Indirect Tax Incidence in Madagascar: Estimations Using the Input-Output Table[*]

Harivelo Rajemison
INSTAT

and

Stephen D. Younger
Cornell University Food and Nutrition Policy Program

[*]We are grateful to Steve Haggblade for his assistance in preparing the input-output table that we use in this paper, and to Sherman Robinson for helping us interpret it. All errors are the responsibility of the authors.

Introduction

Recently, there has been renewed interest in the analysis of tax incidence in Africa (Younger, et.al., 1999; Alderman and del Ninno, 1999; Sahn and Younger, 1998). In part, this is motivated by the obvious need for tax reform in Africa, where revenues are small as a share of GDP (outside the economies with large mineral royalties) and the tax system is often highly distortionary, relying excessively on trade taxes and narrow commodity excises. Yet with every reform comes the concern of how a policy change will affect the distribution of income, and in particular, how poorer households will fare.

All of the newer literature on tax incidence relies on nationally representative household survey data. Surveys of this type are increasingly available in Africa, and they provide an attractive new source of data. Nevertheless, they have their limits for tax analysis, particularly for taxes on intermediate consumption. Existing studies either restrict themselves to taxes on final demand (Alderman and del Ninno, 1999) or make strong assumptions about the incidence of taxes on inputs (Younger, et.al., 1999; Sahn and Younger, 1998).

Our aim in this paper is to follow up on the existing tax incidence study for Madagascar by Younger, Sahn, Haggblade, and Dorosh (YSHD, 1999) with a different set of methodological assumptions. In particular, rather than making use of only households' pattern of demand in the analysis, we also employ an input-output table for Madagascar. This permits us to trace an indirect tax levied on intermediate products through the I-O table to final consumers. This approach is particularly important for analysis of import duties and petroleum taxes. Two-thirds of imports to Madagascar are intermediate goods, as is about 80 percent of petroleum consumption. Clearly, taking some account of the indirect impact of taxes on these goods and services is important to understand their incidence.

To see the importance, and also some limitations, of this new approach, we calculate the incidence of several taxes in Madagascar, making use of the I-O table. We then compare these results to the ones in YSHD, allowing us to see the importance of our methodological changes.

Methods

Our main purpose is to calculate the incidence of different taxes in Madagascar. In general terms, a tax transfers real purchasing power from households to the government. The

"incidence" of the tax refers to whose real purchasing power falls when the government imposes that tax. Taxes are said to be progressive if poorer households pay a proportionately smaller share of the tax than wealthy households, relative to some measure of overall welfare, usually income or expenditures. Taxes are regressive if the opposite is true, and neutral if the tax shares are equal to overall income/expenditure shares. As in YSHD, we use household expenditure (per capita) rather than income as our welfare measure, so that we will concern ourselves with the incidence of taxes across the per capita expenditure distribution.

Assigning Taxes Paid to Households

Previous studies of tax incidence in Africa assign taxes paid based on the observed pattern of demand for taxed goods. YSHD calculate each household's tax paid by multiplying the statutory tax rate times the amount of the good that the household consumes. Alderman and del Ninno make a similar calculation for VAT rates in South Africa. This method is an accurate first-order approximation of the incidence for taxes on final consumption such as a VAT or excise duties on consumer goods like alcohol and cigarettes (Ahmad and Stern, 1991, for example), but presents clear problems for taxes on intermediate goods. YSHD assume that an import duty on good x raises the price of imported and domestic prices for *final* consumption of good x by the amount of the tax, ignoring any impact of import duties on intermediate products. They make a similar assumption for petroleum imports, although they also make an *ad hoc* attempt to compensate for the indirect effects by including 20 percent of passenger transport services in the petroleum tax base.

In this study, we will take a different approach to taxes that fall heavily on intermediate inputs by making use of an input-output (I-O) table for Madagascar.[1] The general idea is to trace the impact of taxes on intermediate goods through the I-O table to final consumers. Thus, some part of petroleum duties falls on passenger transport, and also on most other goods that require transport as an input. We then calculate the incidence of the tax as the sum of the direct and indirect effects of the tax, i.e. we consider both price increases in the product itself and in all other products that use it in their production.

[1] The table that we use is drawn from the 1995 national accounts. See INSTAT (1998) and OGT (1995).

Formally, we use the following model of price formation for domestic production:

$$P_j = \sum_i a_{ij} P_i + (1 + t_j^d) VA_j + \sum_i (1 + t_i^m)(1 + d_i) m_{ij} + s_j P_j \quad (1)$$

where P_j is the price of goods in industry j, a_{ij} is the technical coefficient from the I-O table for domestic inputs from industry i to industry j, t_j^d is the VAT rate for domestic value-added in industry j, t_j^m is the VAT rate for imports in industry j, d_j is the import tariff rate for goods in industry j, , a_{ij} is the technical coefficient from the I-O table for imported inputs from industry i to industry j, and s_j is the tax rate for various turnover-type taxes on domestic production. We assume that the VAT on imported goods is applied to the post-duty price, which is the practice in Madagascar. We also assume that each good may use different combinations of imported and domestic goods in production, which is consistent with the I-O table that we use.

We can write the set of price equations for all industries in matrix form and solve it for a reduced form set of price equations. In matrix notation:

$$P = (I - A - S)^{-1}\left((I + T^d)VA + (I + T^m)M(1 + D)\right) \quad (2)$$

where the unsubscripted variables are matrices corresponding to the variables above. Note that T^d, T^d, and S are all diagonal matrices, with each industry's tax rate on the diagonal. P, VA, and (1+D) are Jx1 vectors, where J is the number of industries in the I-O table. All the other matrices are JxJ.

The fact that both A and M enter into the price formation equation implies that the model will capture the indirect effects of taxes on good j on all other goods in the I-O table. The model is not, however, a general equilibrium model because it does not account for behavioral responses to tax policy. Any policy change is passed through the I-O table mechanically, with fixed technical coefficients. This is consistent with the assumptions of the earlier work in YSHD where all elasticities are assumed to be zero. While a more elaborate model would be preferable, these assumptions provide a first-order approximation of the incidence of small policy changes.

To judge the incidence of a tax, we recalculate prices according to equation (2), but with a vector of zeros substituted for the original taxes in question. The difference between the two

price calculations is the tax paid by consumers. Of course, most of the industries in the I-O table include imports as well as domestically produced goods. To capture the direct effect of taxes on imports, we simply multiply the tax rate times the amount of imports. We then add these two components together, dividing by total supply of the industry to get a "tax rate". As an example, consider the effect of import duties on the cost of domestic supply:

$$Z = \frac{(P - P_0) + (D - D_0)(I + T^m)M^f}{X} \tag{3}$$

P_0 is the price of domestic production in the absence of import duties, calculated using equation (2). Imposing import duties raises prices of domestic goods to P, and the final impact of the price that consumers pay is the difference between the two. That is the indirect effect. In addition, the direct effect raises the cost of imported final goods by the change in the duty rate, $(D\text{-}D_0)$, times the value of imports, increased by the VAT. We then scale this by total supply, X, to get an estimate of the "tax rate" that includes both direct and indirect effects. The calculation for a purely domestic tax, such as the turnover-type taxes, includes only the first term in the numerator.

