclusion applies to other comparisons for taxes not included in these tables as well.

Individually, primary education services tend to be the most progressive of the five we consider, and university education is the least progressive, to the point of being regressive in many countries. Secondary education and both types of health care usually fall in between, with no clear ordering. Within health services, however, hospital care is less progressive than care at other health facilities.

On the tax side, the results are somewhat more optimistic. Many taxes are progressive in Africa, including some broad-based taxes such as the VAT and wage taxation that are preferable from an efficiency as well as an equity perspective. Taxes on gasoline and diesel consumption, which also have an efficiency justification because of the negative externalities associated with them, are highly progressive. This is true even when we include the indirect effects of the petroleum taxes on users of transportation services, although our analysis still does not include other indirect effects that result from gasoline's status as an intermediate input. Nevertheless, the evidence to date contradicts arguments that higher gasoline taxation, an unpopular but increasingly common policy option for African governments trying to raise revenues, is regressive.

At the other extreme, taxes on kerosene are generally regressive in Africa, so that general increases in petroleum taxation would not be as progressive, as reliance on gasoline and diesel taxation alone. In addition, export taxation often appears to be regressive, although it is difficult to get strong statistical results in this regard. However, beyond the limitations of any one sample, the fact that export duties consistently have the highest concentration curve in all countries examined adds weight to the conclusion that they are regressive. Given the well-known efficiency arguments against such taxation, it seems advisable to move away from them as quickly as possible, as indeed many African governments have done in recent years.

For both social services and taxes, cross-country comparisons reveal little of interest. Inequality in South Africa is significantly greater than in any other country, which is not surprising. At the same time, it is interesting that the distribution of social services is more progressive there than in other countries. Beyond these findings, no consistent patterns emerge from the cross-country analysis.

4.2 Methodology observations

One clear implication of our work is that statistical testing is important. While the concentration curves are a very useful way to summarize a lot of information, our experience shows that the standard errors differ substantially among curves. Often, curves that appear to be "far apart" are not statistically distinguishable, while other that are "close" are. Thus, even though statistical testing remains relatively rare in the literature, it makes an appreciable difference.

That said, we recognize that there is considerable controversy surrounding the "correct" way to perform tests, a controversy that we make no attempt to resolve or even weigh in this paper. Instead, we have selected procedures that are consistent with regular econometric practice, even though those procedures make it difficult to reject the null of non-dominance in many cases. Our inability to reject the null of equal concentration curves is particularly striking in light of our comparisons of extended Gini coefficients, which much more frequently yield a rejection and suggest more definitive results in terms of the ordering of the curves. This is true even though we use parameter values for the extended Ginis that implicitly test for dominance at a wide range of social welfare functions, in fact, a range well beyond what many people would consider a reasonable social welfare function. In any case,

a useful extension to this research would be to explore the consequences of other decision rules and testing procedures.

Our comparison of simple use/no use indicators of social services versus valuations based on unit costs at a regional level show few significant differences. This is not so much due to a lack of correlation between welfare and the disaggregation variable (region). We know that residents of rural regions are poorer than those in urban areas. Rather, the estimated cost of service does not vary systematically with region. It is as common to find higher expenditures per student or patient in poorer regions as it is lower ones. Our prior intuition is that this reflects data and/or valuation problems, not the true value of services to the recipients, which we would expect to be lower in rural (and thus, poorer) areas. The one case where the unit value approach clearly gives a different answer is education disaggregated by race in South Africa. Here, both the disaggregating variable and the amount spent per pupil are clearly correlated with welfare, yielding concentration curves that are significantly more convex than the simple binary approach.

If the disaggregated expenditure data that are necessary for the unit value approach were readily available, it would be simple and advisable to make the comparison in any analysis. Unfortunately, the data are often not available in Africa, and collecting them is an expensive and time-consuming task. Our results suggest that it is usually not worth the effort, except in cases where one expects a clear correlation between welfare and both the disaggregating variable and the estimated unit cost.

4.3 The last word on tax and expenditure progressivity in Africa?

Certainly not! By choosing to examine as many surveys and countries as possible, we are forced to make fairly arbitrary choices about methods, and to use rather simple ones. Future work that concentrates on only one country at a time would allow greater attention to idiosyncratic details and broader explorations of variations in the methods. In particular, we think that there is room for useful research in four main sensitivity of the results to the methods chosen; valuations of public services on the basis of demand function estimates; estimation of marginal rather than average benefits; and more careful consideration of the general equilibrium consequences of tax policy.

Research that we have done in Romania (Sahn, Younger and Simler, 1998) suggests that dominance results are quite sensitive to many methodology choices, including the number of ordinates used for the test, the decision rule and the household scaling factor. This suggests that drawing conclusions about dominance results requires a good deal of judgement, not simply the mechanical application of a given set of rules. Explorations of these issues in Africa will provide useful guidance to researchers wanting to know where to look for lack of robustness in their results.

All of the results that we report in this paper implicitly assume that demand and supply elasticities are zero, i.e., that quantities consumed do not change when taxes or subsidies change. This assumption greatly simplifies the analysis, and it does provide accurate first-order approximations to the true incidence (Younger, 1997), but it is an obvious area for improvement. Future research would do well to relax this assumption by estimating demand functions for individual services and for systems of goods and services. Likewise, attempting to determine whether an extra unit of currency spent on schooling will have a greater or lesser benefit to the poor than the benefits they receive on average from present spending is important for telling us how the tax/benenefit incidence would change after a change in policy.

The research also ignores general equilibrium considerations. On the expenditure side, this is probably not a restrictive assumption, but it is clearly a problem with the analysis of tax incidence when taxes fall on intermediate inputs. This is especially a concern for the analysis of petroleum excises and import duties. Exploring these implications may lead to different conclusions than we have found here and should be a priority for future research.

Finally, we reiterate our warning of the introduction: equity is not the only concern of economic policy. In addition to improving the methods of incidence analysis, there is great scope for research into the efficiency consequences of tax and expenditure policy changes. That is, rather than simply describing who benefits under the present state of affairs, researchers should explore comparative static exercises. That, in turn, requires demand estimates that will tell us how taxpayers and public service users will respond to changes in policy, questions that are important for policy makers to consider. We have had to limit our explorations in other directions, and we have surely missed important details that an analysis of a single country would improve upon. By modelling neither demand functions nor general equilibrium consequences, we have also kept our methods simple, but we recognize that a more sophisticated examination of the issues that we address might yield different results.

In the end, this paper should be seen as a first crack, not the last word. Indeed, we hope that its many limitations will spur other researchers to pursue the analysis, examining both individual countries in greater detail and exploring the implications of different methods.

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Table 1: Gini coefficients for selected countries

Country	Year	Gini	Inc/Exp	HH/Ind
Côte d'Ivoire	1986	0.4604 [a]	Exp	Ind
Ecuador	1994	0.4776 [a]	Exp	Ind
Ghana	1987	0.3471 [a]	Exp	Ind
Guinea	1994	0.4604 [a]	Exp	Ind
Madagascar	1994	0.4569 [a]	Exp	Ind
Mexico	1992	0.5031 [b]	Exp	Ind
Netherlands	1991	0.2938 [b]	Inc	HH
New Zealand	1990	0.4021 [b]	Inc	HH
Pakistan	1991	0.3115 [b]	Exp	Ind
Romania	1995	0.4399 [a]	Inc	Ind
South Africa	1993	0.6808 [a]	Exp	Ind
Sweden	1992	0.3244 [b]	Inc	HH
Taiwan	1993	0.3078 [b]	Inc	Ind
Tanzania	1993	0.3914 [a]	Exp	Ind
Tunisia	1990	0.4024 [b]	Exp	Ind
Uganda	1992	0.4089 [a]	Exp	Ind
Ukraine	1992	0.2577 [b]	Inc	Ind
United States	1991	0.3794 [b]	Inc	HH
Vietnam	1992	0.3571 [b]	Exp	Ind

Note: [a] = authors' calculation [b] = Deininger and Squire (1998).

Table 2a: Cross-country dominance results for Household expenditures
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	Ghana		D	D	D	D	D	D
(2)	Uganda				D	D	D	D
(3)	Tanzania							D
(4)	Guinea							D
(5)	Madagascar							D
(6)	Côte d'Ivoire							D
(7)	South Africa							

Table 2b: Cross-country comparison of extended Gini coefficients for Household expenditures
Criteria: t at 5% for all extended ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	Ghana		D	D	D	D	D	D
(2)	Uganda			D	D	D	D	D
(3)	Tanzania							D
(4)	Guinea							D
(5)	Madagascar							D
(6)	Côte d'Ivoire							D
(7)	South Africa							

Source: Government of Côte d'Ivoire (1985); Government of Ghana (1987/88); Government of Guinea (1993/94); Government of Madagascar (1993); Government of South Africa (1993); Government of Tanzania (1995); Government of Uganda (1992).

Table 3a: Cross-country dominance results for primary education services
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) South Africa			D	X			D
(2) Ghana						D	D
(3) Tanzania				X	X		
(4) Madagascar	X		X		X		D
(5) Uganda			X	X			
(6) Côte d'Ivoire							
(7) Guinea							

Table 3b: Cross-country comparison of extended Gini coefficients for primary education services
Criteria: t at 5% for all extended ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) South Africa		D	D	D	D	D	D
(2) Ghana						D	D
(3) Tanzania						D	D
(4) Madagascar					X		D
(5) Uganda				X		D	D
(6) Côte d'Ivoire							D
(7) Guinea							

Source: Government of Côte d'Ivoire (1985); Government of Ghana (1987/88); Government of Guinea (1993/94); Government of Madagascar (1993); Government of South Africa (1993); Government of Tanzania (1995); Government of Uganda (1992).

Table 4a: Cross-country dominance results for secondary education services
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) South Africa			D	D	D	D	D
(2) Ghana							D
(3) Côte d'Ivoire							D
(4) Uganda					X		
(5) Guinea				X		X	
(6) Tanzania					X		
(7) Madagascar							

Table 4b: Cross-country comparison of extended Gini coefficients for secondary education services
Criteria: t at 5% for all extended ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) South Africa			D	D	D	D	D
(2) Ghana					D	D	D
(3) Côte d'Ivoire					D	D	D
(4) Uganda							D
(5) Guinea							
(6) Tanzania							
(7) Madagascar							

Source: Government of Côte d'Ivoire (1985); Government of Ghana (1987/88); Government of Guinea (1993/94); Government of Madagascar (1993); Government of South Africa (1993); Government of Tanzania (1995); Government of Uganda (1992).

Table 5a: Cross-country dominance results for non-hospital health services
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) South Africa							
(2) Uganda							
(3) Madagascar							
(4) Tanzania							
(5) Guinea							
(6) Côte d'Ivoire							
(7) Ghana							

Table 5b: Cross-country comparison of extended Gini coefficients for non-hospital services
Criteria: t at 5% for all extended ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) South Africa							D
(2) Uganda							D
(3) Madagascar							D
(4) Tanzania							
(5) Guinea							
(6) Côte d'Ivoire							
(7) Ghana							

Source: Government of Côte d'Ivoire (1985); Government of Ghana (1987/88); Government of Guinea (1993/94); Government of Madagascar (1993); Government of South Africa (1993); Government of Tanzania (1995); Government of Uganda (1992).

Table 6a: Cross-country dominance results for hospital services
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Uganda							
(2) South Africa				D	D		D
(3) Tanzania							D
(4) Côte d'Ivoire							
(5) Ghana							
(6) Madagascar							
(7) Guinea							

Table 6b: Cross-country comparison of extended Gini coefficients for hospital services
Criteria: t at 5% for all extended ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Uganda			D	D	D	D	D
(2) South Africa			D	D	D	D	D
(3) Tanzania							D
(4) Côte d'Ivoire							D
(5) Ghana							D
(6) Madagascar							
(7) Guinea							

Source: Government of Côte d'Ivoire (1985); Government of Ghana (1987/88); Government of Guinea (1993/94); Government of Madagascar (1993); Government of South Africa (1993); Government of Tanzania (1995); Government of Uganda (1992).

Appendix A: Details of estimator used in this study

This appendix presents the estimator that we use for the covariance matrix of the ordinates of two possibly dependent concentration curves. Davidson and Duclos (1996) developed the estimator, and our exposition is almost entirely dependent on their paper.

Let X and Y be two jointly distributed random variables and let F be the marginal distribution of Y. For our purposes, we can think of Y as the variable that measures household welfare (e.g., per capita income) and X as a public transfer. Let p = [p(1),p(2),…p(k)] be a vector of abscissa on x-axis of a Lorenz or concentration curve. And define $g_{p(j)}$ as the expected value of X given that Y is in the lower p(j) quantile of its distribution. Then an estimator of the ordinate for a concentration curve at p(j) is $p(j)*[g_{p(j)}/g_1]$, where $g_{p(j)} = E[X \mid F(Y)£p(j)]$, i.e., the expected value of X (the transfer payment) conditional on the household being found in the lowest p(j) quantile of the income distribution. Note that g_1 is just the mean value of the transfer payment for all households. If we repeat the same argument for another transfer payment, say W, and another welfare variable, Z, and we define $d_{p(j)} = E[W| F(Z)£p(j)]$, then we have $p(j)*[d_{p(j)}/d_1]$ as an estimator for the ordinate of W's concentration curve, and $p(j)*[(g_{p(j)}/g_1) – (d_{p(j)}/d_1)]$ is the difference between the two at abscissa p(j). For our work, Y and Z are always the same variable, e.g., per capita income.

Both the standard errors for each ordinate and the difference between them depend on the joint distribution of:

$w = [p(1)_{gp(1)}(1),\ldots,p(k)g_{p(k)}(k),g_1,p(1)d_{p(1)}(1),\ldots,p(k)d_{p(k)}(k),d_1]^T$.

Davidson and Duclos prove that $N^{-0.5}$ (ω-ω) is asymptotically normal with mean zero and an asymptotic covariance matrix that can be estimated without knowledge of the population distribution. The actual formulas are long and need not be repeated here. Suffice it to say that they require estimation of both unconditional moments, for which we can use the sample equivalents, and moments conditional on being in the lower p(j) quantile of the income distribution. Davidson and Duclos recommend estimating these with Guassian kernel estimates (e.g., Silverman, 1986, chapter 3), and we have followed their recommendation.

Finally, Davidson and Duclos note that, by a result in Rao (1973: 388–9), we can generate the covariance matrix by 1 by pre-and post-multiplying w's covariance matrix with the Jacobian for 1 with respect to the vectors g and d. Formally, let $q = [g_{p(1)},\ldots g_1,d_{p(1)},\ldots,d_1]^T$, and let $\frac{\P li}{\P qj} = [S(g) \mid S(d)]$ be the Jacobian for w's covariance matrix,

where $S(g) = \begin{pmatrix} \frac{1}{g_1} & -p(1)\frac{g_{p(1)}}{g_1^2} \\ \vdots & \vdots \\ \frac{1}{g_1} & -p(k)\frac{g_{p(k)}}{g_1^2} \end{pmatrix}$ $\frac{\partial li}{\partial qj}$

$$s(g) = \begin{pmatrix} \frac{1}{g_1} & -p(1)\frac{g_{p(1)}}{g_1^2} \\ \vdots & \vdots \\ \frac{1}{g_1} & -p(k)\frac{g_{p(k)}}{g_1^2} \end{pmatrix} 32$$

and S(d) is defined similarly. Then the ^{kxk} matrix $\left(\frac{\P l_i}{\P q_j}\right) w \left(\frac{\P l_i}{\P q_j}\right)^T$ is the covariance matrix for 1. $\left(\frac{\partial g_i}{\partial q_j}\right) w \left(\frac{\partial g_i}{\partial q_j}\right)$

Appendix B: Summary of datasets used

Survey	Abbreviation	Number of households[1]	Year
Côte d'Ivoire, Living Standards Survey	CILS	1,578	1985
Ghana, Living Standards Survey	GLSS	3,035	1987/8
Guinea, Enquete Integral sur les Conditions de Vie des Manages	EIS	4,416	1993/4
Madagascar, Enquete Permanente Aupres des Manages	EPM	4,500	1993
South Africa, Living Standards Survey	SALS	8,816	1993
Tanzania, Human Resource Development Survey	HRD	5,184	1995
Tanzania, National Household Survey	ERB	1,046	1991
Uganda, Integrated Household Survey	IHS	9,924	1992

[1] This is the number after data cleaning by the authors.

Table C1a: Dominance results for public education and health services in Côte d'Ivoire
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) 45-degree line		X				D	D
(2) Primary education	X			D	D	D	D
(3) Non-hospital						D	D
(4) Secondary education							
(5) Hospital							
(6) Total expenditure							
(7) Post-secondary education							

Table C1b: Comparison of extended Gini coefficients for public education and health services in Côte d'Ivoire
Criteria: t at 5% for all extended Ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) 45-degree line				D	D	D	D
(2) Primary education				D	D	D	D
(3) Non-hospital				D	D	D	D
(4) Secondary education						D	D
(5) Hospital						D	D
(6) Total expenditure							
(7) Post-secondary education							

Note: Survey: ICLS (1985).

Table C2a: Dominance results for public education and health services in Ghana
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Primary education							D	D
(2) Middle education			X					D
(3) 45-degree line		X					D	D
(4) Non-hospital								D
(5) Secondary education								
(6) Post-secondary education								
(7) Hospital								
(8) Total expenditure								

Table C2b: Comparison of extended Gini coefficients for public education and health services in Ghana
Criteria: t at 5% for all extended Ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Primary education			D	D	D	D	D
(2)	Middle education			D	D		D	D
(3)	45-degree line			D	D		D	D
(4)	Non-hospital						D	D
(5)	Secondary education							D
(6)	Post-secondary education							
(7)	Hospital							
(8)	Total expenditure							

Note: Survey: ICLS (1985).

Table C3a: Dominance results for public education and health services in Guinea
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	45-degree line		D	D	D	D	D
(2)	Non-hospital			D	D	D	D
(3)	Primary education			D	D	D	
(4)	Secondary education				X		
(5)	Total expenditure			X		X	
(6)	Hospital				X		
(7)	Post-secondary education						

Table C3b: Comparison of extended Gini coefficients for public education and health services in Guinea
Criteria: t at 5% for all extended Ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) 45-degree line		D	D	D	D	D	D
(2) Non-hospital			D	D	D	D	D
(3) Primary education				D	D	D	D
(4) Secondary education					X		D
(5) Total expenditure				X			D
(6) Hospital							
(7) Post-secondary education							

Note: Survey: ICLS (1985).

Table C4a: Dominance results for public education and health services in Madagascar
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Primary education		X			D	D	D
(2) 45-degree line	X				D	D	D
(3) Non-hospital					D	D	D
(4) Hospital							
(5) Secondary education						X	
(6) Total expenditure					X		D
(7) Post-secondary education							

Table C4b: Comparison of extended Gini coefficients for public education and health services in Madagascar
Criteria: t at 5% for all extended Ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Primary education		X		D	D	D	D
(2) 45-degree line	X			D	D	D	D
(3) Non-hospital				D	D	D	D
(4) Hospital							
(5) Secondary education						X	D
(6) Total expenditure					X		D
(7) Post-secondary education							

Note: Survey: ICLS (1985).

Table C5a: Dominance results for public education and health services in South Africa
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Primary education		X		D		D	D
(2) Non-hospital	X			X		D	D
(3) Hospital				X		D	D
(4) 45-degree line		X	X		X	D	D
(5) Secondary education				X		D	D
(6) Post-secondary education							
(7) Total expenditure							

Table C5b: Comparison of extended Gini coefficients for public education and health services in South Africa
Criteria: t at 5% for all extended Ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Primary education				D	D	D	D
(2) Non-hospital					D	D	D
(3) Hospital				X		D	D
(4) 45-degree line			X			D	D
(5) Secondary education						D	D
(6) Post-secondary education							D
(7) Total expenditure							

Note: Survey: ICLS (1985).

Table C6a: Dominance results for public education and health services in Tanzania
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Post-secondary education				X	X	X	X
(2) Primary education			X		D	D	D
(3) 45-degree line		X			D	D	D
(4) Non-hospital	X						D
(5) Hospital	X						
(6) Secondary education	X						
(7) Total expenditure	X						

Table C6b: Comparison of extended Gini coefficients for public education and health services in Tanzania
Criteria: t at 5% for all extended Ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Post-secondary education							
(2) Primary education			X	D	D	D	D
(3) 45-degree line		X		D	D	D	D
(4) Non-hospital					D	D	D
(5) Hospital							D
(6) Secondary education							
(7) Total expenditure							

Note: Survey: ICLS (1985).

