THE WORLD BANK ECONOMIC REVIEW, VOL. 13, NO. 2: 303-31

Tax Incidence in Madagascar: An Analysis Using Household Data

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This article discusses tax incidence in Madagascar and asks who pays the taxes that finance government spending. Its main concern is to identify the progressivity of different taxes levied in Madagascar, based on the consumption and income patterns found in the 1994 Enquête Permanente auprès des Ménages, *a nationally representative survey. The results suggest that most taxes are progressive, meaning that wealthy households pay proportionately more of these taxes relative to their expenditures than do poor households. Two notable exceptions are taxes on kerosene and export duties on vanilla, both of which are regressive. These results are consistent with those of a study of Ghana, the only other comparable research on tax incidence in Africa. That study found taxes on kerosene and cocoa exports to be the most regressive taxes in Ghana.*

Making firm policy recommendations for tax reform would require an analysis of the economic efficiency and administrative efficacy of different taxes to complement this article's work on their equity implications. Nevertheless, the results suggest that the movement away from trade taxes, especially export duties, and toward broadly based value added or income taxes would be more equitable and more economically efficient. The only legitimate impediment to such reforms in Madagascar is administrative, that is, the government's ability to collect different taxes effectively. Although administrative efficiency may be a problem for value added or income taxes, taxes on petroleum products (except kerosene) are highly progressive and provide a good tax handle.

Maintaining fiscal balance is central to any adjustment effort. The most successful adjustment programs in Africa and elsewhere have quickly and permanently eliminated fiscal deficits, while many other attempts to reestablish macroeconomic control have foundered on an inability to match expenditures to revenues. Despite this generally accepted maxim, many critics of adjustment programs have expressed concern that fiscal stabilization will hurt the poor. Most of that literature has focused on expenditure reductions and their likely impact on poor households. The report produced by Cornia, Jolly, and Stewart (1987) for the United Nations Children's Fund is the most famous example (Sahn, Dorosh, and Younger

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1996 contest many of their arguments). Even though tax increases have received much less attention (Younger 1996 is an exception), similar concerns about how tax reform affects poverty and inequality are relevant. When governments change the structure of taxation, who suffers the incidence of those taxes?

This question is especially pertinent in Africa, where interest in reforming taxes takes two directions. First, the ratio of tax revenue to gross domestic product (GDP) is low in Africa (except for countries with large mineral royalties), often no more than 10 or 12 percent of GDP. Thus there is a need to raise overall revenue. Second, many tax systems in Africa are very distortionary, concentrating on trade taxes while neglecting direct taxes and broad-based indirect taxes, such as a value added tax (VAT). To some extent, both of these problems reflect deeper structural issues. Tax handles for broad-based taxes are limited in economies with small formal sectors that are dominated by the public sector. Further, formal sector enterprises and workers are often politically powerful and thus able to lobby against their own taxation.

The situation in Madagascar is typical of these general patterns. Tax revenues fell steadily during the past 20 years, while expenditures remained constant (with the exception of a sharp decline in 1981), leaving a substantial and growing fiscal deficit. At the same time, trade taxes continue to account for more than half of Madagascar's tax revenue, significantly distorting incentives. Thus, like many African countries, Madagascar needs to increase its tax revenue and do so in a less distortionary way.

Policymakers interested in tax reform must consider tax incidence. This article begins to address that issue for Madagascar. We use household income and expenditure data from the *Enquête Permanente auprès des Ménages* (EPM; Government of Madagascar 1994), a nationally representative survey of 4,500 households conducted from April 1993 to April 1994 by the *Institut National de la Statistique* (INSTAT 1995). We use these data to determine which households are likely to pay certain taxes. We then judge the progressivity of the tax based on whether paying households are from the lower or upper ends of the expenditure distribution.

I. Tax Reform in Madagascar

During most of the 1980s Madagascar maintained relatively low budget deficits as part of its stabilization and structural adjustment efforts. But since 1988, and especially after 1990, the fiscal deficit has widened considerably, threatening macroeconomic stability and prospects for economic growth. The share of government expenditures in GDP rose from 16.7 percent in 1990 to 19.7 percent in 1993, before falling back to 17.6 percent in 1995. Over the same period government revenues fell from 11.8 percent to only 8.3 percent of GDP (table 1). Thus by 1995 Madagascar's fiscal deficit stood at 9.3 percent of GDP.