Comparing the Incidence of Different Taxes

Once we establish the tax rates Z in equation (3), we then apply them to observed consumption of households in the 1994 *Enquete Permanente aupres des Menages* (EPM), a nationally representative household income and expenditure survey. This requires a mapping of each expenditure item in the survey to the industries in the I-O table, which we provide in Appendix I. We then compare the incidence of different taxes using concentration curves (Yitzhaki and Slemrod, 1991). Concentration curves are diagrams which are similar to Lorenz curves[2] in that they plot households from the poorest to the wealthiest on the horizontal axis against the cumulative proportion of taxes paid for all households from the poorest up to household n. Yitzhaki and Slemrod prove that for any social welfare function that favors an

[2] A Lorenz curve plots all households in the sample from poorest to the richest on the horizontal axis vs. cumulative household income (expenditure) as a proportion of all households' total income (expenditure).

equitable distribution of income, changing the tax structure by slightly reducing taxes on good x and increasing those on good y by just enough to keep total revenues constant will improve social welfare when x's concentration curve is everywhere below y's. In this case, we say that x dominates y. The intuition is straightforward. If poorer households tend to consume less of a particular good, say gasoline, and more of another, say food, then reducing taxes on the latter and raising those on the former will improve the distribution of welfare. Yitzhaki and Slemrod refer to this as "welfare dominance" because of the analogy with the concept of second order stochastic dominance in the finance literature. The concentration curve for food is above that for gasoline because poorer households account for a larger share of total food consumption than they do for gasoline consumption.

In addition to comparing the concentration curves for different taxes, it is also insightful to compare each tax's concentration curve to two benchmarks: the Lorenz curve for expenditures and the 45 degree line. It is standard in the tax literature to say that a tax is progressive if it falls proportionately less on poorer households and more on wealthy ones, relative to their expenditures, and regressive if it does not. Thus, a tax whose concentration curve is below the Lorenz curve for expenditures is progressive, and vice-versa. As the tax's concentration curve approaches the 45-degree line, it becomes extremely regressive, as in a head tax.

In all cases, we make the comparisons statistically. We use a distribution-free estimator of the standard errors of a set of ordinates on each curve to test the null that the ordinates for each curve are the same (Davidson and Duclos, 1997). Following Howes (1996), we reject the null hypothesis of non-dominance only if the tests at each ordinate differ significantly and are of the same sign. We also reject the null in favor of crossing concentration curves if there are two or more significant t-statistics with opposite signs.

Choosing Tax Rates

In addition to using the I-O table to calculate indirect effects, we have varied from the methods in YSHD by using information in the I-O table to calculate tax rates rather than using the statutory rates. This means that our results may differ from those in YSHD for two reasons: we account for indirect effects, and we use different, more realistic, tax rates in our calculations. In particular, we calculate the diagonal elements of T^d as the total domestic VAT revenues per

industry divided by the industry's value-added. The diagonal elements of T^m are the total VAT revenues from imports per industry divided by the industry's imports (after duties). The diagonal elements of S are total "taxes on producers" divided by the value of domestic output. (This includes a mixture of property taxes on firms, local market taxes, and some specific excise duties, most importantly on alcohol and tobacco.) Finally, we calculate D as the total value of import duties per industry divided by the total value of imports (cif). Petroleum excises, the *taxe unique sur produits petroliers* (TUPP), are included in this vector, as they are levied only as petroleum products pass through the port. This is the only tax on petroleum products, and we assume that the entire value of this element of D is due to the TUPP. Similarly, but less precisely, we assume that the entire value of producer taxes for the beverage and tobacco industries are excises on those products.

A Caution

While the methods that we use in this paper may seem to be obviously superior to those in YSHD, there is one important caution. The I-O table that we use contains only 30 industries, while the expenditure survey has considerable more detail, 222 separate consumption items. Thus, to move from the YSHD approach to the methods we use here, we must aggregate commodities to a considerable extent. Such aggregation will err when the several goods in a category have much different tax rates, because the IO-based analysis must treat all items within an industry as if they had the same rate. We will show an example of this problem in the following section.

Results

Applicable tax rates under different methods

Before considering the incidence results, it is useful to examine the different tax rates that we apply to households' consumption. Table 1 gives the average statutory rates used in YSHD, an average "actual" rate derived from the national income accounts, and an "effective IO" rate derived from the IO table. To calculate the average statutory rates, we first assumed that the official tax rates applied, but only to products that YSHD judged to be in the formal sector and

thus likely to be taxed.[3] We then calculated the implied tax paid by households in the EPM based on those rates and the total expenditures for each good in the survey and aggregated this information to the industries in the IO table. Finally, we calculated the "average statutory rate" as the sum of all tax payments in the industry for the tax in question divided by households' total expenditures in the same industry.

The "average actual rate" is the ratio of the total amount of a given tax paid in each industry divided by the total demand (total resources) for that industry. This information comes entirely from the IO table and national income accounts.

The "IO effective rate" is the sum of the change in the value of domestic production (by industry) due to a change in the "average actual rate" plus the change in the value of imports due to the tax change, all divided by the total demand for that industry. By the nature of the multiplier calculations, these rates are all larger than the "average actual rates," because they include those rates plus any indirect effects of the tax on other industry through the IO table.

In general, the actual taxes collected per industry are substantially lower than the statutory rates that YSHD assumed,[4] a standard observation in developing countries. This means that our own tax calculations will differ significantly from YSHD's. Further, comparison of the average actual with the IO-effective tax rates shows that the latter are much higher, so that the indirect effects of taxes that are passed through the I-O table is important. This, too, will give us results that differ from YSHD. It is also interesting to note that the VAT shows a substantial amount of cascading (noted by comparing the two right columns). This probably is due to the importance of the industries that are exempted, but not zero-rated.[5]

Dominance Results

Figures 1 through 5 show concentration curves for the major taxes paid in Madagascar, for three different methods. The first is the "standard" method of YSHD. The second is similar

[3] See Appendix I for details of the assumptions and calculations.
[4] The exceptions are cases where YSHD assumed a zero tax rate because the household survey did not ask about consumption of any product in that industry .
[5] Gottfried and Wiegard discuss the difference between exemptions, in which an industry does not pay VAT, but does not receive a refund for the VAT already paid by its suppliers, and zero-rating, where the rebates are received. Exemptions are much more common, but they do imply that "exempted" products still include some taxes. Further, they allow cascading, since purchases from exempted sectors do not include any VAT credit, but there may in fact be some tax included in the costs.

to the first, but rather than using statutory rates, it uses estimates of the effective tax rate based on the taxes actually paid, as indicated in the I-O table. The third method adds to the second the indirect effect of taxes accumulated through the IO table. Rather surprisingly, the three different methods often produce similar results with respect to the distributional consequences of these taxes. The concentration curves for the VAT, producer taxes, and excise duties on alcohol are very close for all three methods.[6]

There are, nonetheless, some notable differences. One of these, for tobacco taxes, highlights a weakness in the approach that we take in this paper. While our I-O table includes an industry for tobacco, it does not disaggregate between cigarettes, which are taxed and mostly consumed by the better off, and Parakay, which not taxed and is mostly consumed by the poor. When we aggregate these two products into one industry, the resulting incidence is a combination of the distribution of cigarette and parakay consumption, with the latter diluting the progressive impact of the tobacco excise. YSHD, because they rely only on the household survey, are able to keep these consumption items separate and thus find (more accurately, in this case) that the tobacco excise is progressive.[7]

The other two outstanding differences in concentration curves by method are for import duties and petroleum taxes. It is important to note, however, that the reason for the differences appears *not* to be from the indirect effects of taxes on one intermediate product passing through the I-O table to different final products, but rather from the difference between statutory and effective rates of taxation, as seen in Table 1. In fact, the effective tax and I-O tax methods produce very similar concentration curves in both cases, indicating that the latter differs from the standard method only because it uses effective tax rate estimates, not because of cascading of taxes through the structure of production. Thus, as a methodological point, it seems more important to get accurate information on the actual taxes that a product is likely to pay than to worry about the indirect effects that taxes might have because they affect some producers input prices. Surprisingly, this is true even for two important productive inputs, petroleum and intermediate imports.