Table C7a: Dominance results for public education and health services in Uganda
Criteria: t at 5% for all ordinates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Hospital				X			
(2) Primary education					D	D	D
(3) Non-hospital					D		D
(4) 45-degree line	X				D	D	D
(5) Secondary education							
(6) Post-secondary education							
(7) Total expenditure							

Table C7b: Comparison of extended Gini coefficients for public education and health services in Uganda
Criteria: t at 5% for all extended ginis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Hospital					D	D	D
(2) Primary education				D	D	D	D
(3) Non-hospital					D	D	D
(4) 45-degree line					D	D	D
(5) Secondary education							D
(6) Post-secondary education							
(7) Total expenditure							

Note: Survey: ICLS (1985).

Table C8a: Dominance results for unit values and binary methods for public education and health services in Guinea
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	45-degree line				D	D	D	D	D	D	D
(2)	Non-hospital binary				D		D	D	D	D	D
(3)	Primary education value				X	D	D	D	D	D	D
(4)	Non-hospital value			X		X			D	D	D
(5)	Primary education binary				X		D	D	D	D	D
(6)	Secondary education value								X		
(7)	Secondary education binary								X		
(8)	Total expenditures						X	X		X	X
(9)	Hospital value								X		
(10)	Hospital binary								X		

Table C9b: Comparison of extended Gini coefficients for unit values and binary methods for public education and health services in Guinea
Criteria: t at 5% for all extended Ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	45-degree line	D	D	D	D	D	D	D	D	D	
(2)	Non-hospital binary			D	D	D	D	D	D	D	D
(3)	Primary education value				X	D	D	D	D	D	D
(4)	Non-hospital value			X			D	D	D	D	D
(5)	Primary education binary						D	D	D	D	D
(6)	Secondary education value							D			
(7)	Secondary education binary								X		
(8)	Total expenditures							X			
(9)	Hospital value										
(10)	Hospital binary										

Source: Government of Guinea (1993/94).

Table C9a: Dominance results for unit values and binary methods for public education and health services in Madagascar
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	Primary education binary		X					D	D	D	D
(2)	45-degree line	X		X					D	D	D
(3)	Primary education value		X					D	D	D	D
(4)	Non-hospital binary								D	D	D
(5)	Non-hospital value								D	D	D
(6)	Hospital binary										
(7)	Hospital value										
(8)	Secondary education binary										X
(9)	Secondary education value										X
(10)	Total expenditures								X	X	

Table C9b: Comparison of extended Gini coefficients for unit values and binary methods for public education and health services in Madagascar

Criteria: t at 5% for all extended Ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	Primary education binary		X					D	D	D	D
(2)	45-degree line	X		X					D	D	D
(3)	Primary education value		X					D	D	D	D
(4)	Non-hospital binary								D	D	D
(5)	Non-hospital value								D	D	D
(6)	Hospital binary										
(7)	Hospital value										
(8)	Secondary education binary										X
(9)	Secondary education value										X
(10)	Total expenditures								X	X	

Source: Government of Madagascar (1993).

Table C10a: Dominance results for unit values and binary methods for public education and health services in South Africa
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	Primary binary		X			D			D	D	D	D	D
(2)	Non-hospital binary	X				X				D	D	D	D
(3)	Non-hospital value /[a]				X	X		X		D	D	D	
(4)	Hospital binary									D	D	D	D
(5)	45-degree line		X	X	X		X	X	D	D	D	D	D
(6)	Secondary binary					X			X	D	D	D	D
(7)	Hospital value /[a]					X				D	D	D	D
(8)	Primary value /[b]			X			X				D	D	D
(9)	Secondary value /[b]												D
(10)	Post-secondary binary												
(11)	Post-secondary value /[b]												
(12)	Total expenditures binary												

Table C10b: Comparison of extended Gini coefficients for unit values and binary methods for public education and health services in South Africa
Criteria: t at 5% for all extended Ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	Primary binary					D	D	D	D	D	D	D	D
(2)	Non-hospital binary						D			D	D	D	D
(3)	Non-hospital value /a					X				D	D	D	D
(4)	Hospital binary					X				D	D	D	D
(5)	45-degree line			X	X				D	D	D	D	D
(6)	Secondary binary								X	D	D	D	D
(7)	Hospital value /a									D	D	D	D
(8)	Primary value /b						X			D	D	D	D
(9)	Secondary value /b										D	D	D
(10)	Post-secondary binary										D	D	
(11)	Post-secondary value /b												D
(12)	Total expenditures binary												

Notes: /a Based on regional disaggregation, /b Based on racial disaggregation.
Source: Government of South Africa (1993).

Appendix D: Per beneficiary expenditures in health and education in Guinea and Madagascar

Table D.1: Per student public expenditures in education, by region in Guinea, 1995

Region	Primary	Secondary
	(GF)	
Conakry	39,912	61,309
Lower Guinea	48,705	85,039
Middle Guinea	49,436	91,098
Upper Guinea	61,060	98,256
Forest	49,094	89,425
Per	49,676	79,725

Source: World Bank (1996a).

Table D.2: Per patient recurrent expenditures on health, by region in Guinea, 1994

Region	Health Centre/Clinic	Secondary
	(GF)	
Conakry	2,700	1,430
Lower Guinea	601	1,061
Middle Guinea	755	1,770
Upper Guinea	792	1,276
Forest	552	1,250
Per	902	1,321

Source: World Bank (1996a).

Table D.3: Per student expenditures in education, by region in Madagascar, 1994

Region	Primary	Secondary
	(FMG)	
Antananarivo	50,090	226,508
Antsiranana	34,288	115,247
Fianarantsoa	70,940	205,609
Mahajanga	45,710	130,245
Toamasina	39,076	171,399
Toliara	67,457	324,628
All Madagascar:	50,504	192,491

Sources: World Bank (1996b).

Table D.4: Per patient expenditures on health, by region in Madagascar, 1993

Region	Hospitals	Health Center/Clinic
	(FMG)	
Antananarivo	4,406	844
Antsiranana	2,481	2,062
Fianarantsoa	2,132	2,120
Mahajanga	1,072	1,737
Toamasina	1,893	1,158
Toliara	930	1,978
All Madagascar:	2136	1413

Sources: World Bank (1996b).

Table D.5: Per student public recurrent expenditures on health care, by province in South Africa, 1992/93

Province	Hospital	Health Center/Clinic
	(Rand)	
Western Cape	579	492
Northern Cape	929	365
Eastern Cape	334	54
Kwazulu/Natal	346	77
Free State	723	205
Eastern Transvaal	194	49
North West	676	229
Gauteng	1,454	75
TOTAL:	516	98

Source: Castro-Leal (1996a).

Table D.6: Per student public recurrent expenditure on education by level, department and race in South Africa, 1993

Department and race	Primary	Secondary	Tertiary*
		(Rand)	
Africans/Non-Homeland	1,012	1,014	6,816
Africans/Homeland	660	790	1,892
Whites	3,099	4,675	9,075
Coloureds	2,308	2,735	6,764
Indians	2,565	3,353	8,293
All	1,090	1,401	5,636

*Public spending and enrollments at the tertiary level are calculated by race
Source: Castro-Leal (1996b).

Appendix E: Dominance tests for different taxes, by country

Table E1a: Dominance results for taxes in Côte d'Ivoire
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)	45-degree line			D	D	D	D	D	D	D	D	D	D	D	D	D	D
(2)	Exports				X						D		D		D	D	D
(3)	Tobacco					D				D	D	D	D	D	D	D	D
(4)	Kerosene		X							D		D	D	D	D	D	D
(5)	Excises										D	D	D	D	D	D	D
(6)	Imports									D		D	D	D	D	D	D
(7)	Household expenditures											D	D	D	D	D	D
(8)	Transportation												D		D	D	D
(9)	VAT											D	D	D	D	D	D
(10)	Alcohol															D	
(11)	Gasoline and transportation															D	D
(12)	Beverages																
(13)	Gasoline																
(14)	Wages																X
(15)	Automobile																
(16)	Reported														X		

Table E1b: Comparison of extended Gini coefficients for taxes in Côte d'Ivoire
Criteria: t at 5% for all extended Ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)	45-degree line		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
(2)	Exports				X		D	D	D	D	D	D	D	D	D	D	D
(3)	Tobacco					D	D	D	D	D	D	D	D	D	D	D	D
(4)	Kerosene		X					D	D	D	D	D	D	D	D	D	D
(5)	Excises							D		D	D	D	D	D	D	D	D
(6)	Imports							D	D	D	D	D	D	D	D	D	D
(7)	Household expenditures									D		D	D	D	D	D	D
(8)	Transportation											D	D	D	D	D	D
(9)	VAT											D	D	D	D	D	D
(10)	Alcohol												D		D	D	D
(11)	Gasoline and transportation													D	D	D	D
(12)	Beverages															D	
(13)	Gasoline															D	D
(14)	Wages																X
(15)	Automobile																
(16)	Reported														X		

Source: Government of Côte d'Ivoire (1985).

Table E2a: Dominance results for taxes in Guinea
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1)	Exports		X	X			D	D	D	D	D	D	D	D	D	D	D	D
(2)	45-degree line	X		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
(3)	Reported	X				D	D	D	D	D	D	D	D	D	D	D	D	D
(4)	Kerosene					D	D	D	D	D	D	D	D	D	D	D	D	D
(5)	Household expenditures								D	D		D	D	D	D	D	D	D
(6)	Tobacco								X			D	D		D	D	D	D
(7)	Excises								X	X		D			D	D	D	D
(8)	Imports						X	X			X		D		D	D	D	D
(9)	VAT							X			X		D		D	D	D	D
(10)	Transportation								X	X			X					
(11)	Wages												X		X			
(12)	Automobile										X	X						
(13)	Alcohol																	
(14)	Gasoline and transportation												X					
(15)	Beverage																	
(16)	Gasoline																	
(17)	Diesel																	

Table 18B: Comparison of extended Gini coefficients for taxes in Guinea
Criteria: t at 5% for all extended ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1)	Exports		X	X	D	D	D	D	D	D	D	D	D	D	D	D	D	D
(2)	45-degree line	X		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
(3)	Reported	X			D	D	D	D	D	D	D	D	D	D	D	D	D	D
(4)	Kerosene					D	D	D	D	D	D	D	D	D	D	D	D	D
(5)	Household expenditures							D	D	D	D	D	D	D	D	D	D	D
(6)	Tobacco							D			D	D	D	D	D	D	D	D
(7)	Excises											D	D	D	D	D	D	D
(8)	Imports									D		D	D	D	D	D	D	D
(9)	VAT											D	D	D	D	D	D	D
(10)	Transportation											D			D	D	D	D
(11)	Wages												X			D		D
(12)	Automobile											X					D	
(13)	Alcohol																	
(14)	Gasoline and Transportation																D	
(15)	Beverage																	
(16)	Gasoline																	
(17)	Diesel																	

Source: Government of Guinea (1983/94).

Table 19A: Dominance results for taxes in Madagascar
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)	45-degree line			D	D	D	D	D	D	D	D	D	D	D	D
(2)	Exports			X	X	X	X								
(3)	Kerosene		X		D	D	D	D	D	D	D	D	D	D	D
(4)	Total Expenditures		X			D	D	D	D	D	D	D	D	D	D
(5)	Imports		X				D					D	D	D	D
(6)	VAT		X									D	D	D	D
(7)	Alcohol											D		D	D
(8)	Excises											D		D	D
(9)	Transportation											D	D	D	D
(10)	Tobacco											D			D
(11)	Wages														
(12)	Gasoline														D
(13)	Automobile														
(14)	Gasoline and transportation														

Table E3b: Comparison of extended Gini coefficients for taxes in Madagascar
Criteria: t at 5% for all extended Ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)	45-degree line			D	D	D	D	D	D	D	D	D	D	D	D
(2)	Exports							D	D	D	D	D	D	D	D
(3)	Kerosene				D	D	D	D	D	D	D	D	D	D	D
(4)	Total Expenditures					D	D	D	D	D	D	D	D	D	D
(5)	Imports						D				D	D	D	D	D
(6)	VAT											D	D	D	D
(7)	Alcohol											D	D	D	D
(8)	Excises											D	D	D	D
(9)	Transportation											D	D	D	D
(10)	Tobacco											D	D	D	D
(11)	Wages														D
(12)	Gasoline														D
(13)	Automobile														
(14)	Gasoline and transportation														

Source: Government of Madagascar (1993).

Table E4a: Dominance results for taxes in Tanzania (HRD Survey)
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	45-degree line		D	D	D	D	D	D	D	D	D	D	D
(2)	Kerosene					D		D	D	D	D	D	D
(3)	Total Expenditures					D		D	D	D	D	D	D
(4)	Tobacco						X					D	D
(5)	Imports							X		D		D	D
(6)	Licenses				X							D	D
(7)	Sales tax					X				D		D	D
(8)	Excises											D	D
(9)	Alcohol											D	D
(10)	Transportation											D	D
(11)	Gasoline and transportation												D
(12)	Gasoline												

Table E4b: Comparison of extended Gini coefficients for taxes in Tanzania (HRD Survey)
Criteria: t at 5% for all extended Ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	45-degree line		D	D	D	D	D	D	D	D	D	D	D
(2)	Kerosene					D		D	D	D	D	D	D
(3)	Total expenditures					D		D	D	D	D	D	D
(4)	Tobacco								D	D	D	D	D
(5)	Imports							X	D	D	D	D	D
(6)	Licenses									D	D	D	D
(7)	Sales tax					X			D	D	D	D	D
(8)	Excises									D		D	D
(9)	Alcohol											D	D
(10)	Transportation											D	D
(11)	Gasoline and transportation												D
(12)	Gasoline												

Source: Government of Tanzania (1995).

Table E5a: Dominance results for taxes in Tanzania (ERB/CU Survey)
Criteria: t at 5% for all ordinates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	45-degree line		X	D	D	D	D	D		D	D	D
(2)	Exports	X		X								
(3)	Kerosene		X		D	D	D			D	D	D
(4)	Total Expenditures										D	D
(5)	Sales tax										D	D
(6)	Imports										D	D
(7)	Tobacco									X		
(8)	Transportation											
(9)	Wages							X				
(10)	Excises											
(11)	Alcohol											

Table E5b: Comparison of extended Gini coefficients for taxes in Tanzania (ERB/CU Survey)
Criteria: t at 5% for all extended Ginis

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	45-degree line		D	D	D	D	D	D	D	D	D	D
(2)	Exports							D	D		D	D
(3)	Kerosene				D	D	D	D		D	D	D
(4)	Total Expenditures						D				D	D
(5)	Sales tax										D	D
(6)	Imports										D	D
(7)	Tobacco										D	D
(8)	Transportation											D
(9)	Wages											
(10)	Excises											D
(11)	Alcohol											

Source: Economic Research Bureau, University of Dar es Salaam and Cornell University (1991).

Appendix F: Cross-country comparisons of taxes

Table F1a: Cross-country dominance test results for export duties

	Guinea	Madagascar	Côte d'Ivoire	Tanzania (Cornell/ERB survey)
Guinea			X	
Madagascar				
Côte d'Ivoire		X		X
Tanzania (Cornell/ERB survey)			X	

Table F1b: Cross-country comparison of extended Gini coefficients for export duties

	Guinea	Madagascar	Côte d'Ivoire	Tanzania (Cornell/ERB survey)
Guinea			D	
Madagascar				
Côte d'Ivoire				
Tanzania (Cornell/ERB survey)				

Source: Government of Côte d'Ivoire (1985); Government of Guinea (1993/94); Government of Madagascar (1993); Economic Research Bureau, University of Dar es Salaam and Cornell University (1991).

Table F2a: Cross-country dominance test results for import duties

	Côte d'Ivoire	Tanzania (HRD survey)	Tanzania (Cornell/ERB survey)	Guinea	Madagascar
Côte d'Ivoire				D	
Tanzania (HRD survey)				D	
Tanzania (Cornell/ERB survey)					
Guinea					
Madagascar					

Table F2b: Cross-country comparison of extended Gini coefficients for import duties

	Côte d'Ivoire	Tanzania (HRD survey)	Tanzania (Cornell/ERB survey)	Guinea	Madagascar
Côte d'Ivoire			D	D	D
Tanzania (HRD survey)				D	D
Tanzania (Cornell/ERB survey)					
Guinea					
Madagascar					

Source: Government of Côte d'Ivoire (1985); Government of Guinea (1993/94); Government of Madagascar (1993); Government of Tanzania (1995); Economic Research Bureau, University of Dar es Salaam and Cornell University (1991).

Table F3a: Cross-country dominance test results for VAT/sales tax

	Tanzania (Cornell/ERB survey)	Tanzania (HRD survey)	Côte d'Ivoire	Guinea	Madagascar
Tanzania (Cornell/ERB survey)		X			
Tanzania (HRD survey)	X		D	D	
Côte d'Ivoire					
Guinea					
Madagascar					

Table F3b: Cross-country comparison of extended Gini coefficients for VAT/sales ta

	Tanzania(Cornell/ERB survey)	Tanzania (HRD survey)	Côte d'Ivoire	Guinea	Madagascar
Tanzania (Cornell/ERB survey)				D	
Tanzania (HRD survey)				D	D
Côte d'Ivoire				D	D
Guinea					
Madagascar					

Source: Government of Côte d'Ivoire (1985); Government of Guinea (1993/94); Government of Madagascar (1993); Government of Tanzania (1995), Economic Research Bureau, University of Dar es Salaam and Cornell University (1991).

Table F4a: Cross-country dominance test results for all non-petroleum excises

	Côte d'Ivoire	Tanzania (HRD survey)	Guinea	Madagascar	Tanzania (Cornell/ERB survey)
Côte d'Ivoire				D	D
Tanzania (HRD survey)				D	D
Guinea					
Madagascar					
Tanzania (Cornell/ERB survey)					

Table F4b: Cross-country comparison of extended Gini coefficients for all non-petroleum excises

	Côte d'Ivoire	Tanzania (HRD survey)	Guinea	Madagascar	Tanzania (Cornell/ERB survey)
Côte d'Ivoire		D	D	D	D
Tanzania (HRD survey)				D	D
Guinea				D	D
Madagascar					
Tanzania (Cornell/ERB survey)					

Source: Government of Côte d'Ivoire (1985); Government of Guinea (1993/94); Government of Madagascar (1993); Economic Research Bureau, University of Dar es Salaam and Cornell University (1991).

Table F4a: Cross-country dominance test results for gasoline

	Côte d'Ivoire	Guinea	Tanzania (HRD survey)	Madagascar
Côte d'Ivoire		D	D	D
Guinea				
Tanzania (HRD survey)				
Madagascar				

Table F5b: Cross-country comparison of extended Gini coefficients for gasoline

	Côte d'Ivoire	Guinea	Tanzania (HRD survey)	Madagascar
Côte d'Ivoire		D	D	D
Guinea			D	D
Tanzania (HRD survey)				
Madagascar				

Source: Government of Côte d'Ivoire (1985); Government of Guinea (1993/94); Government of Madagascar (1993); Government of Tanzania (1995).

Table F6a: Cross-country dominance test results for gasoline and public transportation

	Côte d'Ivoire	Tanzania (HRD survey)	Guinea	Madagascar
Côte d'Ivoire		D	D	D
Tanzania (HRD survey)				
Guinea				X
Madagascar			X	

Table F6b: Cross-country comparison of extended Gini coefficients for gasoline and public transportation

	Côte d'Ivoire	Tanzania (Cornell/ERB survey	Tanzania (HRD survey)	Guinea	Madagascar
Côte d'Ivoire				D	D
Tanzania (Cornell/ERB survey)					
Tanzania (HRD survey)					D
Guinea					X
Madagascar				X	

Source: Government of Côte d'Ivoire (1985); Government of Guinea (1993/94); Government of Madagascar (1993); Government of Tanzania (1995).

Table F7a: Cross-country dominance test results for Kerosene

	Madagascar	Tanzania (Cornell/ERB survey)	Guinea	Côte d'Ivoire	Tanzania (HRD survey)
Madagascar				X	D
Tanzania (Cornell/ERB survey)					
Guinea				X	
Côte d'Ivoire	X		X		
Tanzania (HRD survey)					

Table F7b: Cross-country comparison of extended Gini coefficients for kerosene

	Madagascar	Tanzania (Cornell/ERB survey)	Guinea	Côte d'Ivoire	Tanzania (HRD survey)
Madagascar					D
Tanzania (Cornell/ERB survey)					
Guinea					D
Côte d'Ivoire					
Tanzania (HRD survey)					

Source: Government of Côte d'Ivoire (1985); Government of Guinea (1993/94); Government of Madagascar (1993); Government of Tanzania (1995); Economic Research Bureau, University of Dar es Salaam and Cornell University (1991).