Trade taxes account for more than half of Madagascar's government revenue, and fluctuations in trade tax revenues explain most of the variation in total gov-

Table 1. *Central Government Budgetary Revenue in Madagascar, 1978 and 1988–95*
(percentage of GDP)

Type of revenue	*1978*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Tax revenue	12.7	10.5	8.8	9.4	6.8	8.7	8.2	7.7	8.1
Taxes on net income and profits	2.6	1.5	1.1	1.5	1.3	1.3	1.6	1.7	1.2
Taxes on property	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Taxes on domestic goods and services	3.5	2.8	2.5	2.2	1.7	2.7	2.2	2.2	2.1
Taxes on foreign trade	6.3	5.8	5.0	5.5	3.8	4.5	4.5	3.7	4.6
Import duties	4.4	4.6	3.9	4.7	3.1	4.0	4.0	3.5	4.3
Import duties on petroleum	—	0.3	0.2	0.1	0.2	0.6	0.9	0.2	0.6
Export duties	1.9	1.3	1.2	0.8	0.7	0.5	0.2	0.2	0.3
Other taxes	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nontax revenue	0.7	0.3	0.5	0.7	0.4	0.3	0.4	0.5	0.2
Total budgetary revenue	13.4	10.7	9.3	10.1	7.2	9.0	8.6	8.2	8.3
Nonbudgetary revenue	3.0	2.3	1.9	1.7	1.3	0.8	1.1	0.1	0.0
FNUP[a]	3.0	2.0	1.3	0.8	0.5	0.8	0.2	0.1	0.0
Export duties including FNUP[a]	4.9	3.3	2.5	1.7	1.2	1.3	0.4	0.3	0.3
Total trade taxes including FNUP[a]	9.3	7.8	6.4	6.4	4.3	5.2	4.7	3.8	4.6
Nontrade taxes	7.1	5.2	4.9	5.4	4.2	4.6	5.1	4.5	3.7
Total revenue	16.4	13.1	11.3	11.8	8.5	9.8	9.7	8.3	8.3

— Not available.

a. FNUP is the *Fonds National Unique de Péréquation*, the export price stabilization fund.

Source: World Bank (1984, 1986, 1991); International Monetary Fund data.

ernment revenue in the past two decades. In the late 1970s, when world prices of Madagascar's major exports—coffee, vanilla, and cloves—were high, export tax revenues, including revenues of the export price stabilization fund, *Fonds National Unique de Péréquation* (FNUP), surged, helping to finance an ill-fated public investment push (the *investir à outrance* policy). Import tax revenues also increased as imports of capital and intermediate goods rose, so that trade taxes reached 9.3 percent of GDP in 1978. World prices of Madagascar's exports fell in the early 1980s, however, and trade tax revenues also declined, necessitating large cuts in government expenditures to reduce budget deficits. Later in the decade the government liberalized marketing and eliminated most export taxes on all crops, except vanilla, as part of an overall trade reform designed to promote exports. These lower tax rates together with a decline in world prices of exports reduced export tax revenues from 5.0 percent of GDP in 1987 to 0.3 percent in 1995 (table 1).

Explicit export taxes represented only part of the total taxation on export crop producers. In most years prior to 1994 Madagascar maintained foreign exchange controls that forced exporters to surrender their foreign exchange earnings at the official exchange rate, while limiting importers' access to foreign exchange. Excess demand for foreign exchange at the official exchange rate led to a parallel market. Exporters were thus implicitly taxed through the overvalued exchange rate, with the premium in the parallel market approximating this implicit tax.[1] These implicit taxes on coffee producers significantly raised the total rate of taxation. The system of fixed producer prices and government-controlled marketing resulted in generally large, but variable, rates of effective taxation on exports and wide fluctuations in FNUP revenues.

Government efforts to raise tax revenues through other channels have not been effective. Nontrade tax revenues have declined along with export tax revenues, from 5.4 percent of GDP in 1990 to only 3.7 percent in 1995. Recent efforts to reform the tax system have shifted focus from sales taxes and turnover taxes to a VAT, which was instituted in 1994. In theory, the advantage of a VAT is that it is less distortionary than turnover taxes, which essentially tax intermediate purchased inputs twice: first, when the firm purchases intermediate goods and, second, when the firm sells final goods. Likewise, the VAT is in theory more efficient than import tariffs, which raise the domestic price of imported goods, thus protecting import-substituting industries. In contrast, a uniform VAT taxes both the value added content of imports and the value added in domestically produced goods at the same rate.

Madagascar's VAT differs from a uniform nondistortionary VAT in two respects: many import tariffs remain, and most domestic production escapes the VAT. Thus

1. A better measure of the indirect tax rate on exporters is the difference between an equilibrium real exchange rate and the actual official real exchange rate (Krueger, Schiff, and Valdes 1988). Dorosh, Bernier, and Sarris (1990) use this methodology to calculate that Madagascar's total tax on coffee producers in 1981–87 averaged 77.5 percent of the border price measured at the equilibrium exchange rate, with the indirect tax from exchange rate distortions equaling 49.3 percent.

in 1995 total revenues from the VAT on domestic value added equaled only 232.6 billion Madagascar francs (FMG)—only about 8 percent of value added in Madagascar's formal sector. Officially, however, the VAT rate was 25 percent. In contrast, the average import tariff (calculated as total import tariffs divided by the c.i.f. value of imports) was 23 percent, whereas the VAT on imports equaled 10.9 percent of the c.i.f. value of imports.