[6] For petroleum, we compare only the total under the standard method with the effective and IO methods, as the latter aggregate duties on all types of petroleum products.

[7] A similar problem exists for petroleum, where aggregation of kerosene, diesel, and gasoline into one product/industry masks substantially different distribution patterns for consumption of these three items.

These conclusions are born out in the statistical tests. Tables 2 to 5 show results of dominance tests for the different taxes. For each tax, no concentration curve derived using effective tax rates differs statistically from the corresponding concentration curve derived using the I-O methods. Thus, while it would seem to be important in theory, the indirect effect that taxes have on downstream producers makes little difference to the incidence of a tax in Madagascar. Further, for all taxes except import duties and tobacco, where the aggregation of two different products leads to imprecise results, even the simplest methods used on YSHD produce results similar to the more elaborate ones found here. Thus, even though those methods appear vulnerable to criticism in theory, in practice, the methods do not perform badly.

A practical consequence of this correspondence between different methods' results is that the policy implications in this paper are similar to those in YSHD. Tables 6 shows dominance test results for the major taxes in Madagascar when taxes are calculated using YSHD's methods. Table 7 gives the same results for the I-O based methods of this paper. In both cases, the vanilla duty has the lowest gini coefficient, but its strongly s-shaped concentration curve means that it crosses most other taxes' concentration curves, and statistically dominates none.[8] For the standard method (Table 6), all taxes are progressive, and the same is true for all taxes except tobacco excises for the I-O method (Table 7). But again, we have every reason to believe that tobacco's concentration curve is too high because the I-O methods force us to aggregate cigarettes and parakay.

Among individual taxes, the only strong difference between the YSHD and I-O table results is in regards to import duties. Using the standard method, YSHD found that import duties were more regressive than other taxes in Madagascar, and we reproduce that result here.[9] For the I-O methods, however, import duties are substantially more progressive, and no tax dominates them. In fact, with the exception of tobacco, who's results are doubtful, the test provide no clear evidence that one or the other tax is more progressive, except that, as in YSHD, taxes on wages are by far the most progressive, dominating all others.

[8] As YSHD note, there are few cases of vanilla producers in the EPM, so the statistics suffer from large standard errors.

[9] As in YSHD, we cannot reject the null that the VAT does not dominate import duties because of one (out of 20) insignificant t-statistic, at the first (poorest) quantile. If we discount this test point, which is quite close to the origin, then we would also find that the VAT dominates import duties.

Conclusions

Our aim in this paper has been to examine the relative progressivity of different taxes in Madagascar. YSHD also addressed this topic in a recent publication, but their methods include an obvious weakness: by using only information on household consumption from the EPM, they cannot account for the effects of taxes on intermediate products. This likely to produce biased results, especially when evaluating petroleum excises or import duties, where a large proportion of sales are as intermediate rather than final goods. This study attempts to deal with this problem by combining the information on household consumption patterns from the EPM with information on the flow of intermediate production found in an I-O table.

In practice, this innovation turns out not to have been very important. The incidence of most taxes is similar in the two methods. Further, in cases where there are substantial differences, such as import duties and petroleum taxes, the differences exist because our new methods use estimates of actual taxes paid in each industry category (drawn from the I-O table) rather than the statutory rates the YSHD used. Once we account for this change of tax rates, the difference between simple consumption based estimates like YSHD's and those that make use of the I-O table are always small.

One further methodological point merits mention: the problem of aggregation. The EPM includes 222 consumer items, while the I-O table includes only 30 industries (not all of the consumer items).[10] This forces us to aggregate the very detailed information from the EPM into broad classes that, in turn, obscures some of the distributional consequences of taxation. We have seen, for example, that this papers finds tobacco taxes to be less progressive than YSHD, but that is because it has aggregated cigarettes (mostly consumed by wealthier households) and parakay into one industry. In Madagascar, the tobacco tax falls only on cigarettes, but when we apply it to the tobacco industry in the I-O table, we actual apply it to all tobacco products, including parakay. This makes the taxation appear less progressive than it actually is.

The same problem exists for petroleum taxation. While the EPM includes information on kerosene, diesel, and gasoline purchases separately, and thus permits an analysis of the (quite different) incidence of each product, the I-O table includes only one industry, forcing us to consider all petroleum taxes as on package.

Thus, in the end, the innovation that this paper offers has not been terribly useful. On the one hand, its results are reasonably similar to YSHDs. On the other, its higher order of product aggregation has led to a misleading conclusion (for tobacco), or an inability to draw conclusions (for specific petroleum products). The one genuinely interesting result the incidence of some taxes, especially import duties, changes substantially when we use actual taxes collected rather than the statutory tax rates to estimate how much households that consume imported goods pay in taxes. This suggests that future research should attempt to obtain estimates of how much tax is actually paid rather than using statutory tax rates.

[10] Of course, it is possible in theory to build very large, detailed, I-O tables to avoid this problem. But in practice in Africa, that is not the norm.

References

Ahmad, Ehtisham, and Nicholas Stern, 1991, *The Theory and Practice of Tax Reform in Developing Countries*, Cambridge: Cambridge University Press.

Davidson, Russell, and Jean-Yves Duclos, 1997, "Statistical inference for the measurement of the incidence of taxes and transfers, *Econometrica*, v.65, pp.1453-1466.

Gottfried, Peter and Wolfgang Wiegard, 1991, "Exemption versus Zero Rating: A Hidden Problem of VAT," *Journal of Public Economics*, v.46 n.3 (December), pp. 307-28.

Howes, Stephen, 1996b, "A New Test for Inferring Dominance from Sample Data," draft.

INSTAT, 1998, "Comptes nationaux de Madagascar 1995," Antananarivo: Ministere des finances et de l'economie.

OGT, 1995, "Operations generales du Tresor," Antananarivo: Ministere des finances et de l'economie.

Sahn, David E., and Stephen D. Younger, 1998, "Fiscal Incidence in Africa," Ithaca: CFNPP Working Paper #91.

Yitzhaki, Shlomo, and Joel Slemrod, 1991, "Welfare dominance: An application to commodity taxation," *American Economic Review*, v.81(3), p.480–496.

Younger, Stephen D., David E. Sahn, Steven Haggblade, and Paul A. Dorosh, 1999, "Tax Incidence in Madagascar: An Analysis Using Household Data," *World Bank Economic Review*, v.13, no.2 (May).

Appendix I – Assumed statutory tax rates from YSHD, and and I-O table industry assignments for products in the *ECM*

This appendix details the assumptions that YSHD used to calculate tax payments for the households in the *ECM*. Table A.1 lists all of the expenditure items included in the EPM survey and indicates which indirect taxes we have assumed that expenditure on these items includes. It also gives the I-O table industry that we assign each product to when aggregating to the 30-industry I-O table.