Table F8a: Cross-country dominance test results for wages taxes

	Tanzania (Cornell/ERB survey)	Côte d'Ivoire	Guinea	Madagascar
Tanzania (Cornell/ERB survey)				
Côte d'Ivoire				
Guinea				
Madagascar				

Table F8b: Cross-country comparison of extended Gini coefficients for wage taxes

	Tanzania (Cornel/ERB survey)	Côte d'Ivoire	Guinea	Madagascar
Tanzania (Cornell/ERB survey)				
Côte d'Ivoire				D
Guinea				
Madagascar				

Source: Government of Côte d'Ivoire, 1985; Government of Guinea, 1993/94; Government of Madagascar, 1993; University of Dar es Salaam and Cornell University, 1991.

Figure 1: Concentration curves for health and education in Cote d'Ivoire

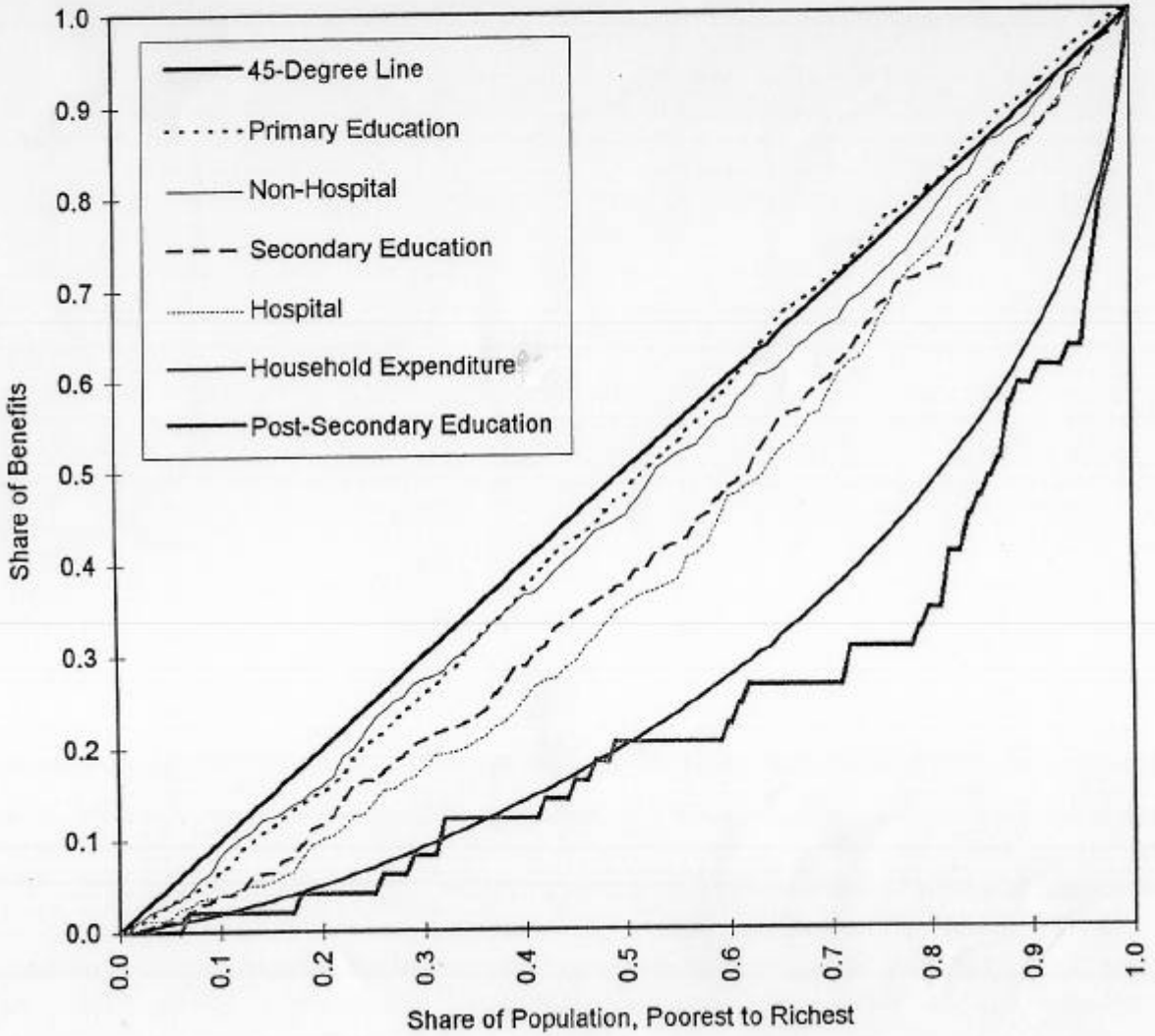
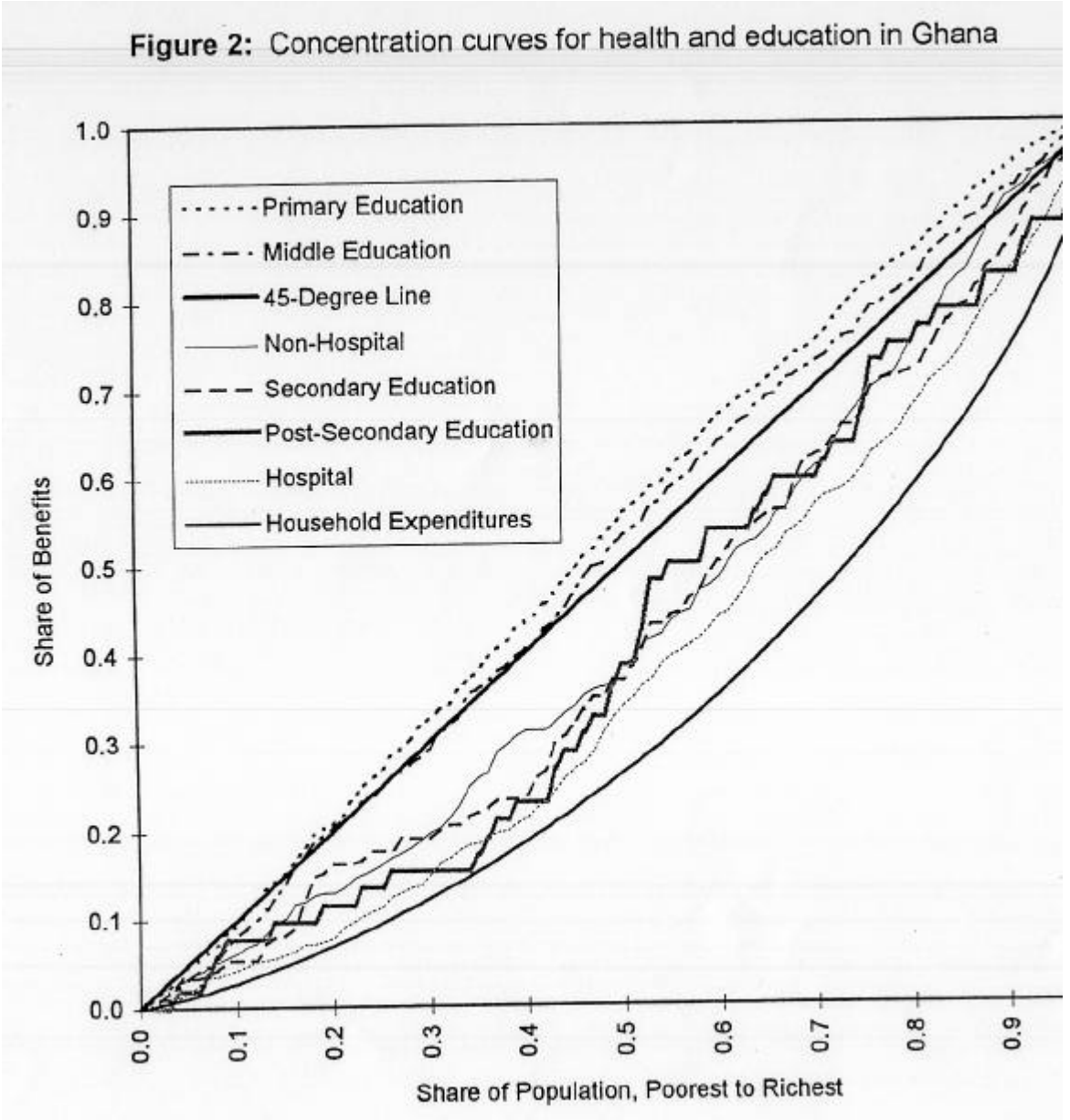