To estimate the tax base for each tax, we have assumed that:

1) the VAT is levied on the CIF value of imports plus all import duties paid;
2) import duties and tariffs are levied on the CIF value of imports;
3) commodity-specific excises are levied on the CIF value of imports (if the goods are imported) or the value of domestic sales;
4) there is an untaxed retail markup on all expenditure items.

We then apply the rate shown in the table to the calculated base. We calculate the retail markup from a 1995 input-output table for Madagascar, using the ratio of retail and wholesale services to the sum of domestic sales plus imports. We then use the appropriate industry's ratio for each product in the expenditure survey. Results for single-item taxes are not sensitive to errors in the percentages we use because the concentration curves are calculated as ratios. However, for multi-item taxes (import duties and the VAT), errors across items with different tax rates could change the incidence calculations.

The only other indirect tax we examine is the vanilla export duty. We apply the duty rate (25 percent) to each household's sales of vanilla (in FMG) to estimate their tax payments for vanilla exports. Note that this assumes that farmers only pay a part of the total duty, equal to their share in the total FOB price of vanilla, i.e., they share the tax incidence with middlemen who buy their vanilla output and sell it to the vanilla marketing board. As with the expenditure taxes, this will not affect the concentration curve for vanilla duties, but probably underestimates the nominal amount that farmers pay.

The only direct tax included in this report is the income tax on wages. We have assumed that only workers who work for the public sector or for formal enterprises pay income taxes on their wages and benefits (question 13, section 4, part B responds 1 or 2, and analogously for other

jobs). In contrast to the expenditure taxes, we use the 1994 tax tables to be consistent with the nominal value of salaries earned in those years.

Table A.1: Assumed taxes on Expenditure Items in the Madagascar *Enquete Permanente Aupres des Menages*

Expenditure Item	Import Duties	VAT	Others	I-O Table Industry
Adults' clothing	50%	20%		Textiles et de Confection
Children's clothing	50%	20%		Textiles et de Confection
Underwear	50%	20%		Textiles et de Confection
Cloth for clothing	50%	20%		Textiles et de Confection
Accessories	50%	20%		Textiles et de Confection
Other clothing	50%	20%		Textiles et de Confection
Sewing materials	50%	20%		Textiles et de Confection
Adults' shoes	50%	20%		Textiles et de Confection
Children's shoes	50%	20%		Textiles et de Confection
Electricity		20%		Eléctriques
Water		20%		Energie
Kerosene 4/			133 FMG/liter	Energie
Natural gas			50 FMG/kilo	Energie
Candles		20%		Chimiques
Furniture		20%		Du Bois
Household accessories		20%		Diverses et du Cuir
Household linen		20%		Textiles et de Confection
House furnishings		20%		Diverses et du Cuir
Household appliances	40%	20%		Diverses et du Cuir
Kitchen appliances	40%	20%		Diverses et du Cuir
Cooking appliances	40%	20%		Diverses et du Cuir
Glassware	40%	20%		Diverses et du Cuir
Kitchen utensils	40%	20%		Diverses et du Cuir
Household utensils	40%	20%		Diverses et du Cuir
Home maintenance products		20%		Services aux particuliers
Home maintenance tools		20%		Diverses et du Cuir
Other home maintenance		20%		Services aux particuliers
Sports and cultural events		20%		Services aux particuliers
Hotels, vacations		20%		Services aux particuliers
Radios and VCRs	40%	20%		Diverses et du Cuir
Cameras	40%	20%		Diverses et du Cuir
Sports equipment	40%	20%		Diverses et du Cuir
Other durable equipment and repairs	40%	20%		Services aux particuliers
Books, magazines, and newspapers		20%		Du Papier et Edition
Leisure accessories		20%		Diverses et du Cuir
Medicine	10%			Chimiques
Personal care articles	50%	20%		Diverses et du Cuir
Automobile	50%	50%	15%	Métal et mécaniques
Motorcycle	40%	50%		Métal et mécaniques
Bicycles	20%	20%		Métal et mécaniques
Gasoline and lubricants			480 FMG/liter	Energie
Transportation in cities		20%	20% of 480 FMG/liter /2	Auxilieres de transports
Inter-city transportation		20%	20% of 480	Auxilieres de transports

			FMG/liter /2	
Mail and telecommunications		20%		Services aux particuliers
Watches	40%	20%		Diverses et du Cuir
Jewelry		20%		Extractives
Education and training fees		20%		Services aux particuliers
All foods except those listed below:	0%	0%		Agriculture ou Elevage
Milled Rice	30%			Agriculture
Rice flour	30%			Agriculture
Wheat	20%			Agriculture
Other cereals	20%			Agriculture
Cheese	30%			Elevage
Other dairy products	30%			Elevage
Peanut oil	20%			Alimentaire
Coconut oil	20%			Alimentaire
Soybean oil	20%			Alimentaire
Butter	20%			Alimentaire
Margarine	20%			Alimentaire
Lard	20%			Des Corps gras
Marinated or salted vegetables	40%	20%		Alimentaire
Other canned vegetables	40%	20%		Alimentaire
Jams and jellies	40%	20%		Alimentaire
Canned fruits	40%	20%		Alimentaire
Canned meats	40%	20%		Alimentaire
Canned fish	40%	20%		Alimentaire
Other canned food	40%	20%		Alimentaire
Condensed or powdered milk	40%	20%		Alimentaire
Baby food		20%		Alimentaire
Fruit juice	50%	20%		Des Boissons
Syrup/Soda	50%	20%		Des Boissons
Bottled water	50%	20%		Des Boissons
Meals in restaurants		20%		Services aux particuliers
Rum	50%	20%	170%	Des Boissons
Beer	50%	20%	70%	Des Boissons
Wine & Liquor	50%	20%	120%	Des Boissons
Cigaret detes	50%	25%	60%	Du Tabac
Parakay		15%		Du Tabac
Chairs 1/		20%		Du Bois
Tables 1/		20%		Du Bois
Beds 1/		20%		Du Bois
Other furniture 1/		20%		Du Bois
Sewing machine 1/	40%	20%		Diverses et du Cuir
Gas stove 1/	40%	20%		Diverses et du Cuir
Refrigerator 1/	40%	20%		Diverses et du Cuir
Television 1/	40%	20%		Diverses et du Cuir

Notes: 1/ For durable items, we have used 10 percent of the value of the items owned, found in section 11, part B, rather than the expenditure information in section 8. 2/ For transport, we assume that 20 percent of the cost is due to taxes on pet deroleum products. 3/ Includes wheat in bread. 4/There was no excise tax on kerosene in 1994. In order to say somet dehing about the incidence of the kerosene duty that came later we have used the 1996 duty per liter, deflated by the proportion that the gasoline duty increased from 1994 to 1996.

Source: Calculated from Government of Madagascar (1994).

Table 1 - Average statutory, actual, and effective tax rates for Madagascar, 1995

	VAT			Import Duties			Petroleum Excises		
Industry	Average Statutory	Average Actual	IO - Effective	Average Statutory	Average Actual	IO - Effective	Average Statutory	Average Actual	IO - Effective
Agriculture	0.000	0.002	0.010	0.115	0.001	0.006	0.000	0.000	0.001
Elevage	0.000	0.000	0.020	0.035	0.000	0.007	0.000	0.000	0.003
Sylviculture et Chasse	0.000	0.000	0.016	0.000	0.000	0.005	0.000	0.000	0.003
Pêche	0.000	0.008	0.021	0.000	0.007	0.012	0.000	0.000	0.002
Agro-industrie	0.000	0.027	0.046	0.000	0.020	0.032	0.000	0.000	0.002
Industries extractives	0.121	0.024	0.037	0.000	0.017	0.023	0.000	0.000	0.002
Energie	0.013	0.008	0.033	0.000	0.000	0.018	0.095	0.036	0.039
Industrie alimentaire	0.006	0.008	0.030	0.025	0.004	0.016	0.000	0.000	0.002
Industries des boissons	0.065	0.019	0.045	0.108	0.010	0.030	0.000	0.000	0.002
Industries du tabac	0.077	0.006	0.036	0.078	0.002	0.016	0.000	0.000	0.004
Industries des Corps gras	0.000	0.035	0.070	0.120	0.027	0.055	0.000	0.000	0.010
Industries chimiques	0.022	0.040	0.059	0.051	0.031	0.047	0.000	0.000	0.002
IndustriesTextiles et de Confection	0.114	0.012	0.035	0.176	0.007	0.021	0.000	0.000	0.002
Industries du bois	0.134	0.010	0.030	0.000	0.002	0.011	0.000	0.000	0.002
Industries non métalliques	0.000	0.013	0.041	0.000	0.005	0.022	0.000	0.000	0.013
Industries métalliques et mécaniques	0.187	0.051	0.075	0.128	0.041	0.061	0.000	0.000	0.002
Industries électriques	0.103	0.044	0.063	0.000	0.036	0.050	0.000	0.000	0.002
Industries du Papier et Edition	0.116	0.028	0.057	0.000	0.022	0.043	0.000	0.000	0.002
Industries diverses et du cuir	0.094	0.028	0.052	0.090	0.018	0.033	0.000	0.000	0.003
Bâtiments et Travaux Publics	0.000	0.004	0.060	0.000	0.000	0.046	0.000	0.000	0.005
Transports de marchandises et Commerce	0.092	0.018	0.029	0.000	0.000	0.006	0.000	0.000	0.007
Transports de voyageurs	0.017	0.009	0.030	0.000	0.000	0.012	0.082	0.000	0.012
Auxiliaires de transports	0.000	0.007	0.019	0.000	0.000	0.007	0.000	0.000	0.000
Télécommunications	0.000	0.020	0.031	0.000	0.000	0.007	0.000	0.000	0.001
Banques et Assurances	0.000	0.023	0.028	0.035	0.000	0.007	0.000	0.000	0.000
Services rendus aux entreprises	0.000	0.011	0.014	0.000	0.000	0.005	0.000	0.000	0.000
Services rendus collectivement aux particuliers	0.084	0.010	0.027	0.000	0.007	0.012	0.000	0.000	0.001
Services rendus individuellement aux particuliers	0.016	0.026	0.027	0.000	0.020	0.032	0.000	0.000	0.000
Services non marchands	0.000	0.016	0.030	0.000	0.017	0.023	0.000	0.000	0.001

Notes: We calculate the average statutory rates as the statutory rates times households' total expenditure on the good(s) in the industry in the EPM survey, divided by total expenditure on the same goods.
We calculate the average actual rates as the actual tax receipt shown in the 1995 I-O table divided by the total value of resources used in the industry.
We calculate the average "effective" rates as the estimated change in resources that a tax increase would cause both directly and indirectly via the IO table. (See the text.)

Table 2 – Dominance tests for VAT, using different methods

		(1)	(2)	(3)	(4)	(5)
(1)	45 Degree Line		D	D	D	D
(2)	Household Expenditure			D	D	D
(3)	VAT, I-O method					
(4)	VAT, standard method					
(5)	VAT, effective tax rate method					

Table 3 – Dominance tests for import taxes, using different methods

		(1)	(2)	(3)	(4)	(5)
(1)	45 Degree Line		D	D	D	D
(2)	Household Expenditure				D	D
(3)	Import Duties, standard method				*[/1]	D
(4)	Import Duties, I-O method					
(5)	Import Duties, effective tax rate method					

[/1] The I-O method dominates the standard method at all test points except one (0.05), where the t-statistic is insignificant.

Table 4 – Dominance tests for excise taxes, using different methods

		(1)	(2)	(3)	(4)	(5)	(6)
(1)	45 Degree Line		D	D	D	D	D
(2)	Household Expenditure				D	D	D
(3)	Tobacco, I-O method				D	D	D
(4)	Alcohol, I-O method						
(5)	Alcohol, standard method						
(6)	Tobacco, standard method						

Table 5 – Dominance tests for petroleum taxes, using different methods

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	45 Degree Line		D	D	D	D	D	D	D
(2)	Kerosene Excise, standard method			D	D	D	D	D	D
(3)	Household Expenditure							D	D
(4)	Petroleum Duties, standard method							D	D
(5)	Petroleum Duties, effective tax rate method							D	D
(6)	Petroleum Duties, I-O method							D	D
(7)	Gasoline & Transport, standard method								D
(8)	Gasoline, standard method								

Table 6 – Dominance results for major taxes in Madagascar, YSHD (standard) method

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	45 Degree Line			D	D	D	D	D	D	D
(2)	Vanilla Duty			X	X	X	X			
(3)	Household Expenditure		X			D	D	D	D	D
(4)	Petroleum Duties									D
(5)	Import Duties		X				D	D	D	D
(6)	VAT		X						D	D
(7)	Alcohol		X							D
(8)	Tobacco									D
(9)	Wages									

Table 7 – Dominance results for major taxes in Madagascar, I-O methods

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	45 Degree Line			D	D	D	D	D	D	D
(2)	Vanilla Duty (standard method)			X	X	X	X	X	X	
(3)	Household Expenditure		X			D	*[1]	D	D	D
(4)	Tobacco Excise		X			D			D	D
(5)	VAT		X							D
(6)	Petroleum Duties		X							D
(7)	Import Duties		X							D
(8)	Alcohol Excise		X							D
(9)	Wages (standard method)									

[1] Petroleum duties dominate household expenditure at all test points except one (0.05), where the t-statistic is insignificant.

Figure 1 - Concentration curves for import duties in Madagascar: Comparison of methods