Figure 2: Concentration curves for health and education in Ghana



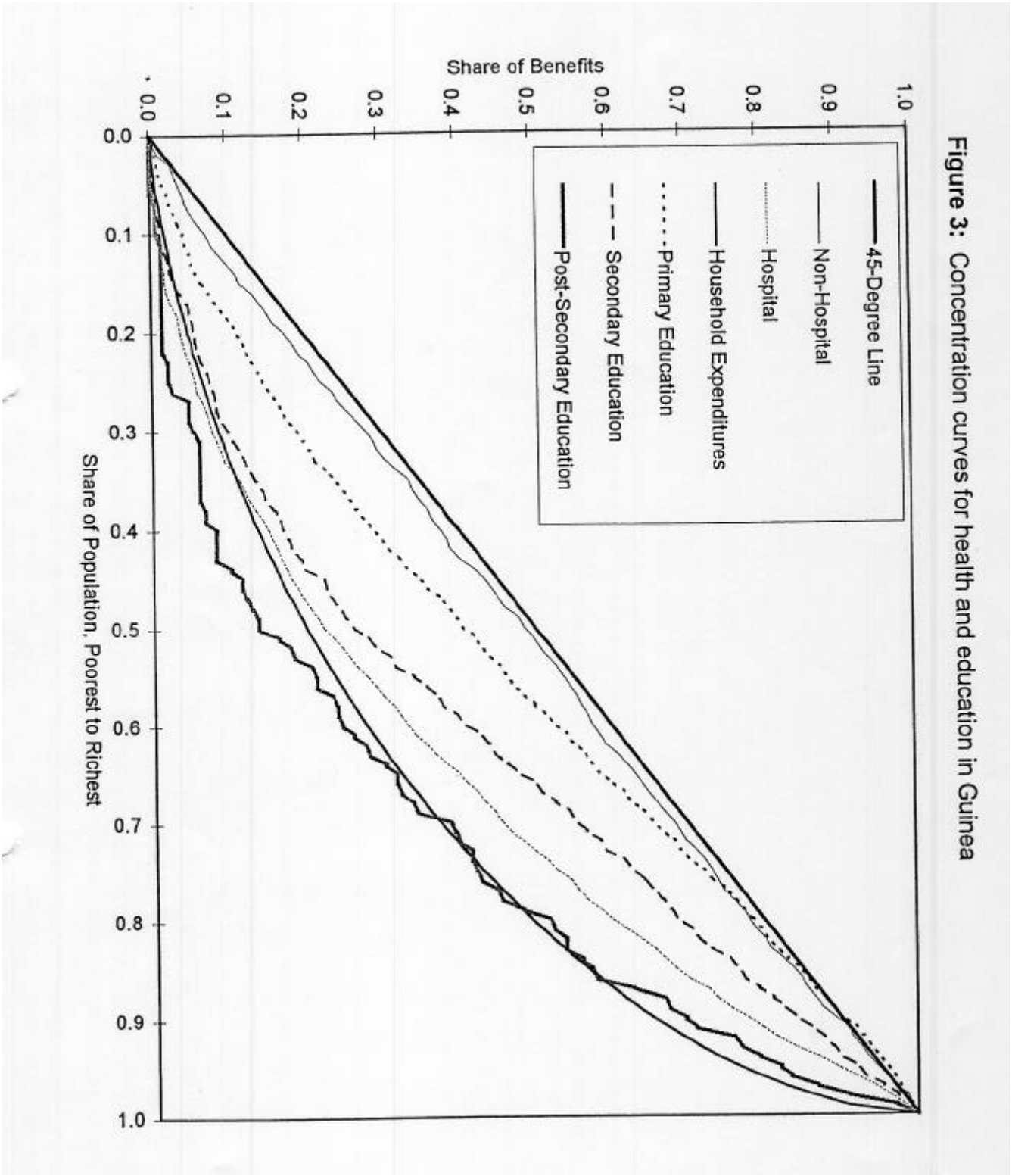


Figure 3: Concentration curves for health and education in Guinea

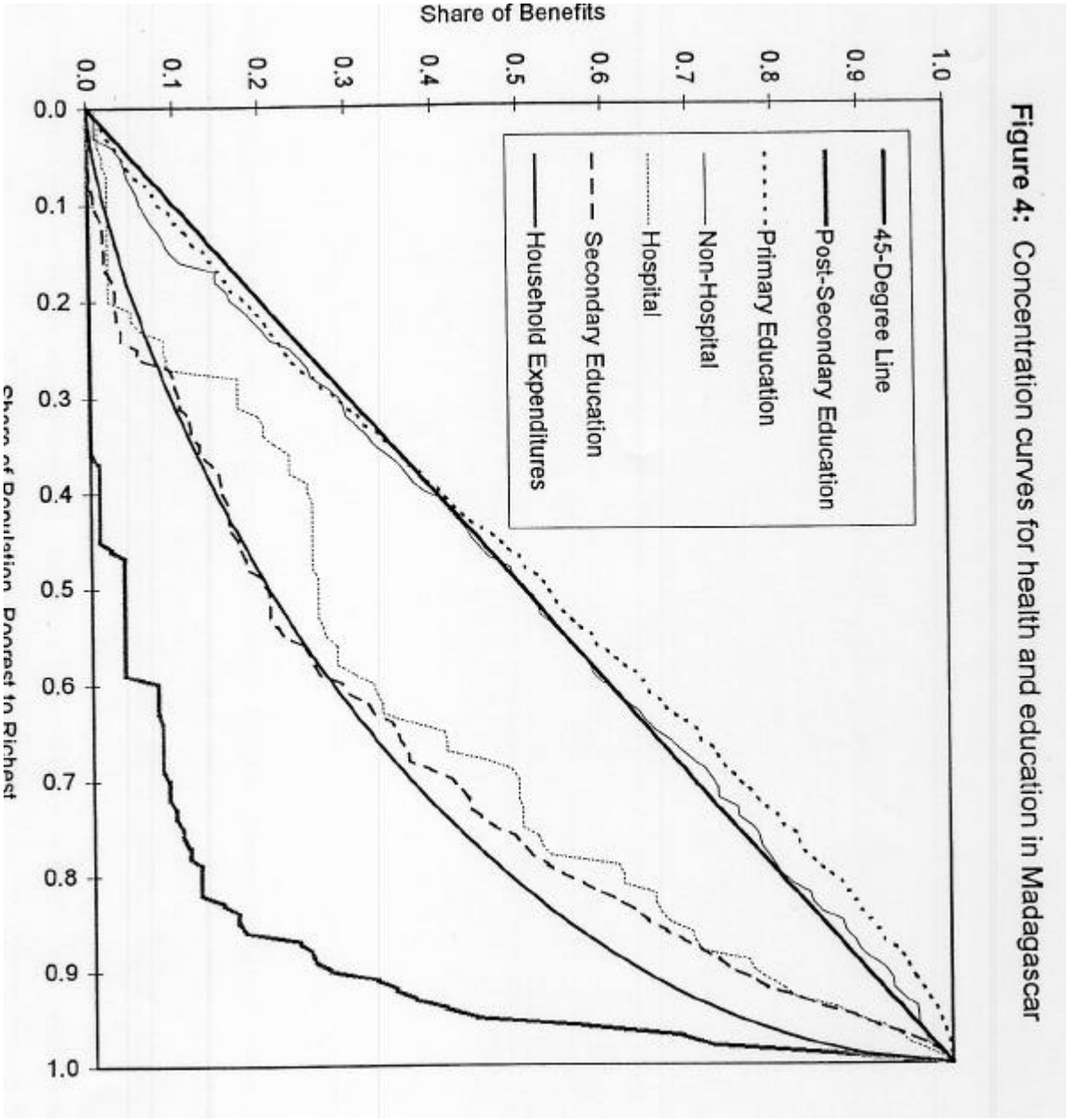


Figure 4: Concentration curves for health and education in Madagascar

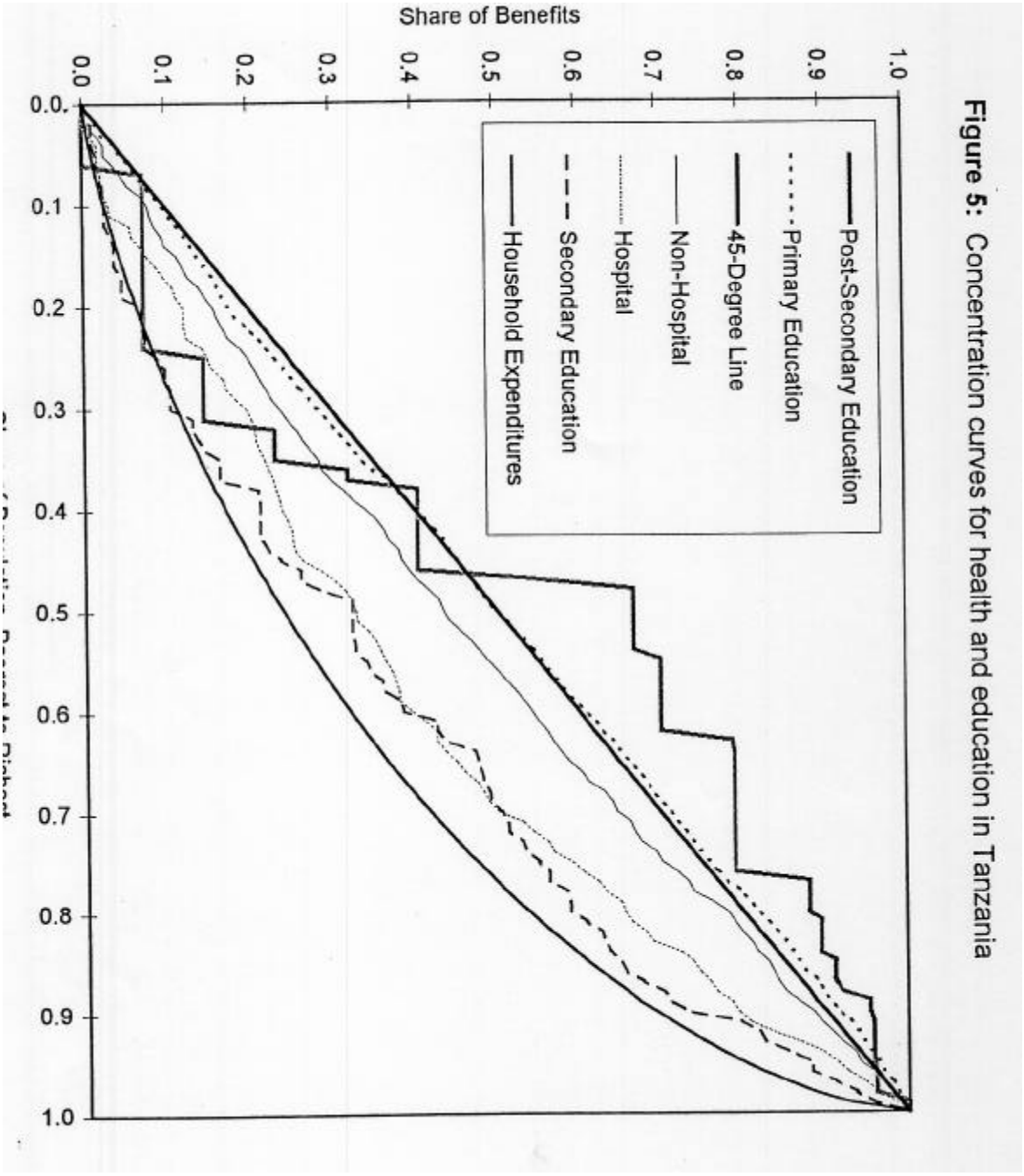
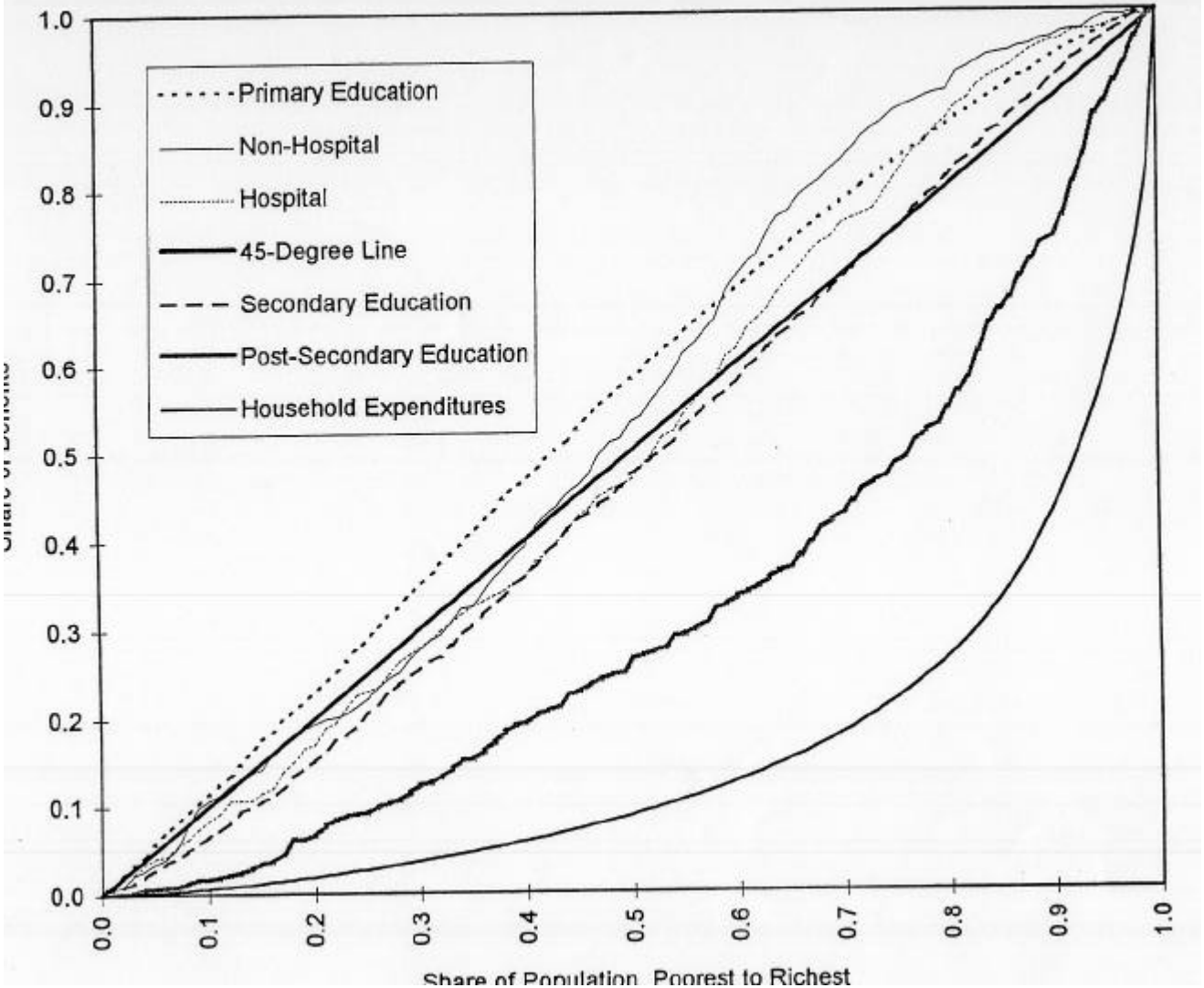
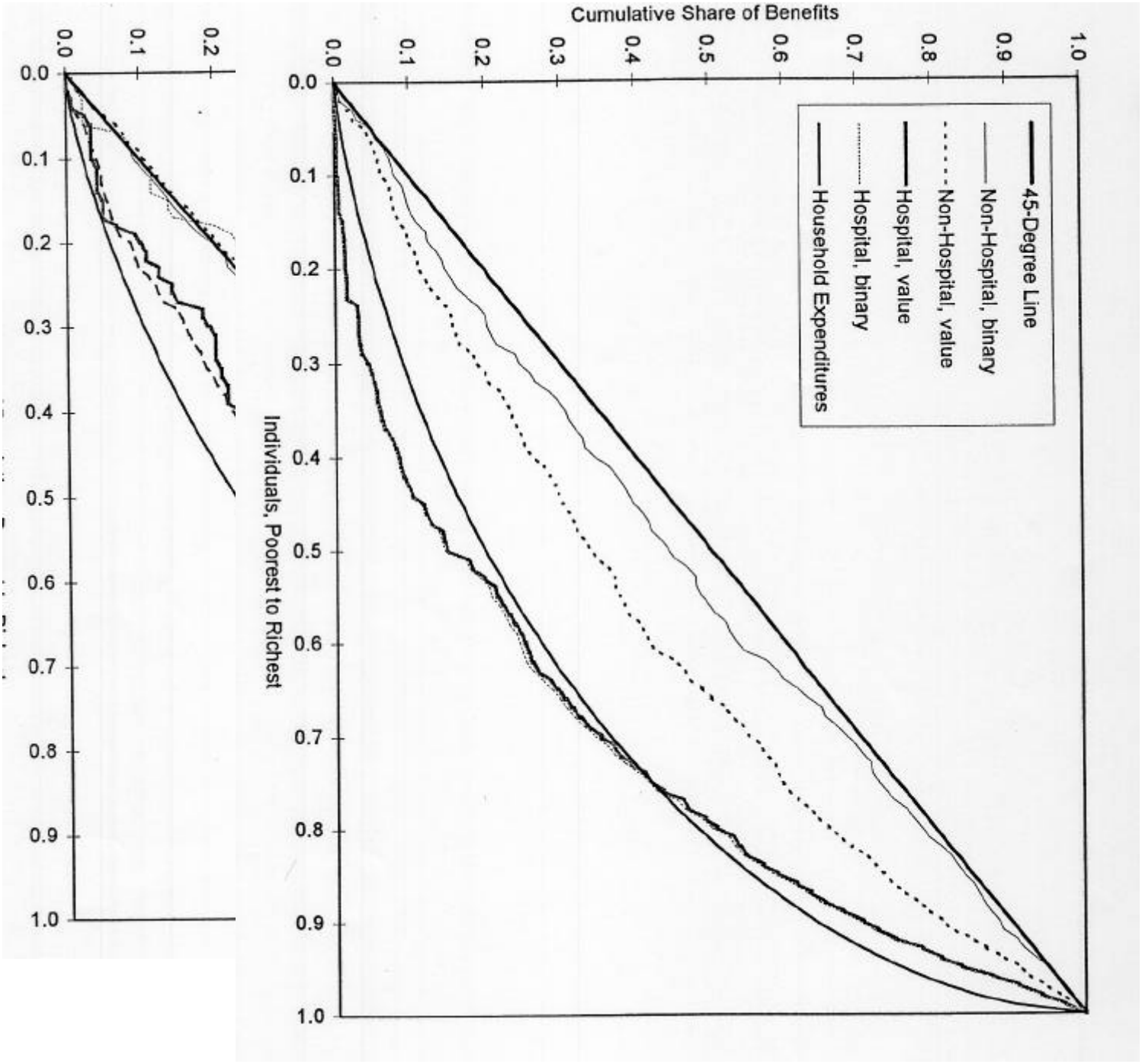


Figure 5: Concentration curves for health and education in Tanzania

Figure 6: Concentration curves for health and education in South Africa




Cumulative Share of Benefits
Individuals, Poorest to Richest
45-Degree Line
Non-Hospital, binary
Non-Hospital, value
Hospital, value
Hospital, binary
Household Expenditures

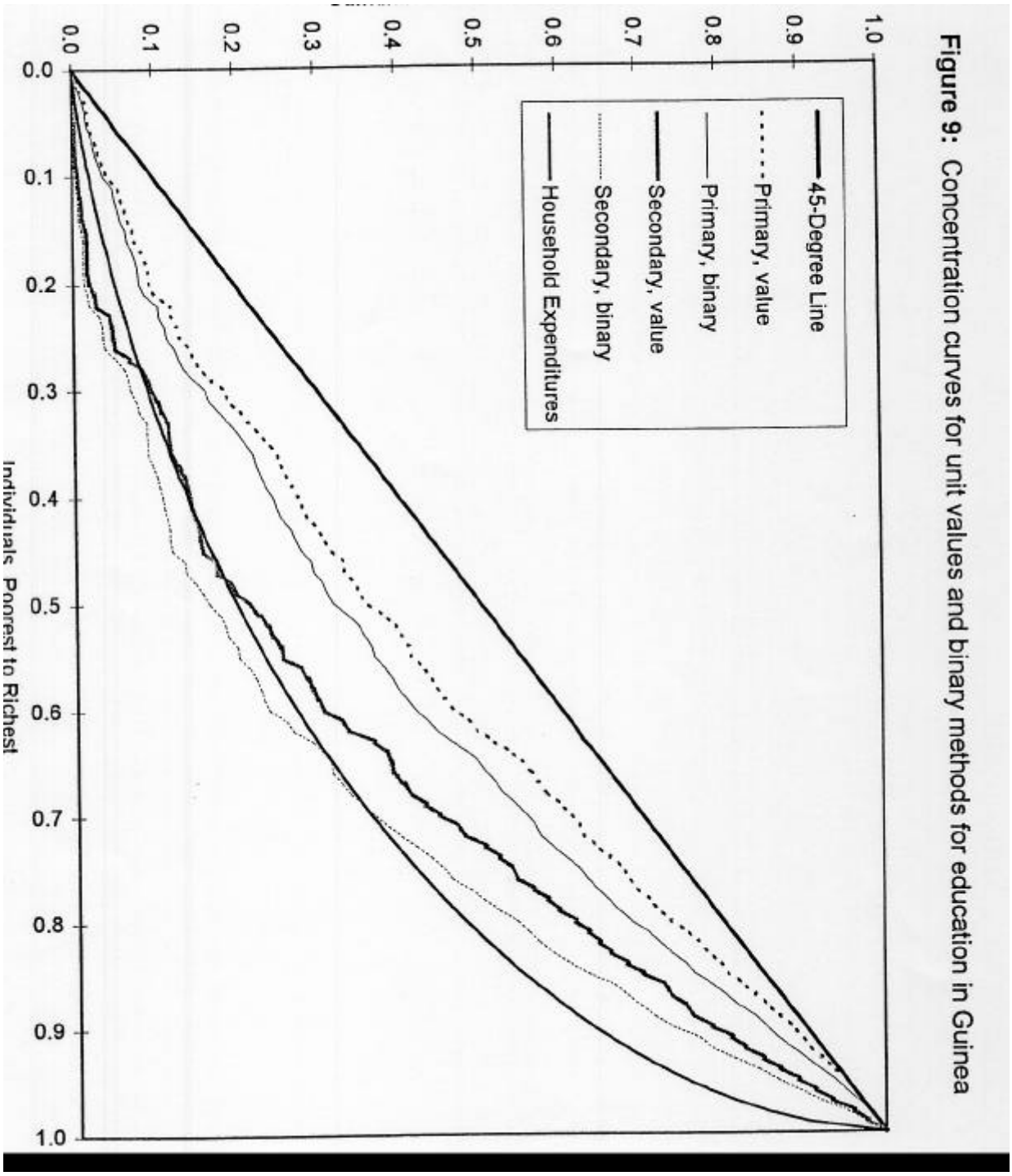


Figure 9: Concentration curves for unit values and binary methods for education in Guinea

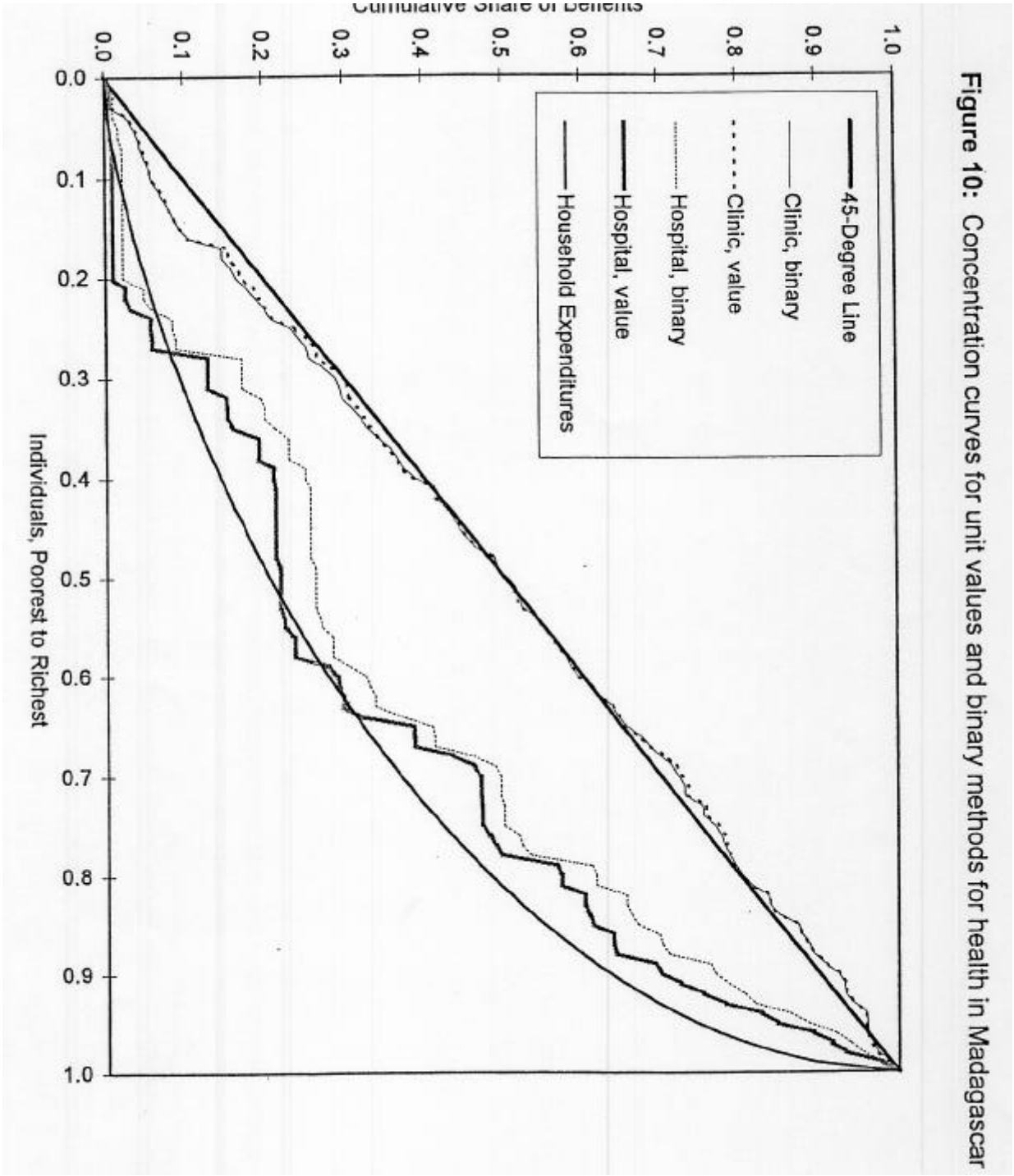


Figure 10: Concentration curves for unit values and binary methods for health in Madagascar

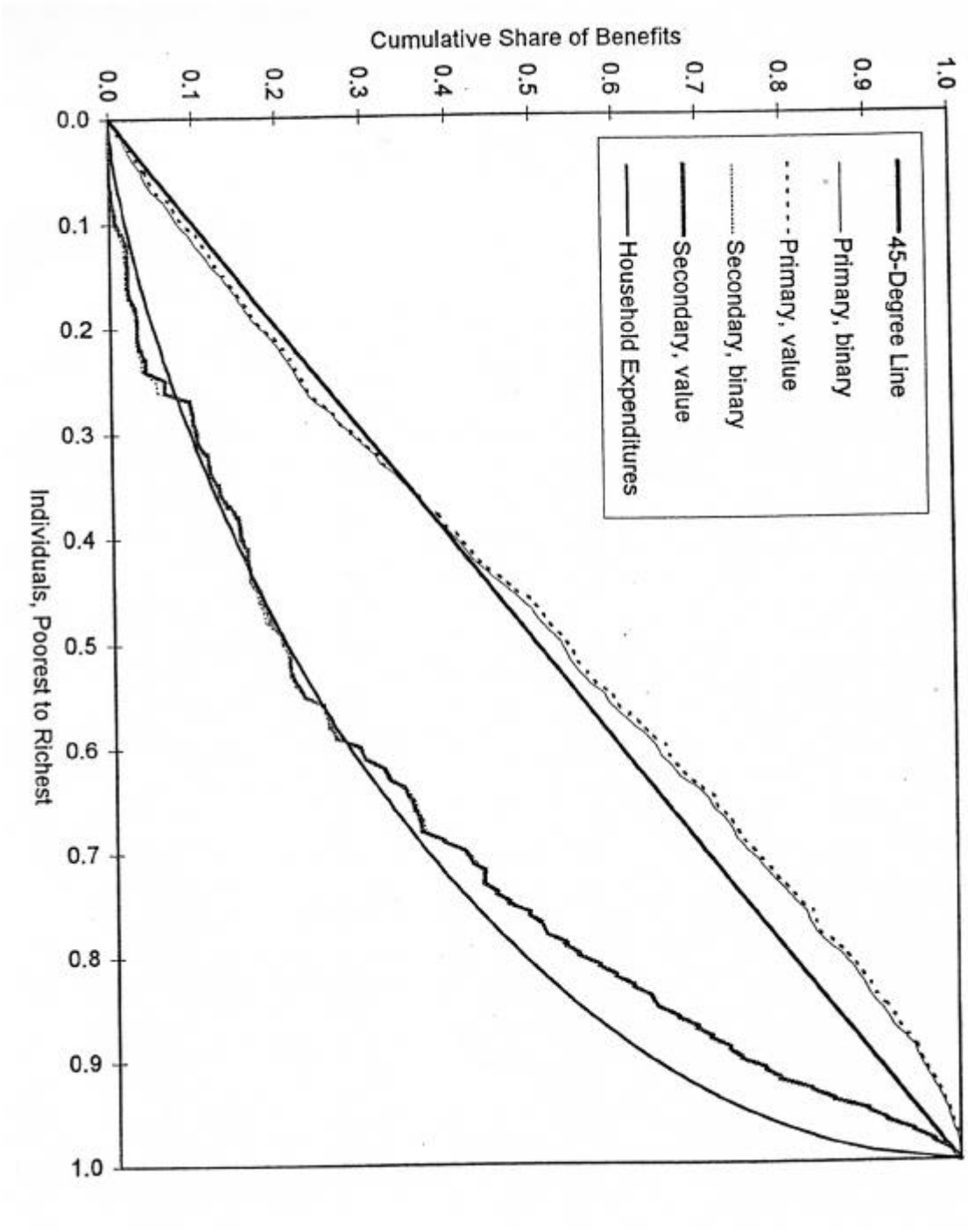


Figure 11: Concentration curves for unit values and binary methods for education in Madagascar

Figure 12: Concentration curves for unit values and binary methods for health in South Africa