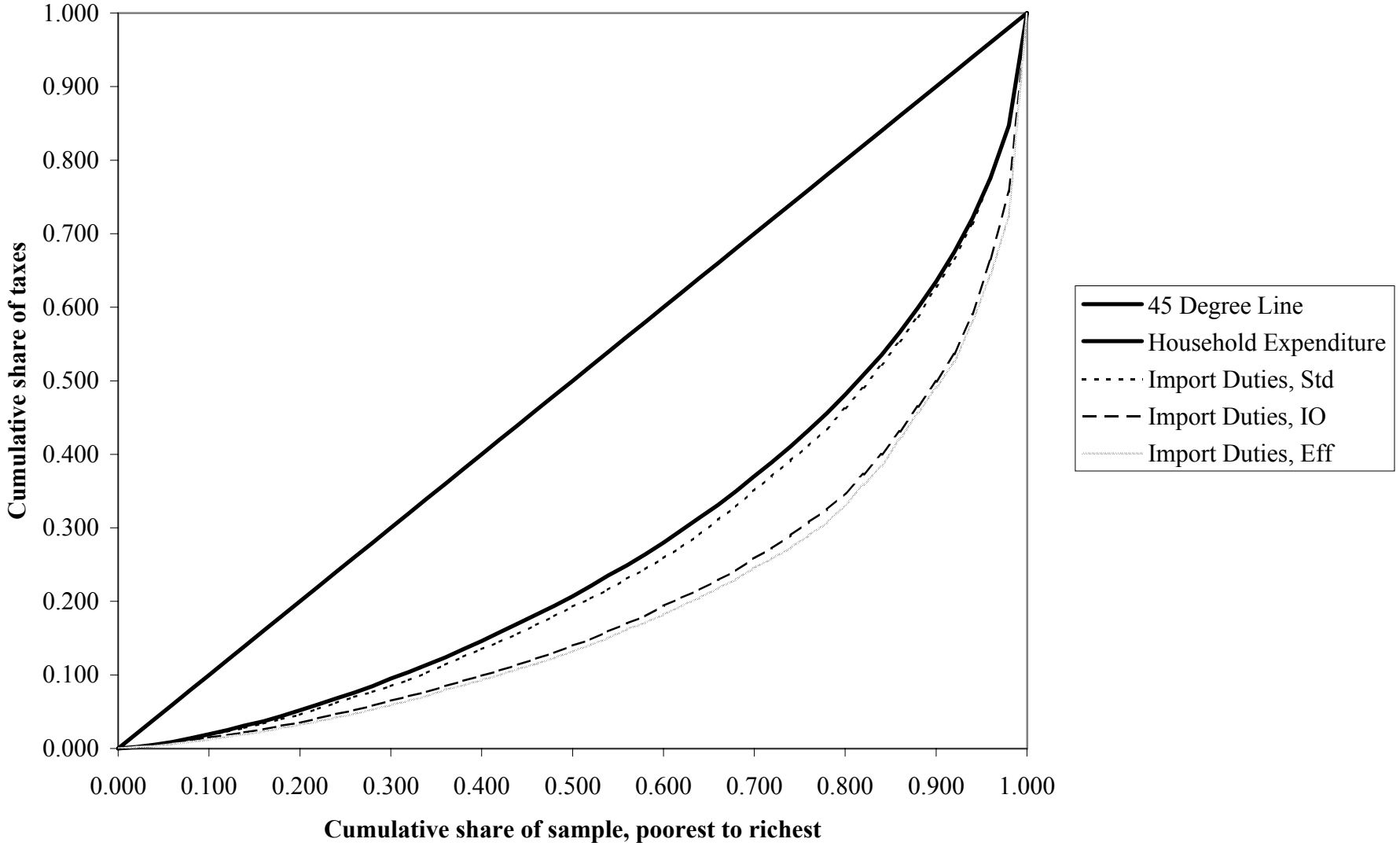

Figure 2 - Concentration curves for VAT in Madagascar: Comparison of methods

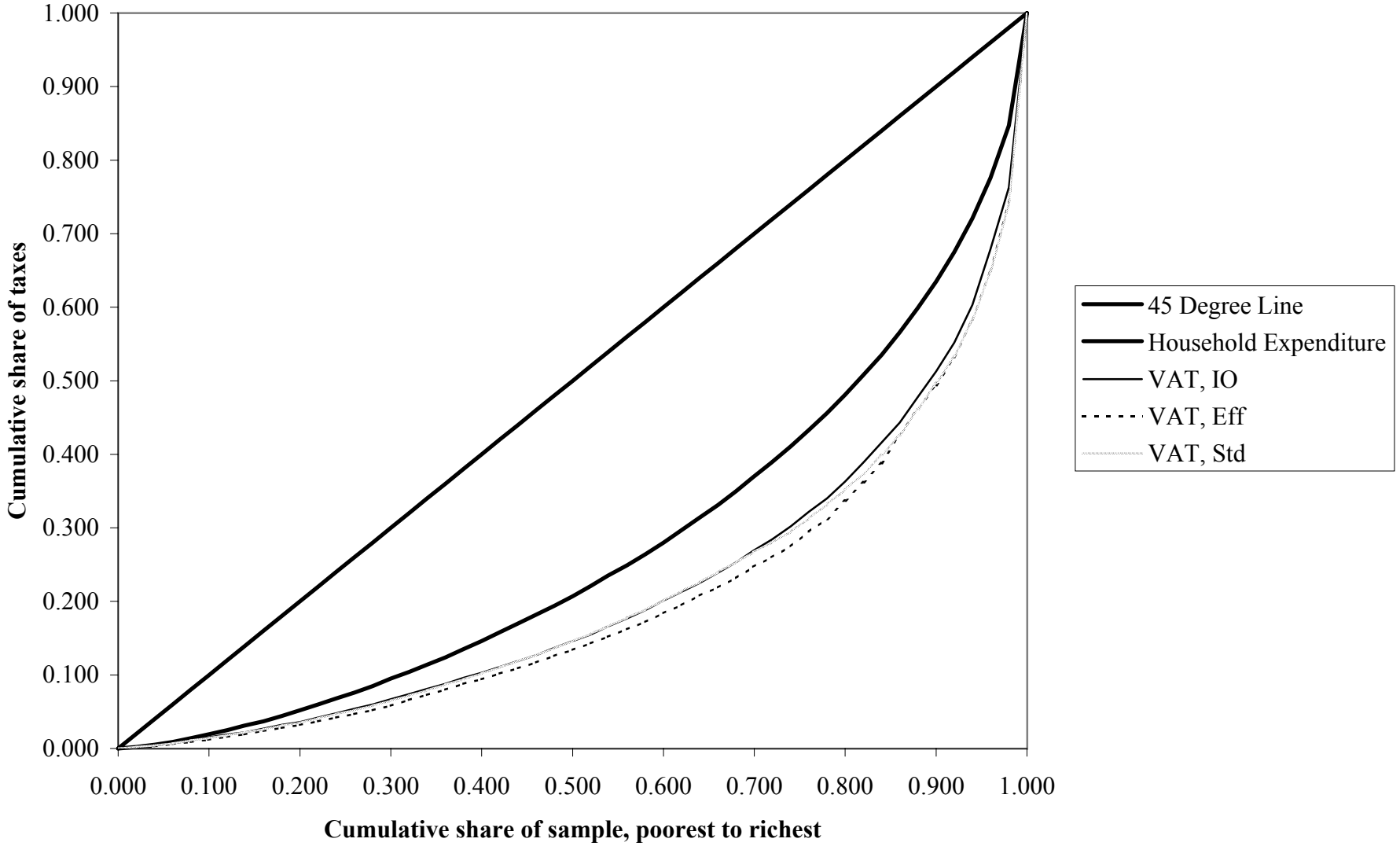

Figure 3 - Concentration curves for producer taxes in Madagascar: Comparison of methods