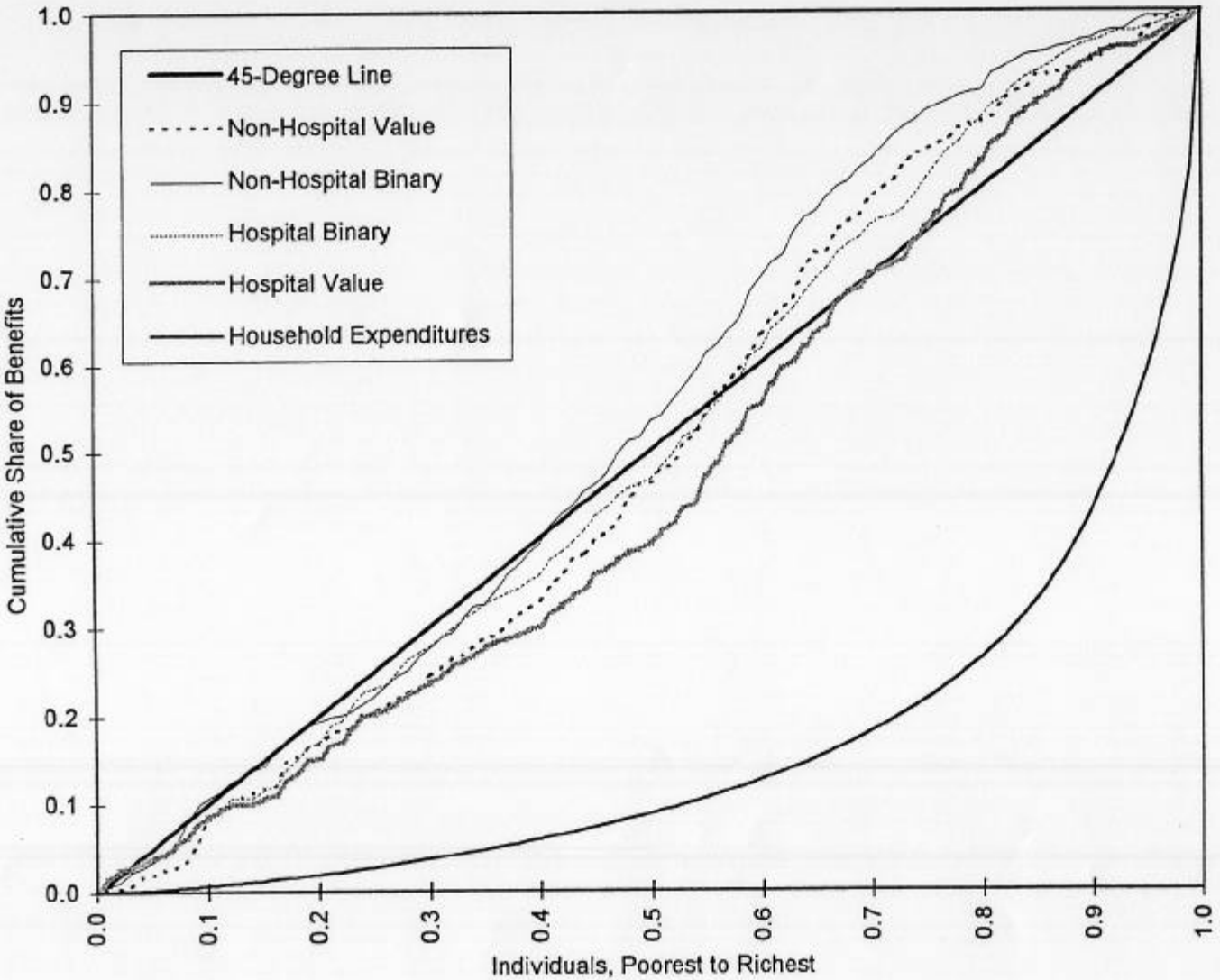
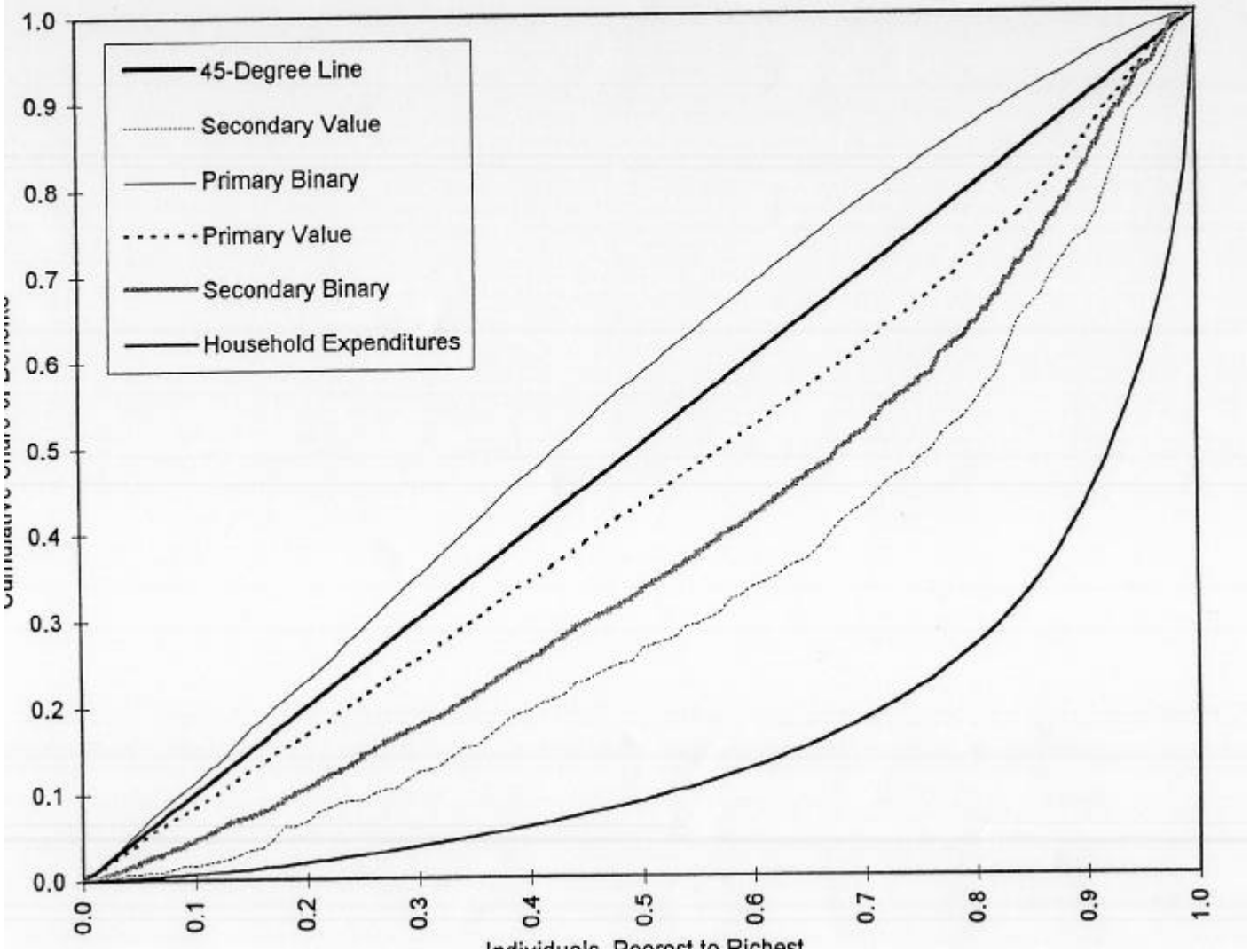


Figure 13: Concentration curves for unit values and binary methods for education in South Africa



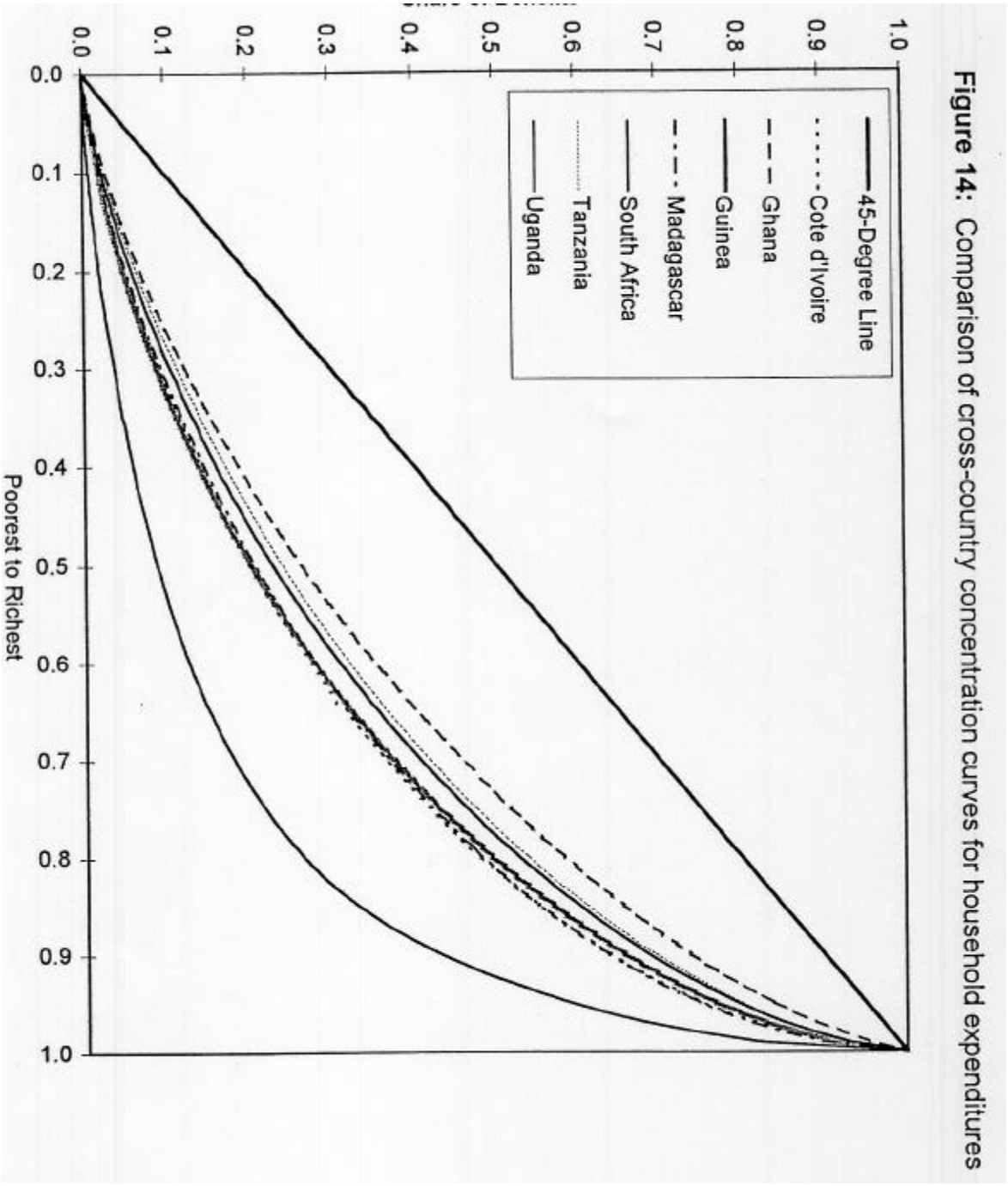
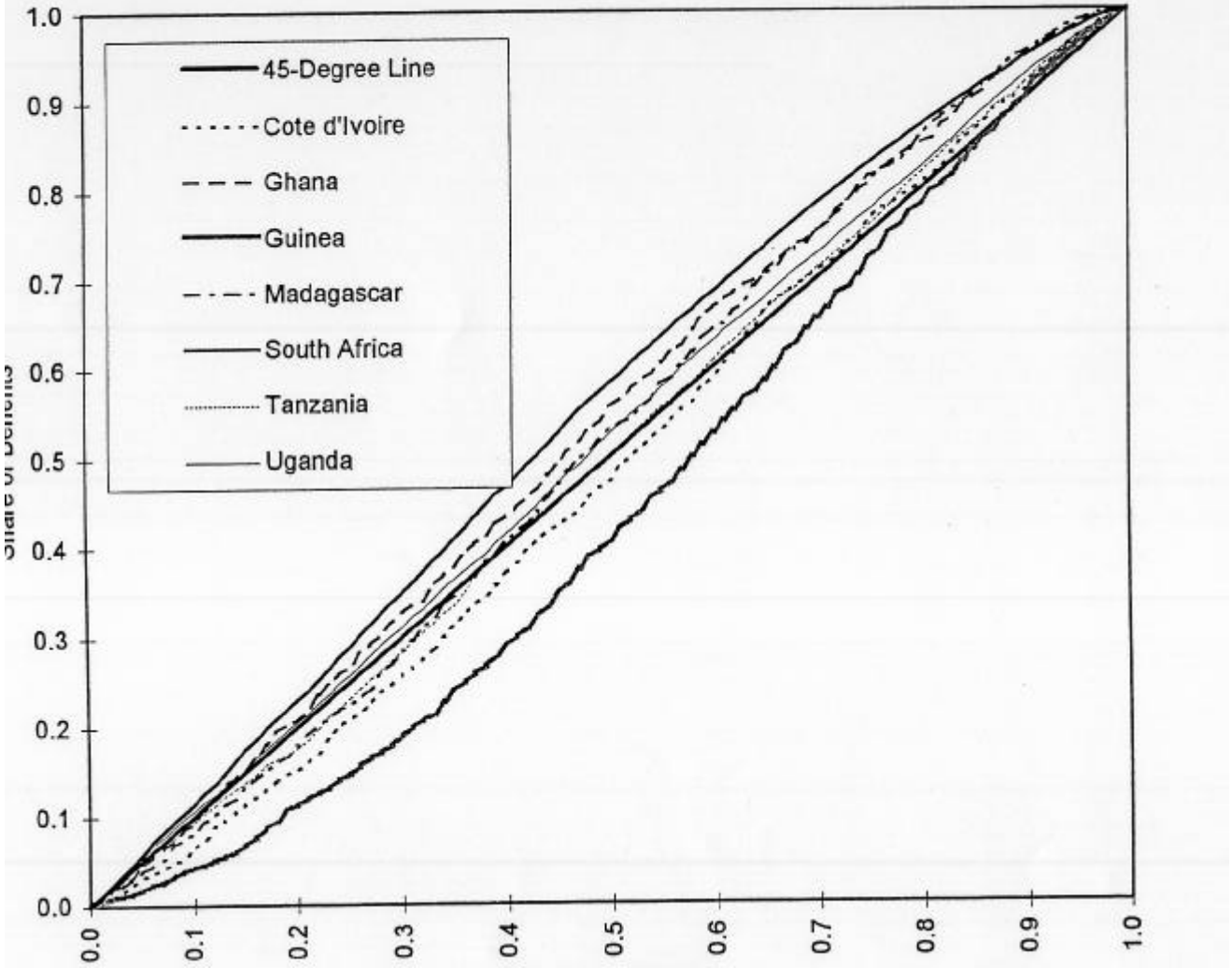


Figure 14: Comparison of cross-country concentration curves for household expenditures

Figure 15: Comparison of cross-country concentration curves for primary education



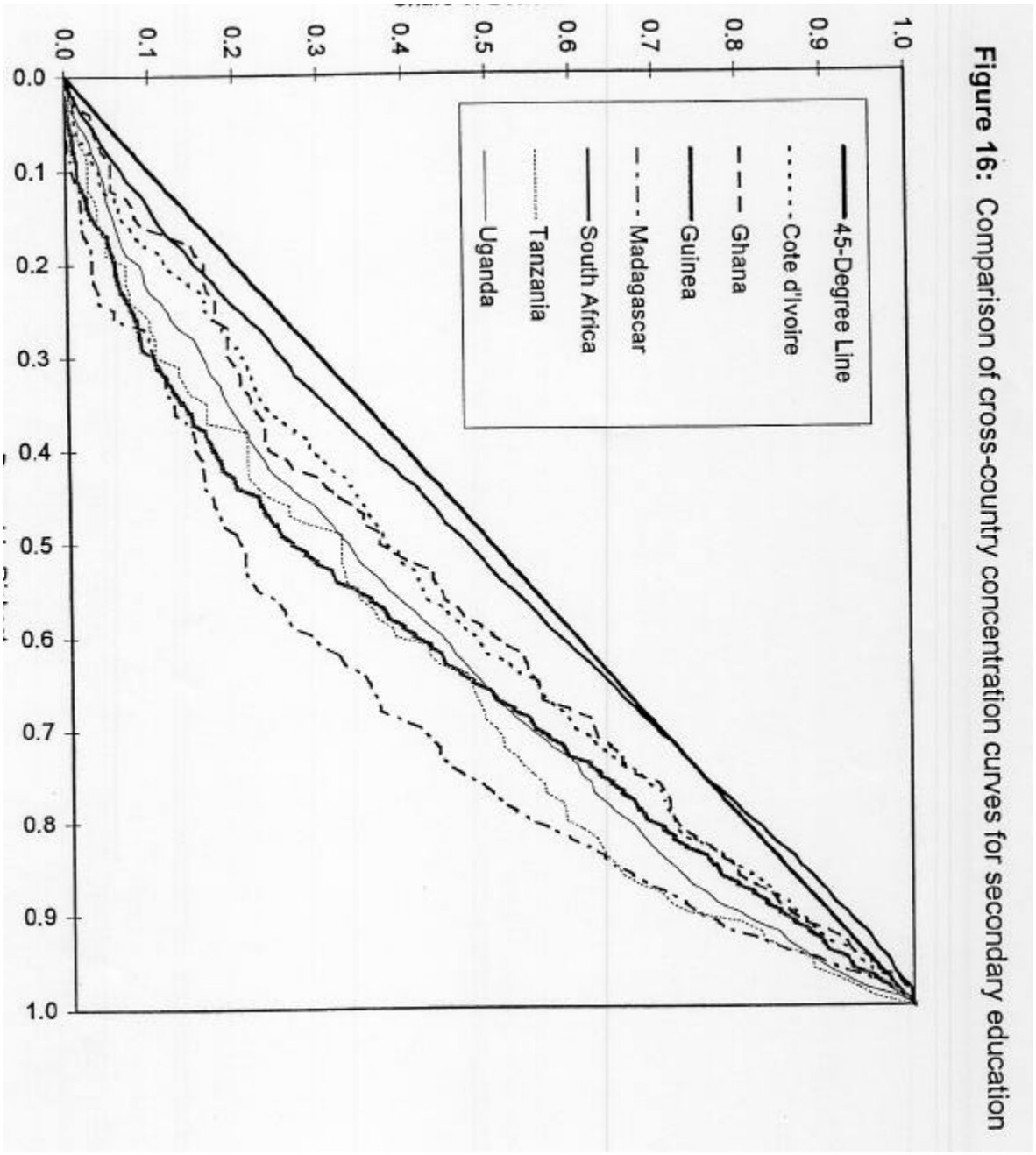


Figure 16: Comparison of cross-country concentration curves for secondary education

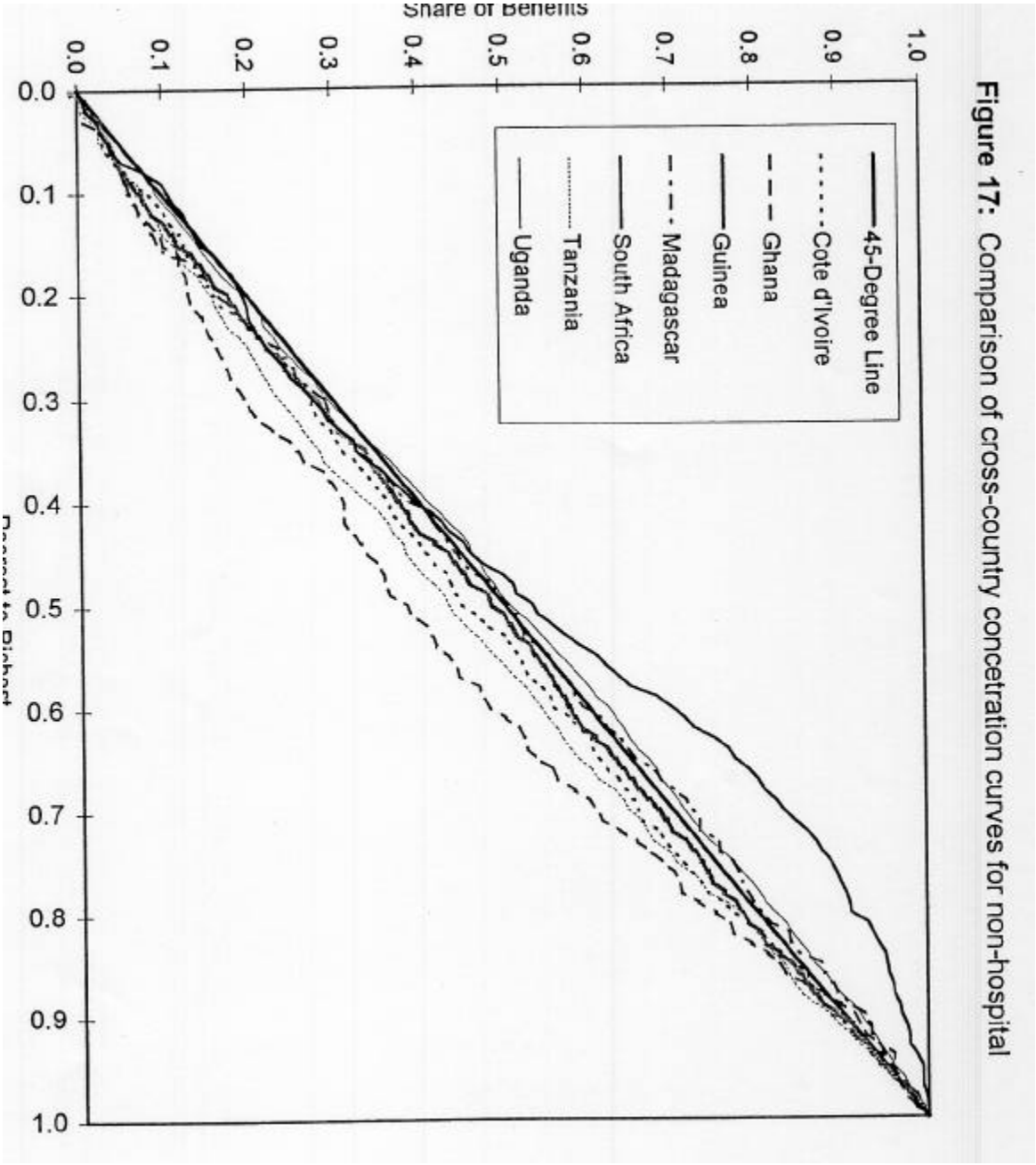


Figure 17: Comparison of cross-country concetration curves for non-hospital

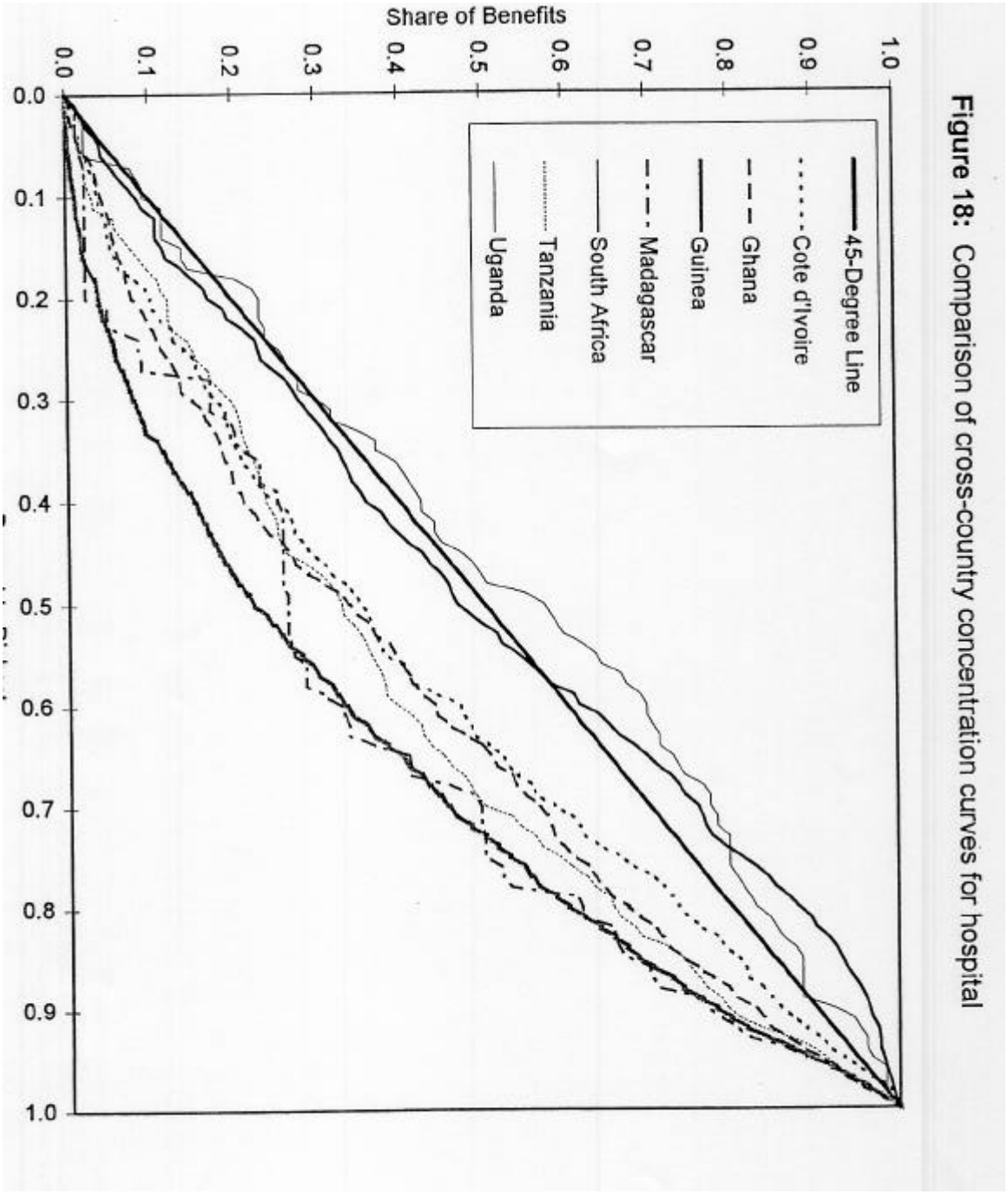


Figure 18: Comparison of cross-country concentration curves for hospital

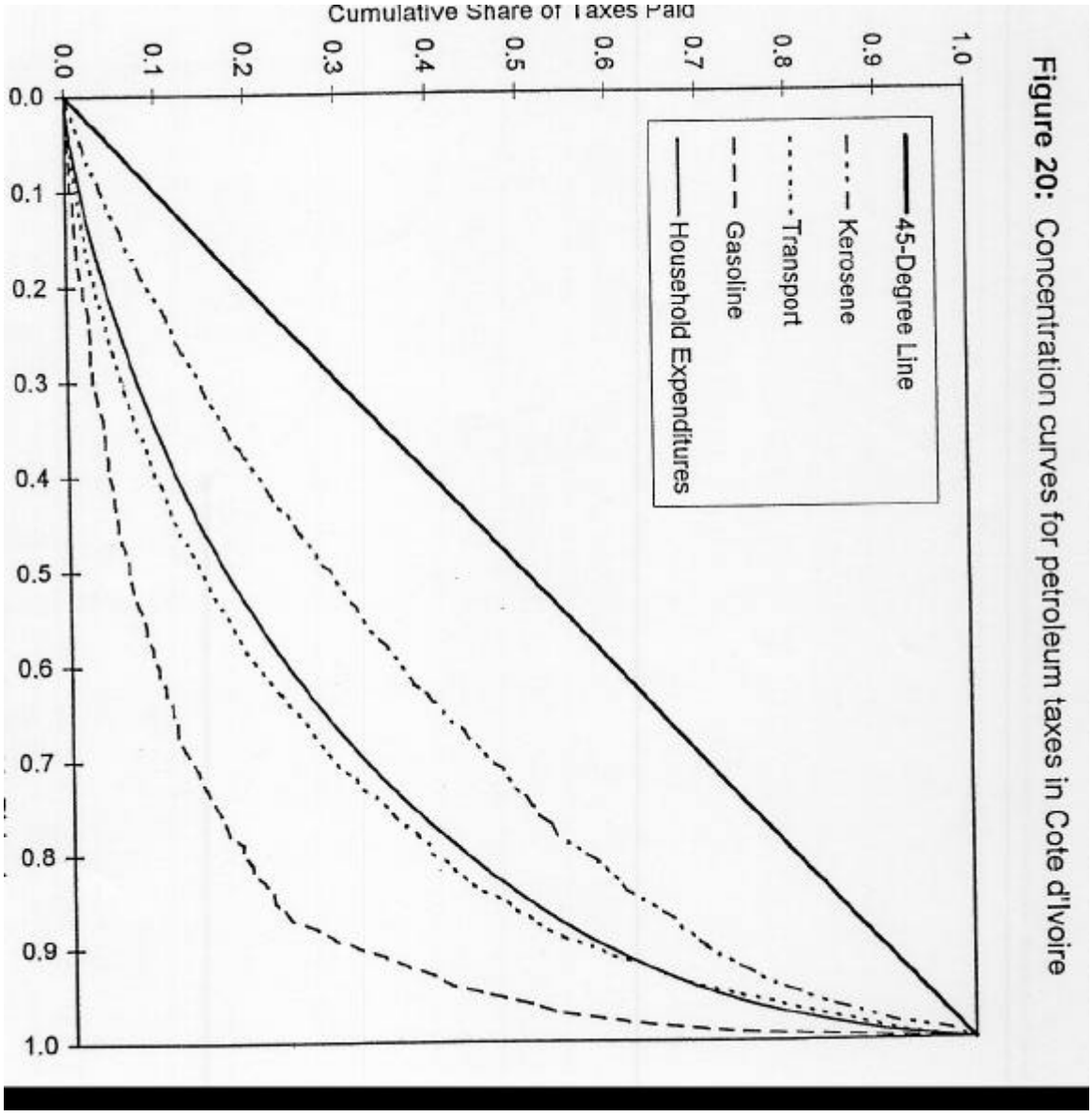


Figure 20: Concentration curves for petroleum taxes in Cote d'Ivoire

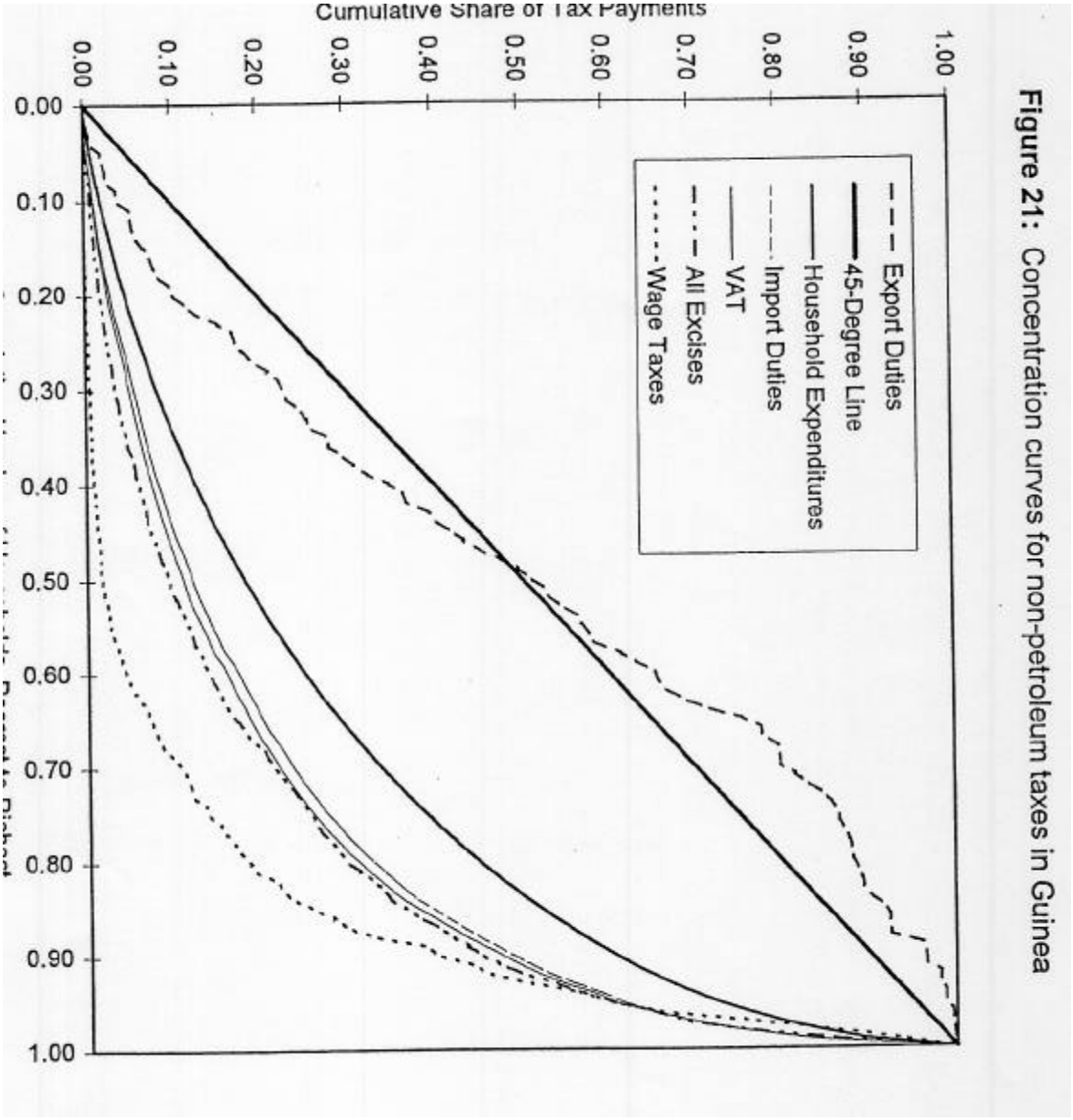


Figure 21: Concentration curves for non-petroleum taxes in Guinea

Figure 22: Concentration curves for petroleum taxes in Guinea

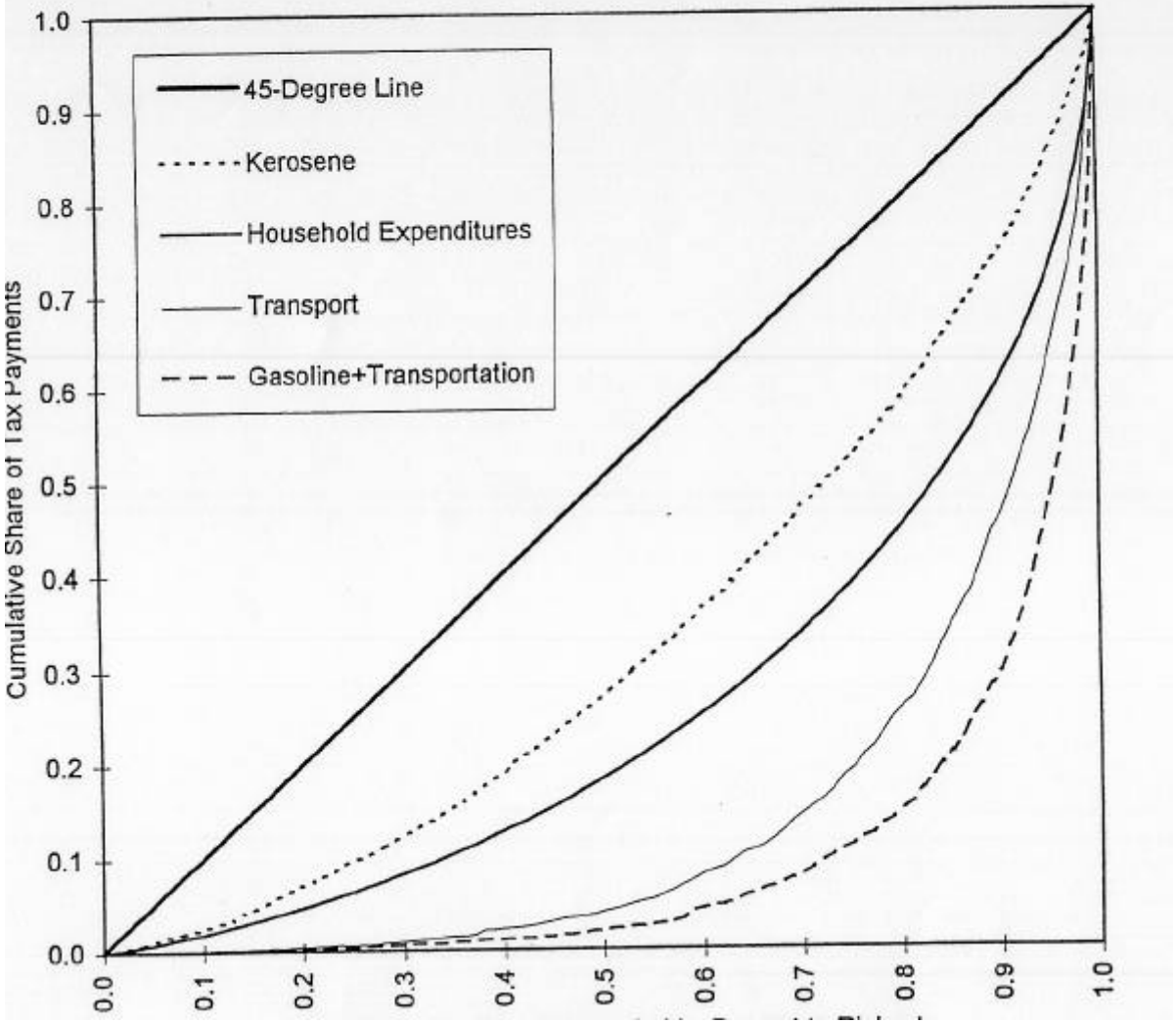


Figure 23: Concentration curves for non-petroleum taxes in Madagascar

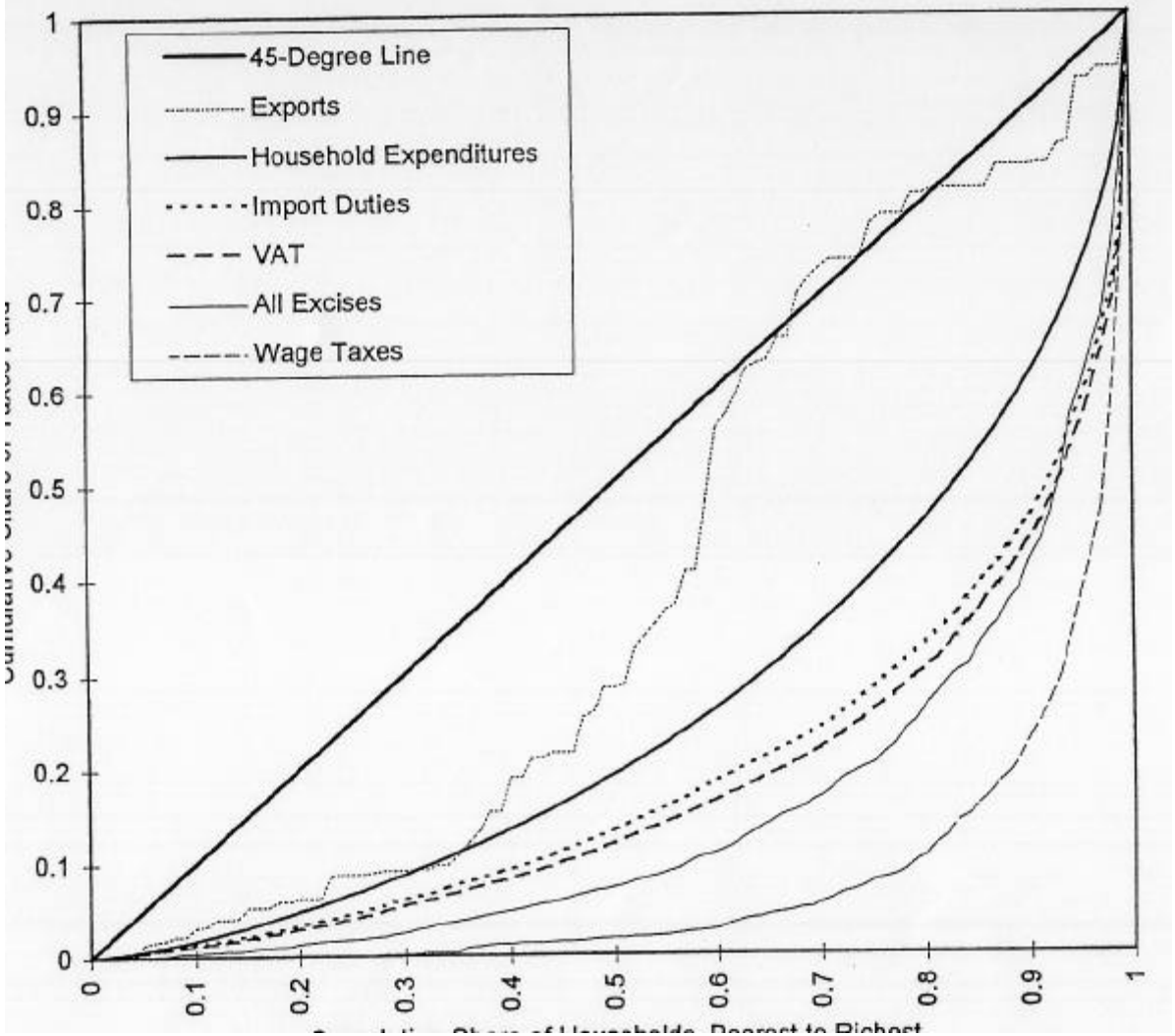
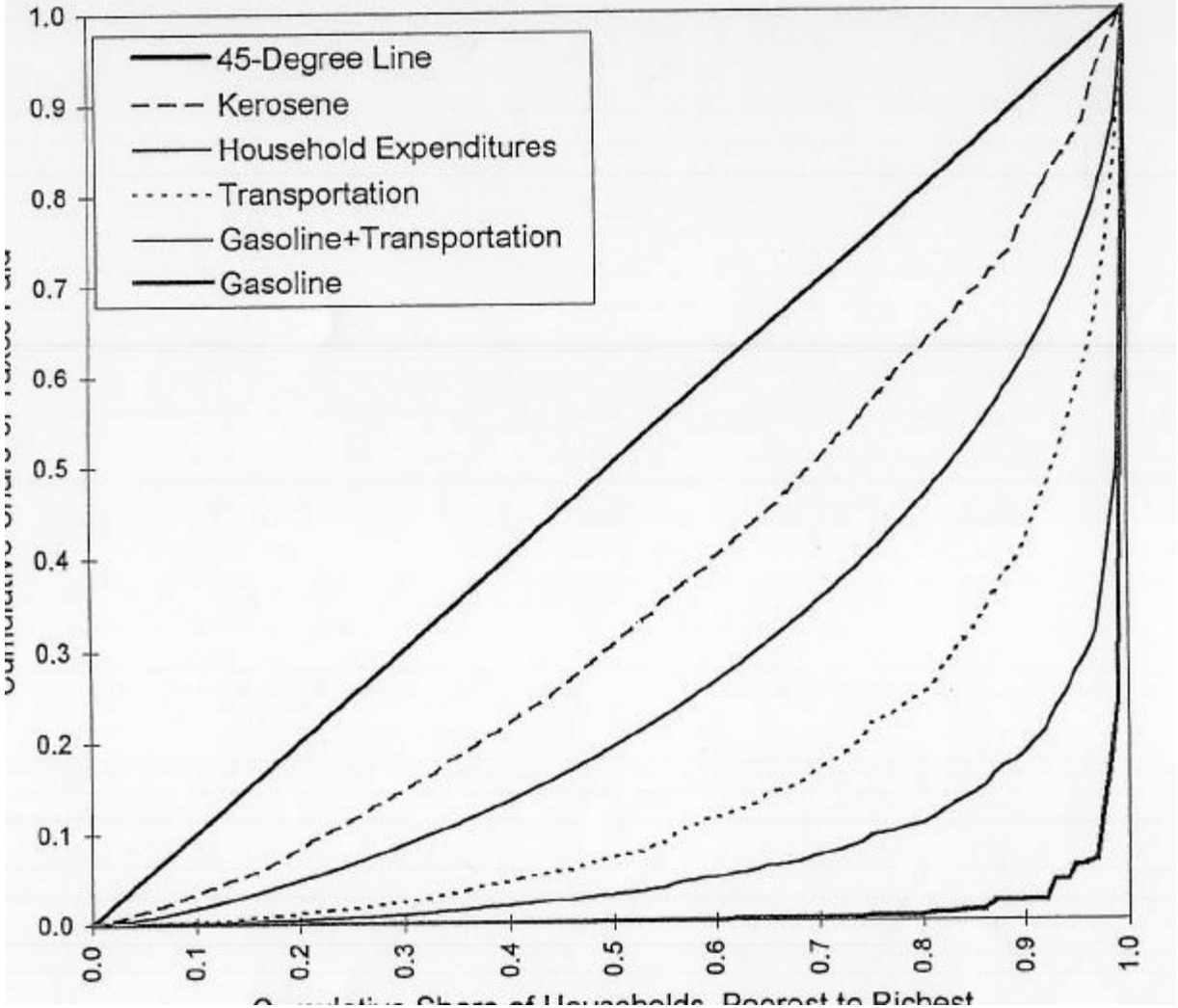