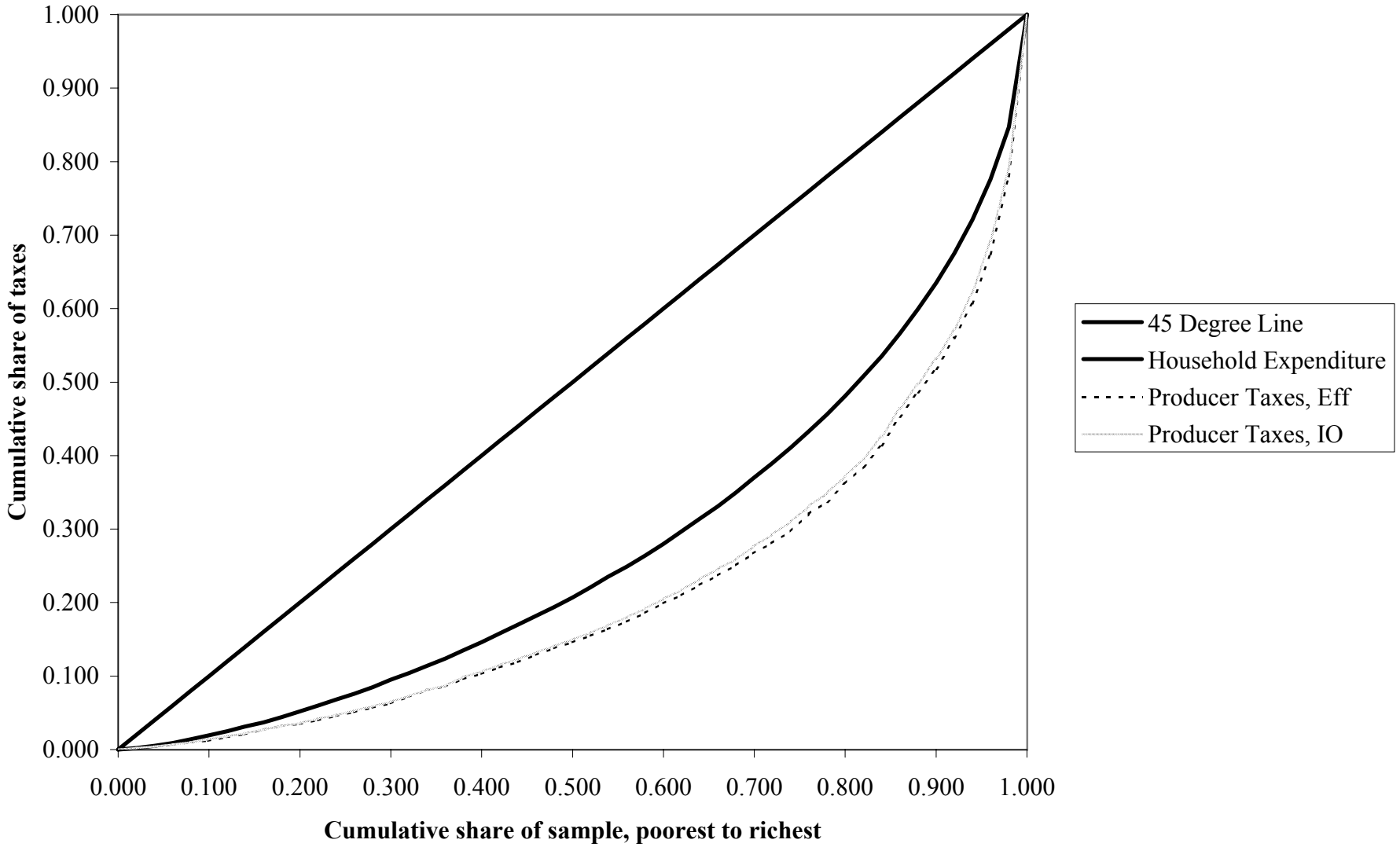

Figure 4 - Concentration curves for petroleum duties in Madagascar: Comparison of methods

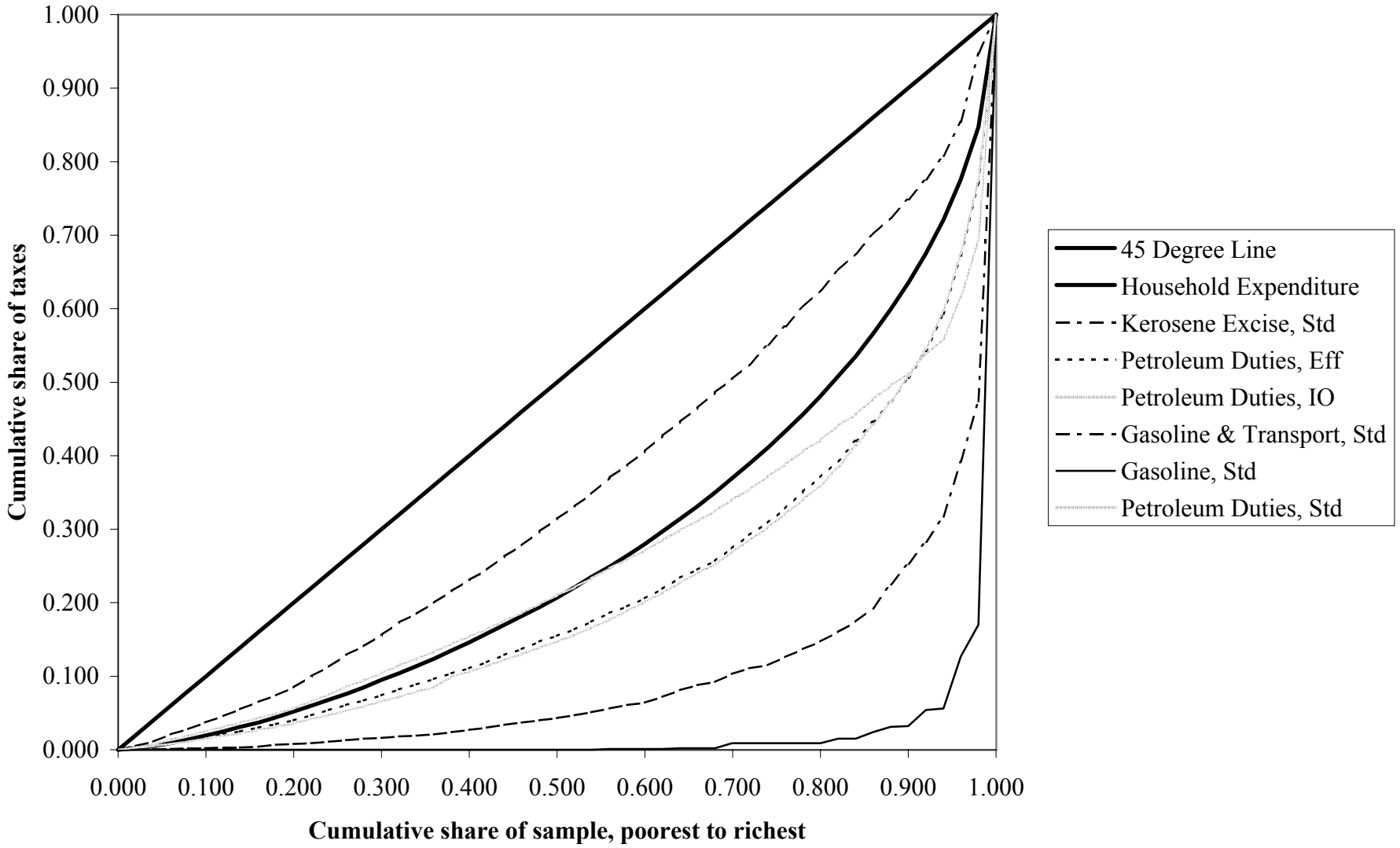

Figure 5 - Concentration curves for excise taxes in Madagascar: Comparison of methods

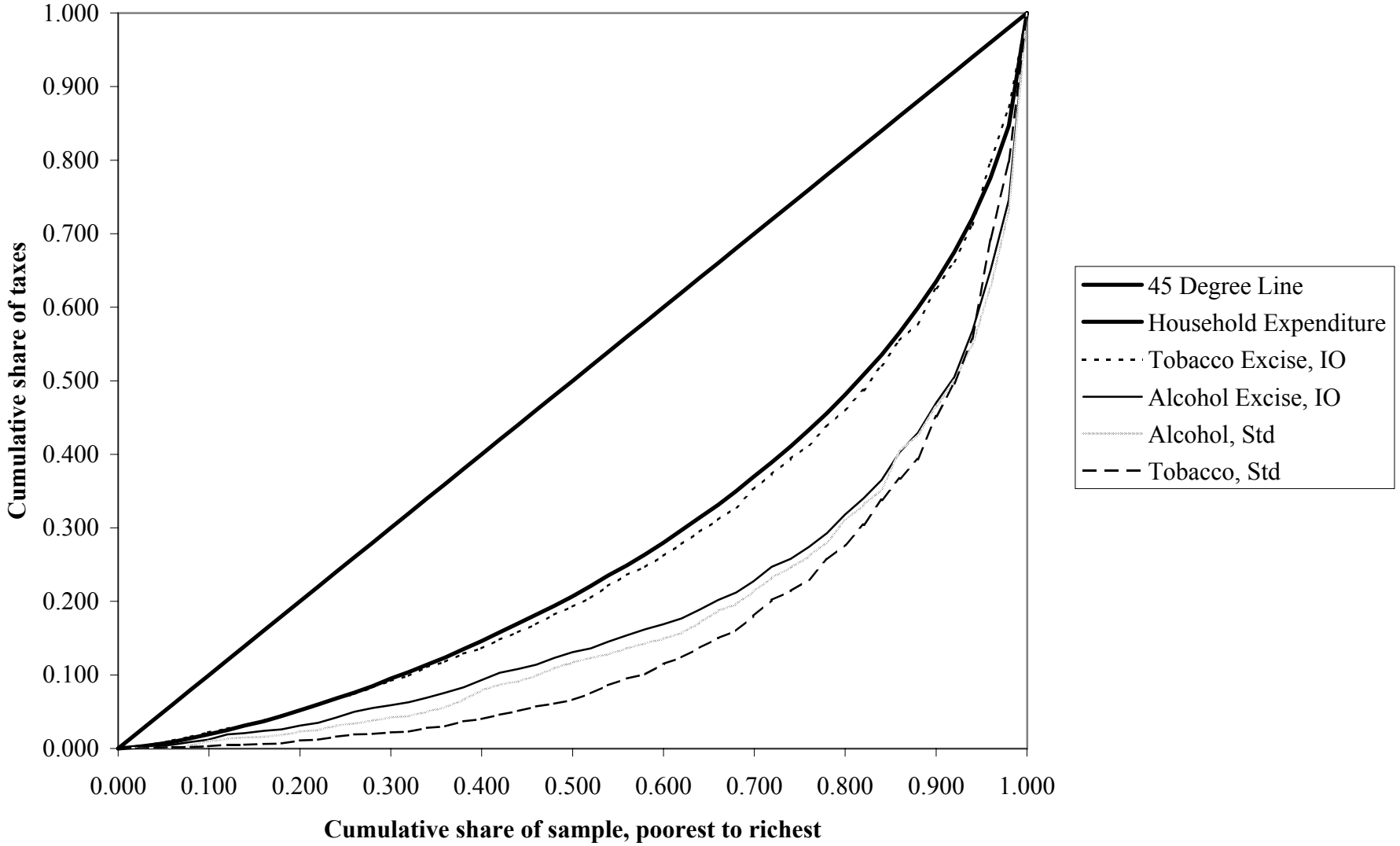

Figure 6 - Concentration curves for each tax in Madagascar, standard method

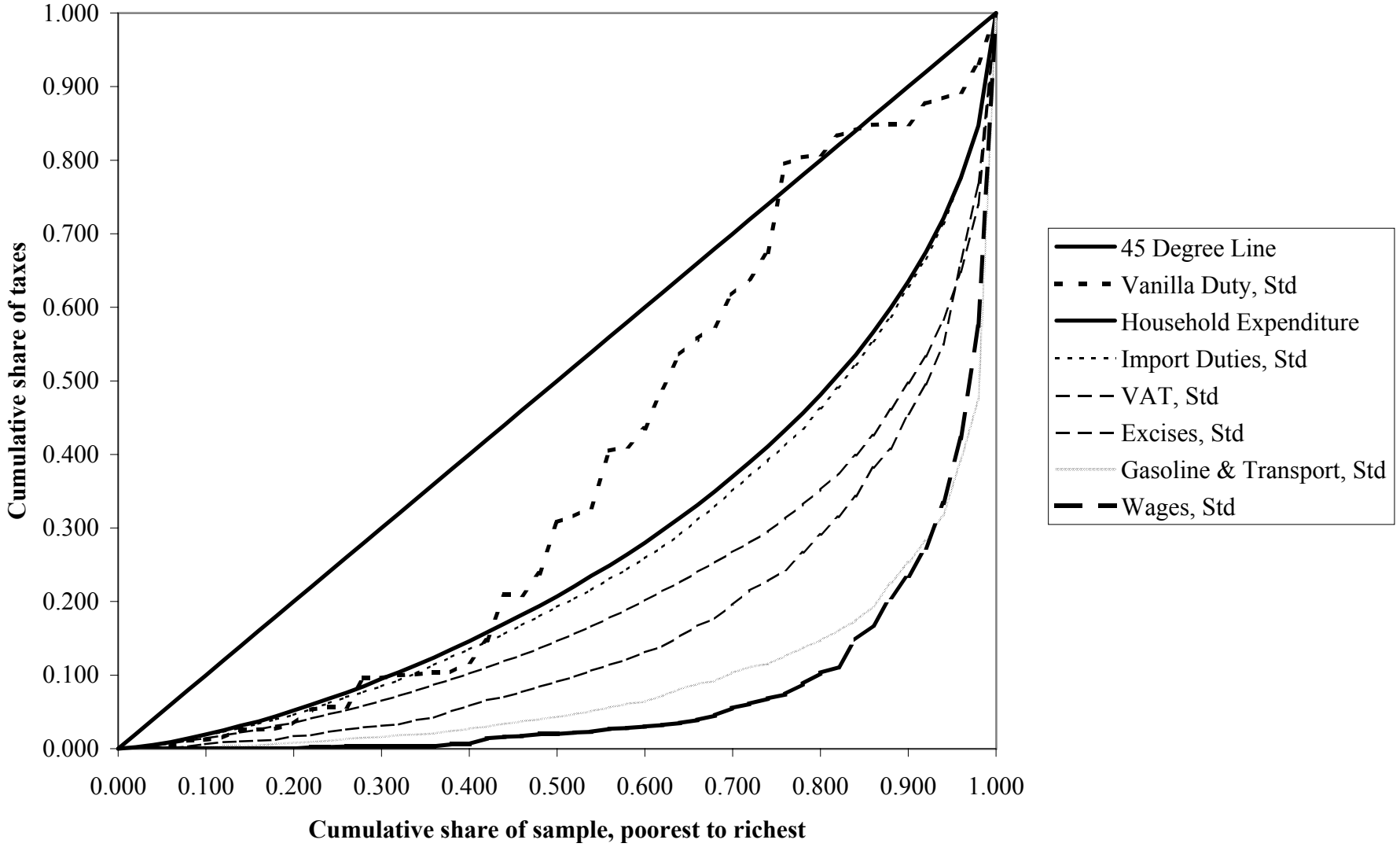

Figure 7 - Concentration curves for each tax in Madagascar, I-O table method