Figure 24: Concentration curves for petroleum taxes in Madagascar



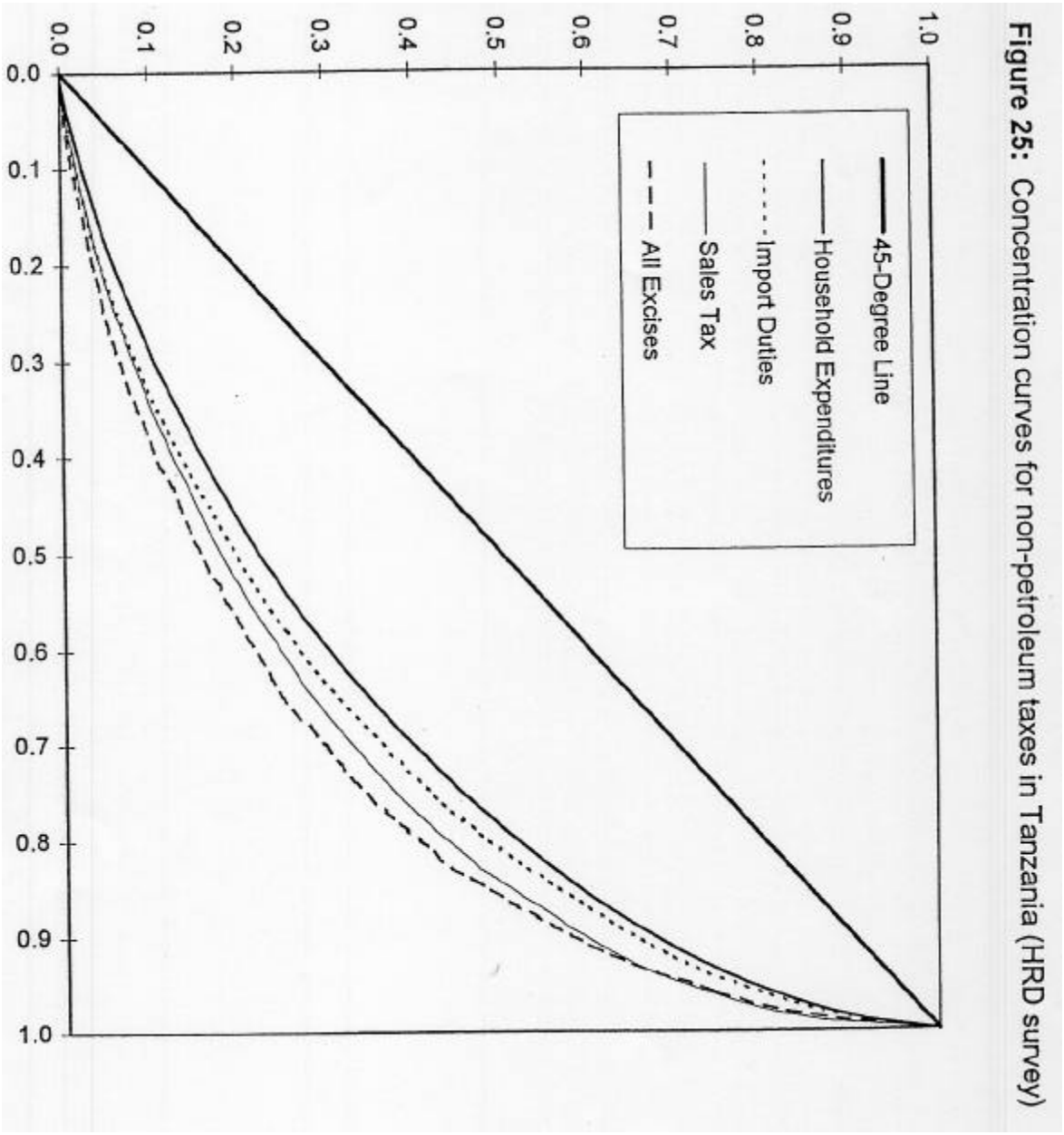


Figure 25: Concentration curves for non-petroleum taxes in Tanzania (HRD survey)

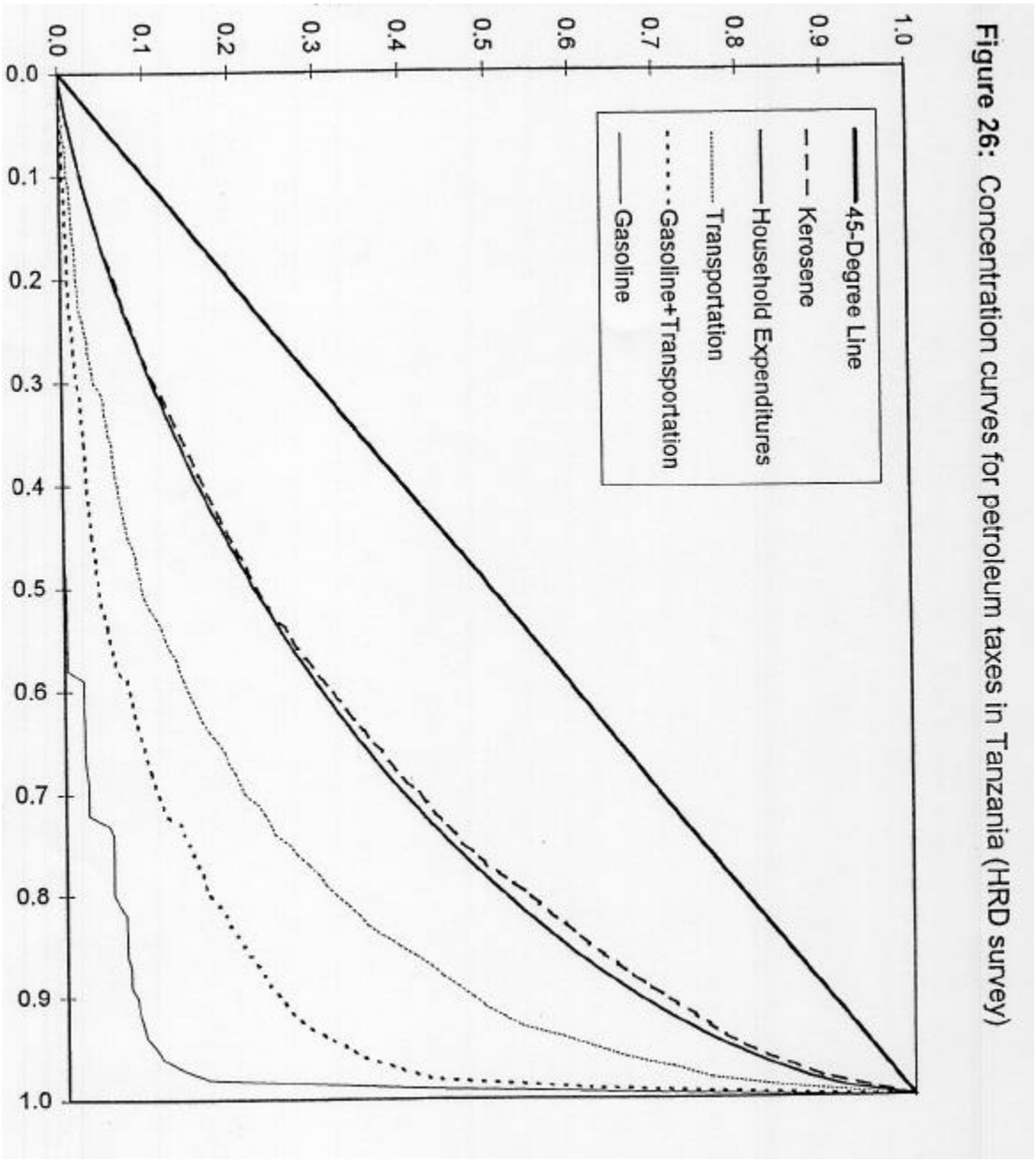


Figure 26: Concentration curves for petroleum taxes in Tanzania (HRD survey)

Figure 27: Concentration curves for non-petroleum taxes in Tanzania (ERB/CU survey)

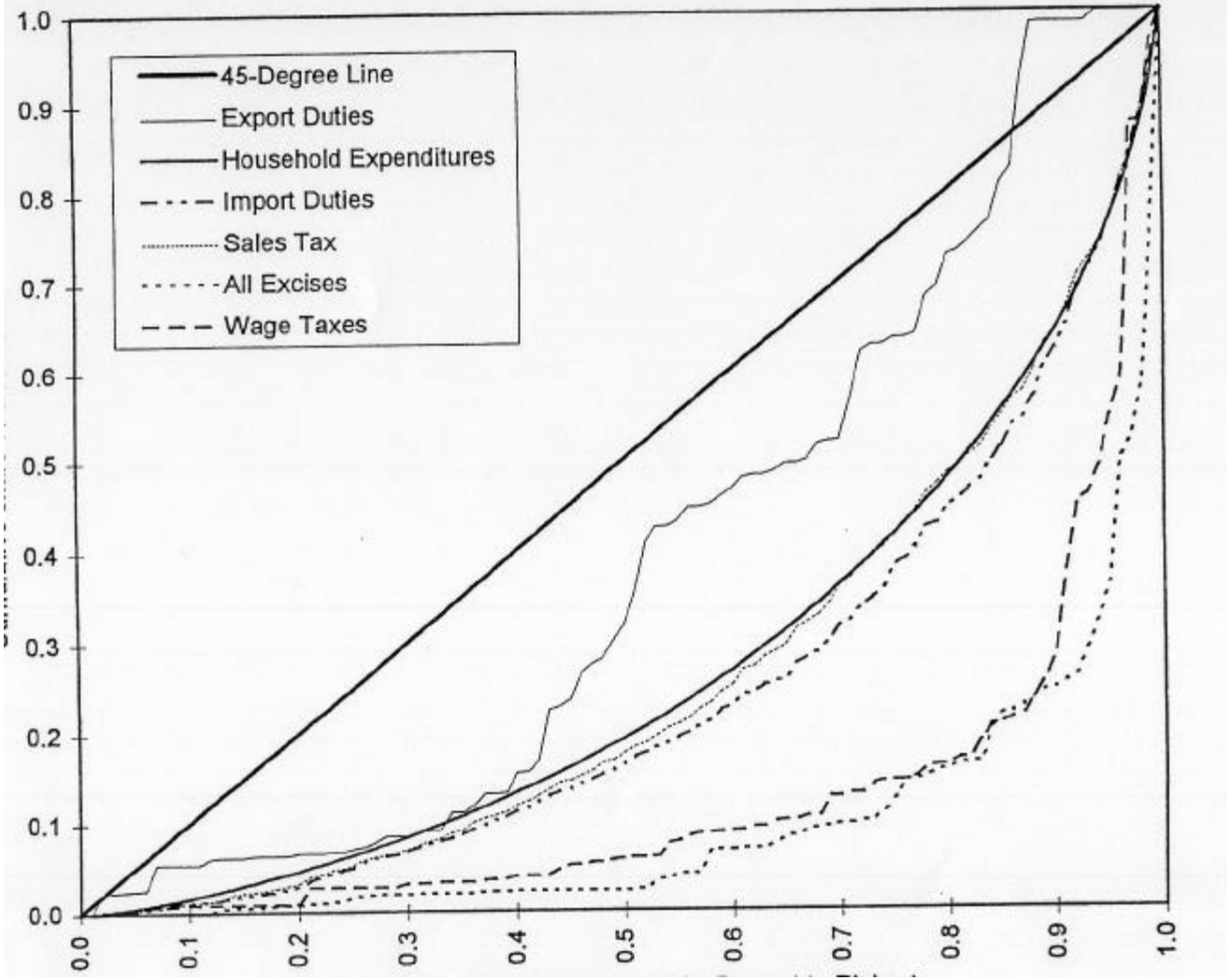
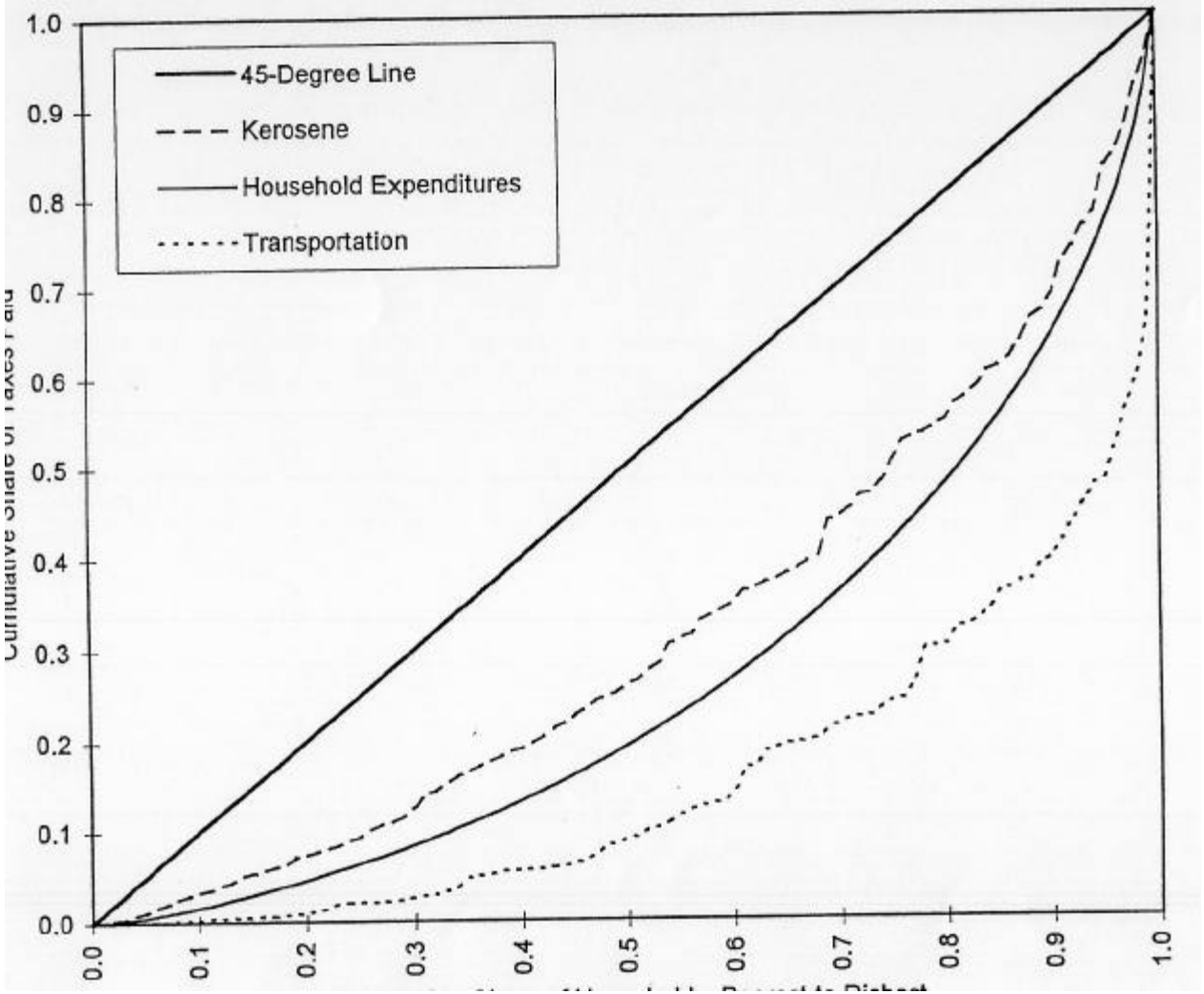


Figure 28: Concentration curves for petroleum taxes in Tanzania (ERB/CU survey)



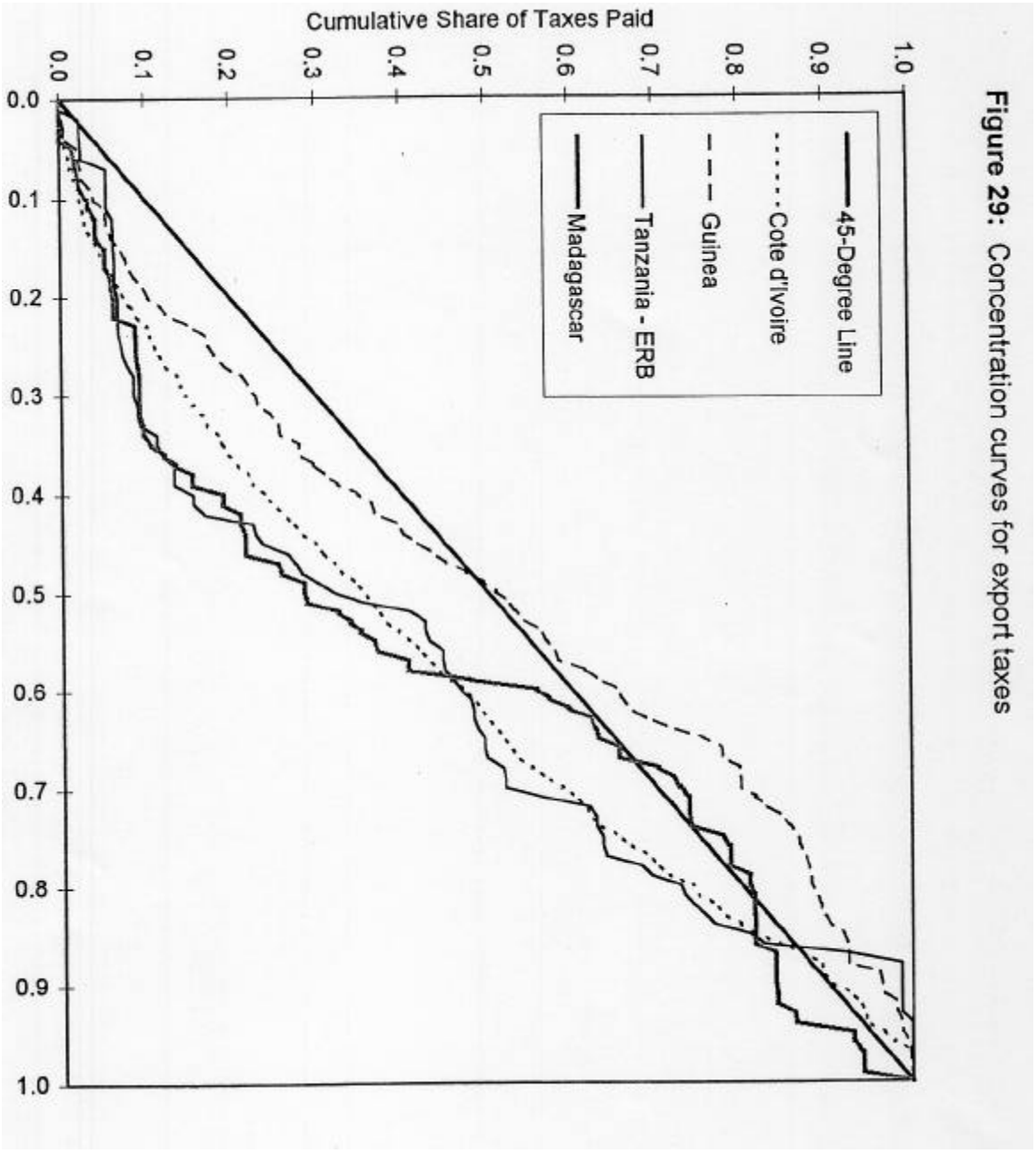


Figure 29: Concentration curves for export taxes

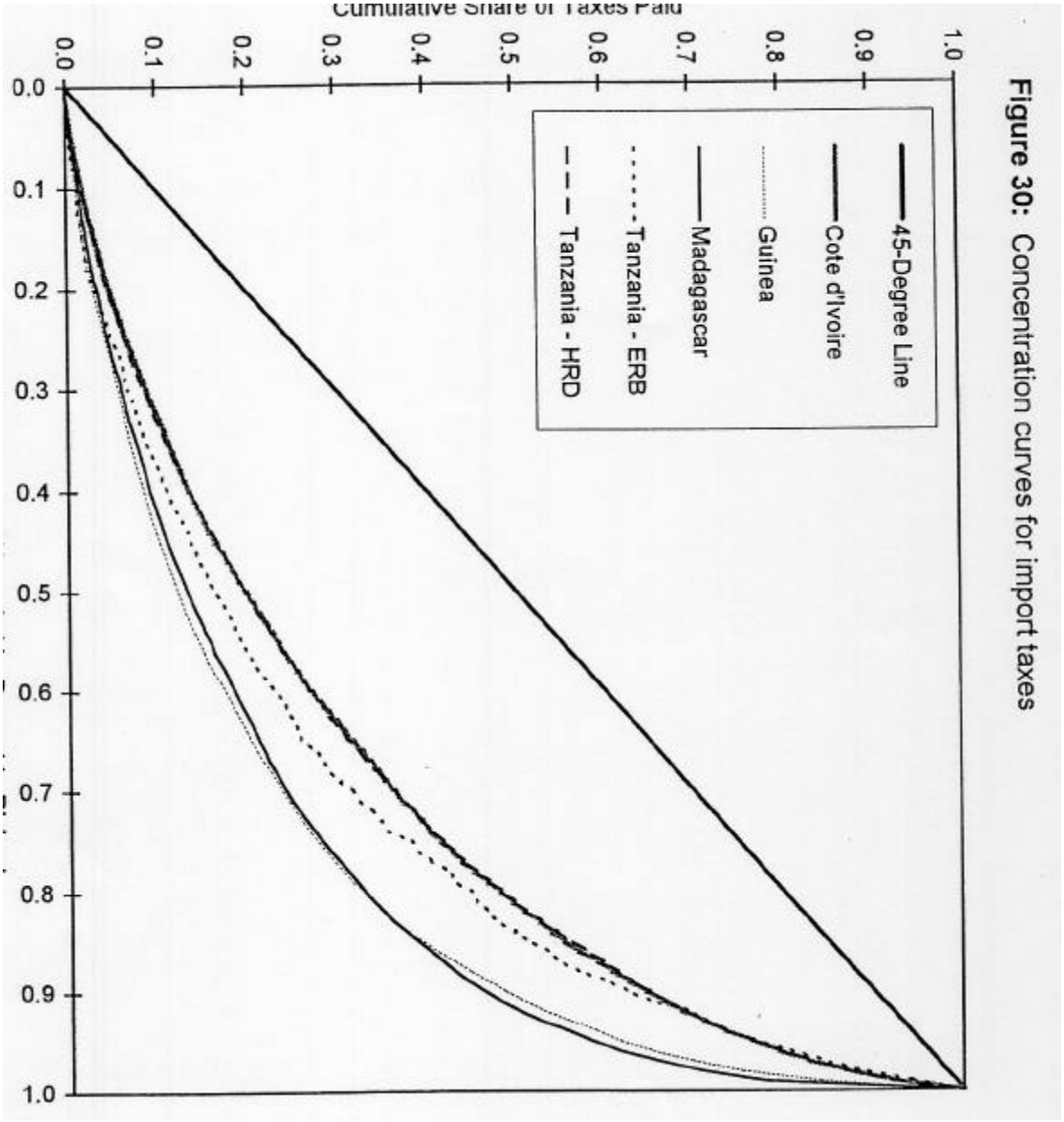


Figure 30: Concentration curves for import taxes

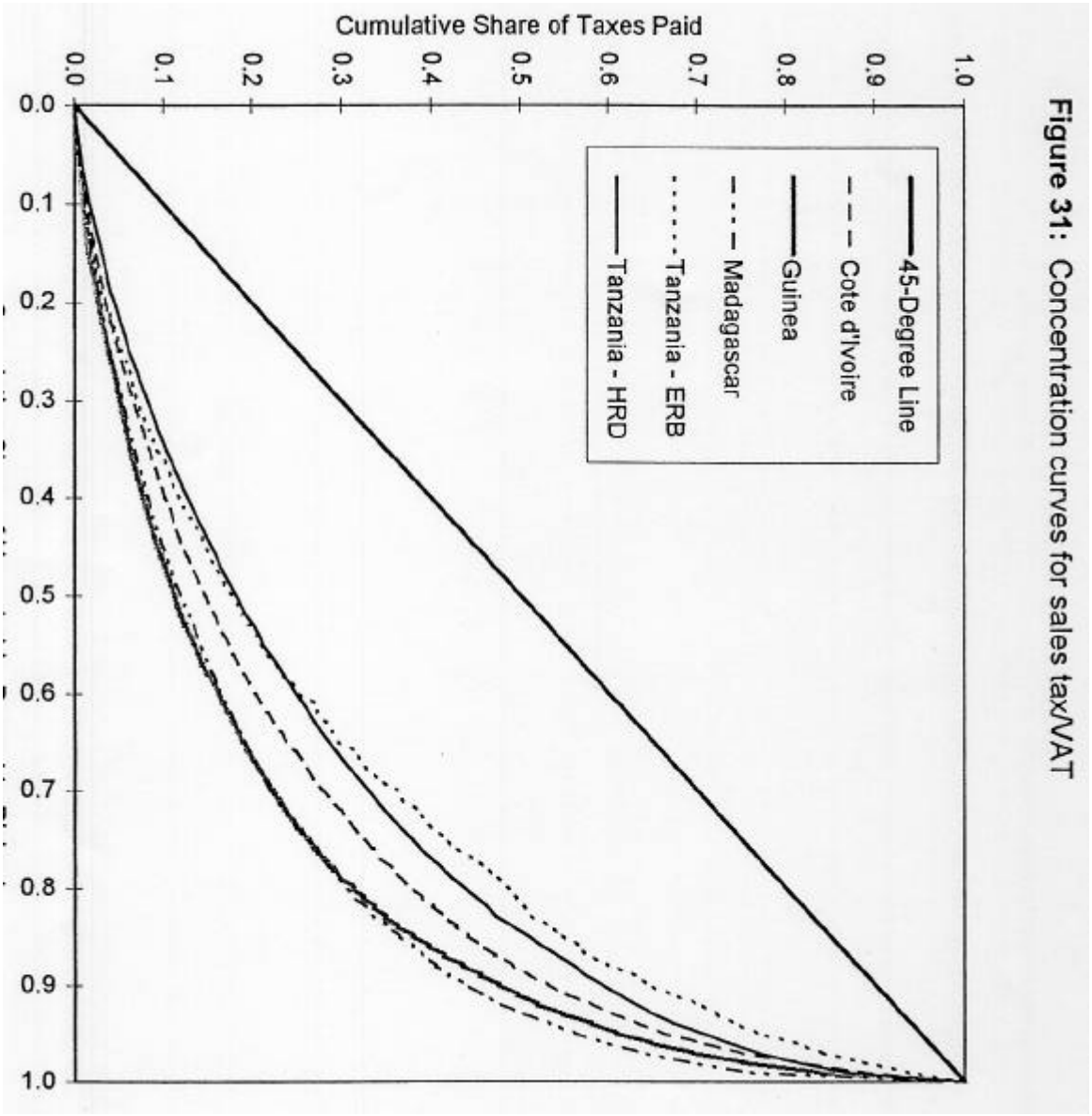


Figure 31: Concentration curves for sales tax/VAT

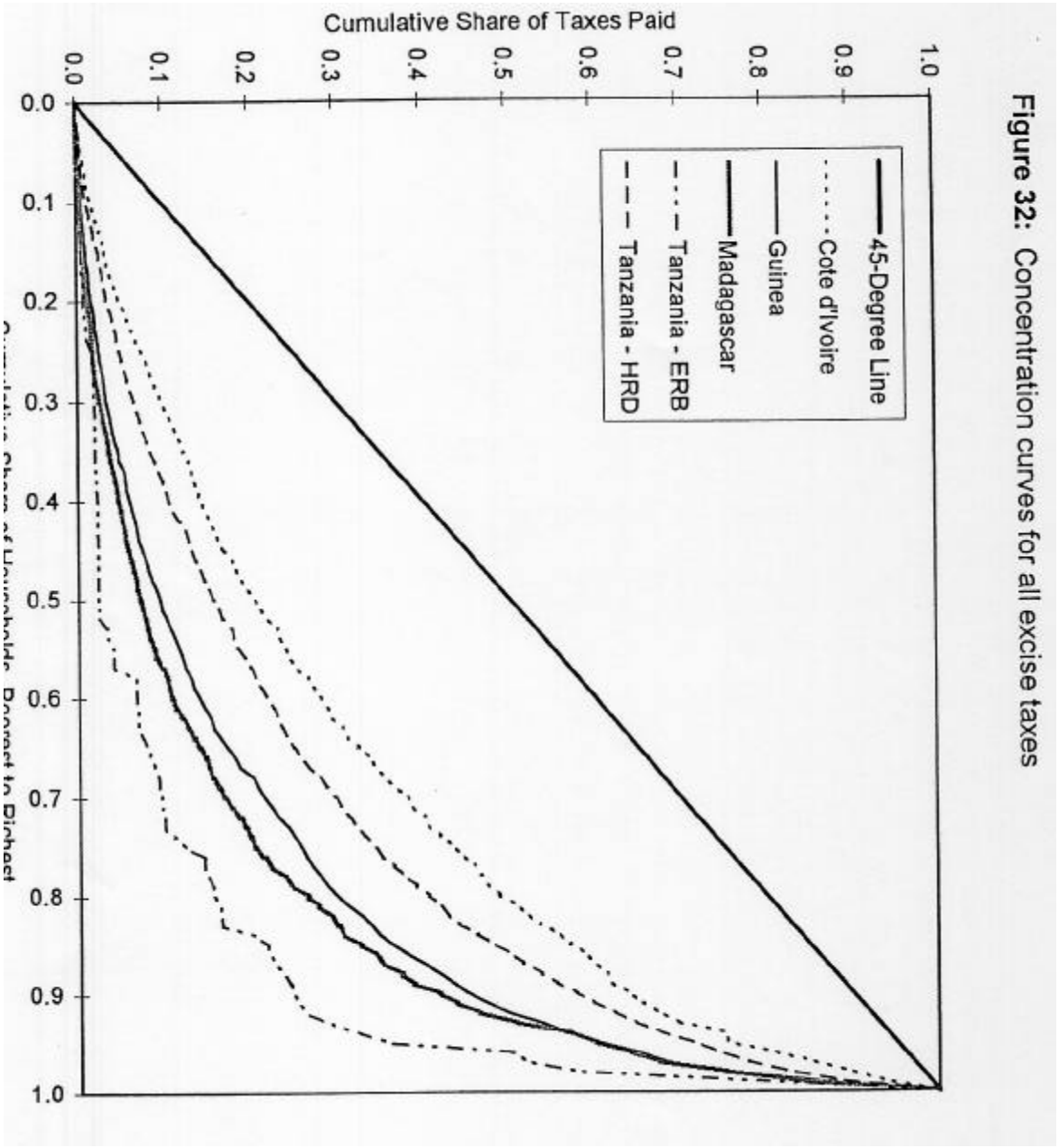
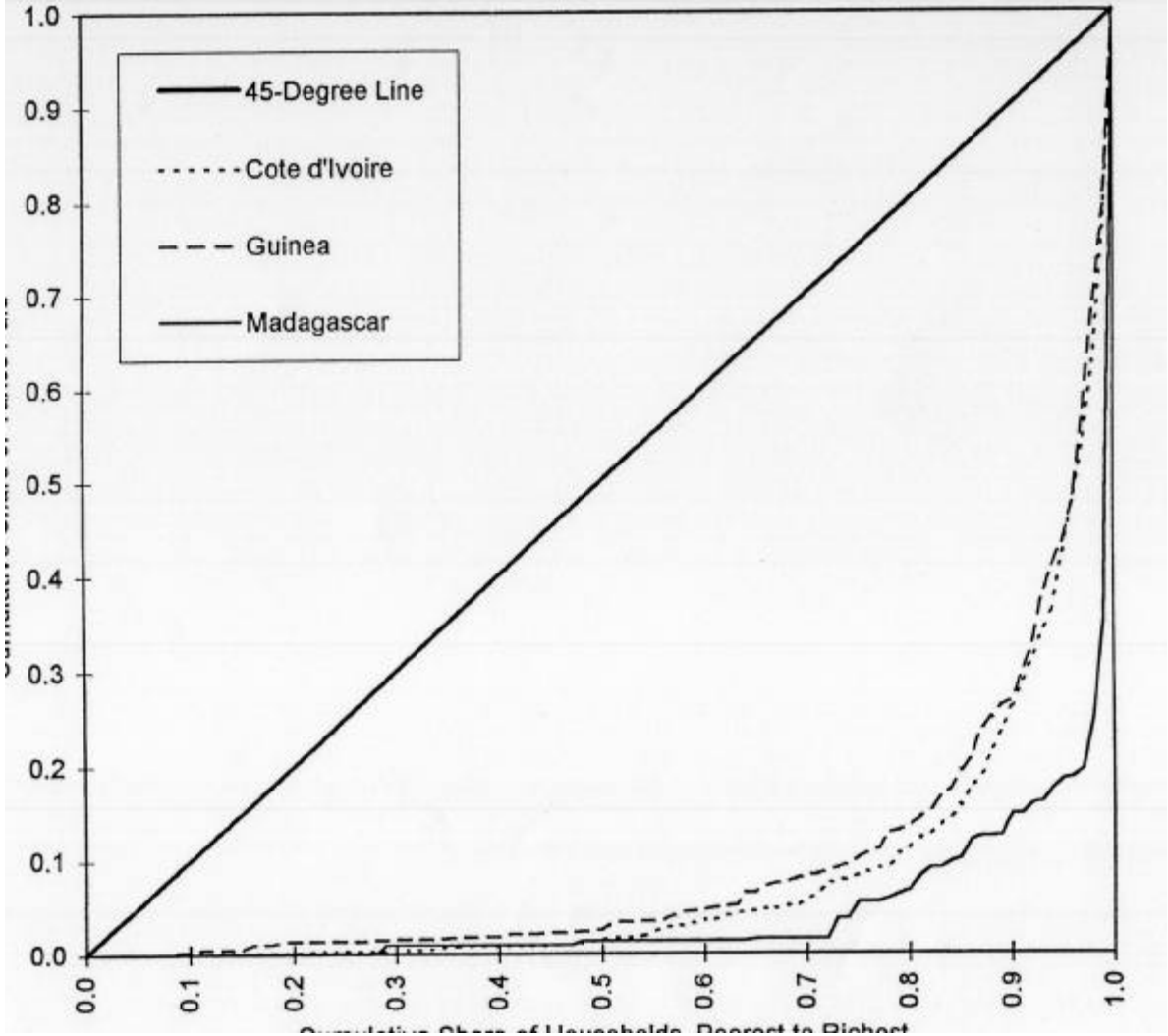


Figure 32: Concentration curves for all excise taxes

Figure 33: Concentration curves for automobile taxes



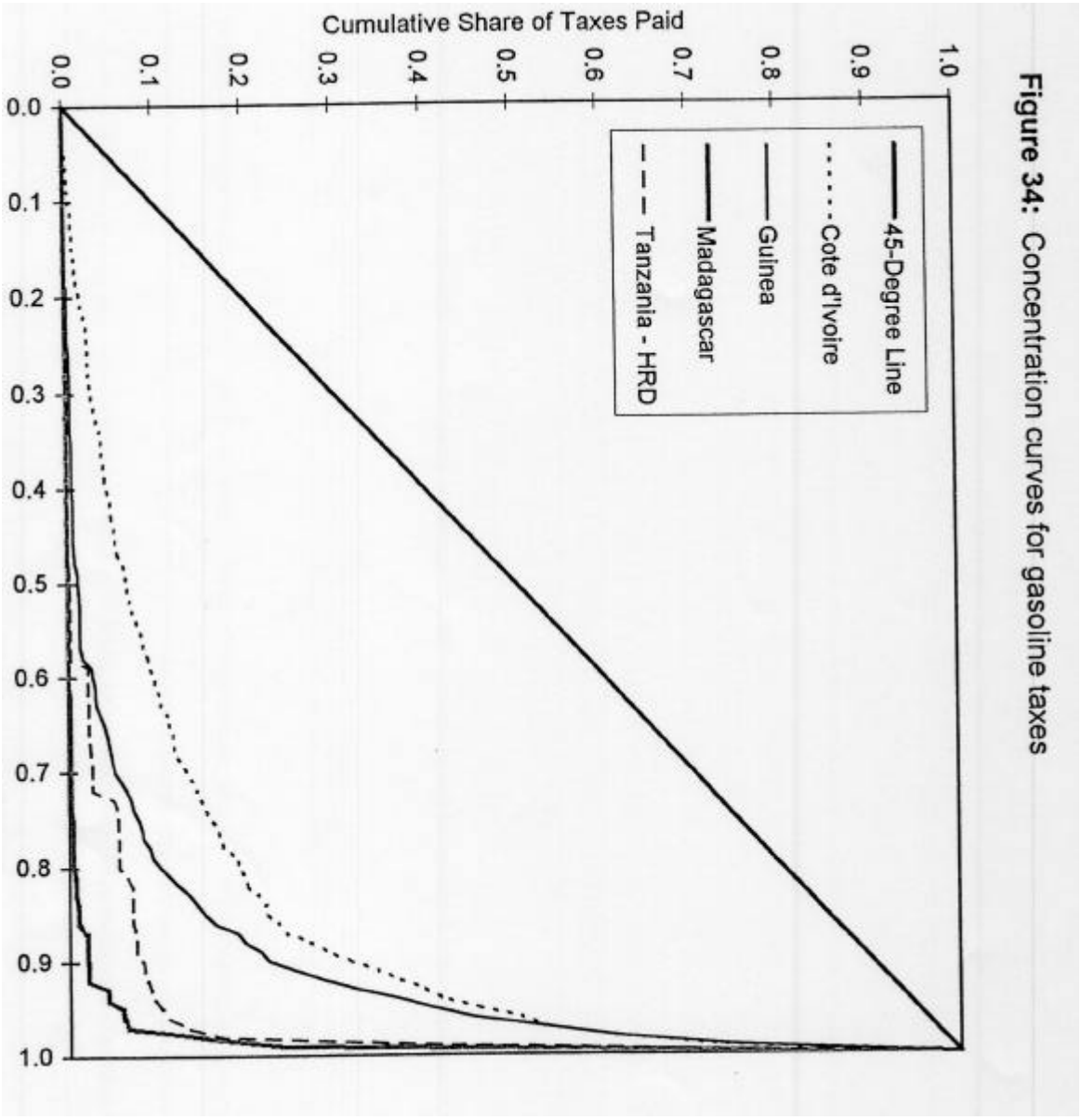


Figure 34: Concentration curves for gasoline taxes

Figure 35: Concentration curves for transportation taxes