II. Methodology

In general terms, a tax transfers real purchasing power from households to the government. The incidence of the tax refers to who pays the tax in real terms, that is, whose real purchasing power falls when the government imposes the tax. Taxes are said to be progressive if poorer households pay a proportionately smaller share of the tax than do wealthy households, relative to some measure of overall welfare, usually income or expenditures. Taxes are regressive if the opposite is true and neutral if tax shares are equal to overall income or expenditure shares.

In this study we use household expenditures (per capita) rather than income as our welfare measure. We do this for two reasons. Practically, households tend to report their expenditures more accurately than they report their incomes. They have less incentive to hide expenditures than income (from the enumerator and from family members). Theoretically, the life-cycle/permanent-income hypothesis suggests that expenditures are a more stable representation of a household's long-term welfare than is income, because households try to smooth their expenditures given income fluctuations over time. As a result, expenditures reflect households' own estimates of their permanent income over time and are thus a better proxy for their long-term welfare.

Statutory and Economic Incidence

Since the work of David Ricardo 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 from imposition of the tax. They may successfully shift the tax onto other households. Governments in developing countries collect most taxes from firms, but firms do not suffer reductions in purchasing power. Either the households that own them do, or firms shift the taxes onto their customers or suppliers by changing prices. For example, it is standard to assume that if an industry is competitive, then a tax on its product will be passed onto consumers through a price increase equal to the tax rate. In contrast, a tax on a firm's profits probably falls mostly on the firm's owners. The other common example is avoiding a tax by changing one's pattern of consumption or income. For instance, households that have high elasticities of demand for gasoline can avoid paying 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.

The *economic incidence* of a tax refers to where the reduction in real purchasing power falls, while the *statutory incidence* refers to who is legally required to pay the tax. Clearly, it is the economic incidence that is of interest in any analysis of how taxes affect poverty and inequality. Unfortunately, it is often much easier to identify the statutory incidence. Here, we examine economic incidence, but in doing so we must rely on strong assumptions. For direct taxes we assume that the factors producing the associated incomes pay the taxes. Thus wage workers pay the withholding tax on wage income, business owners pay the tax on their firm's profits, and so on. This assumption is equivalent to assuming that households supply the associated factors completely inelastically so that they cannot shift the tax. Selden and Wasylenko (1992) defend this 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 time and effort.

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 taxes on kerosene, and so on. There are, however, two exceptions to this general rule, made 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 taxes is regressive because an increase in gasoline prices gives rise to increases in other prices, especially transport, on which poor people depend more than rich people. To include this effect, we assume that the gasoline tax falls on both direct consumers of gasoline and on consumers of public transport. Still, this adjustment is only partial, because it does not include the effects of the tax when transport is an intermediate product.

Import duties are the other type of tax that is difficult to manage. Household surveys do not ask whether goods consumed are imported or not, so we cannot directly identify consumers of imports. 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 imported or produced domestically. But the full payment does not go to the government. A share of the benefits from the import duty goes to protected local producers who can charge a higher price for their output. Thus the cost to consumers is not equal to the government's revenue.

We describe our tax calculations in greater detail in appendix A. Data problems call for some caution in interpreting results. Total household consumption is substantially underreported in the EPM survey, which may be due to underreporting (by households) or to undervaluing consumption from own production. In addition, the total value of taxes paid by households in the survey is lower than revenues reported by the Ministry of Finance. For example, the value of the VAT, income tax, and vanilla tax reported in the survey is three-quarters or more of government revenue. In contrast, this figure is only 56 percent for excises on alcohol and tobacco, probably reflecting underreporting of consump-

tion. Import taxes on food and consumer products, excluding petroleum, are roughly equal in the survey and in the national accounts. But despite the good correspondence of consumer products, we do not capture the import taxes paid on intermediate inputs and raw materials.

Conceptual Methods for Evaluating Tax Incidence

A general method for studying tax incidence is to test for "welfare dominance" (Yitzhaki and Slemrod 1991). Yitzhaki and Slemrod construct concentration curves—diagrams that are similar to Lorenz curves in that they align households from the poorest to the wealthiest along the horizontal axis and the cumulative proportion of taxes paid along the vertical axis. Yitzhaki and Slemrod then prove that for any social welfare function that favors an 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 above y's.[2] In this case we say that taxing x dominates taxing y (or 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 food and raising taxes on gasoline will improve the distribution of welfare. Yitzhaki and Slemrod refer to this as "welfare dominance," making an analogy to 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 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. A tax whose concentration curve is below the Lorenz curve for expenditures is progressive, and a tax whose concentration curve is above the Lorenz curve is regressive.[3] As the tax's concentration curve approaches the 45-degree line, it becomes extremely regressive, as in a head tax.

Statistical Tests

Unlike many other works in the field (including Yitzhaki and Slemrod 1991), we use statistical tests to determine whether one concentration curve is everywhere above another. In particular, we use Davidson and Duclos's (1997) variance-covariance estimator for the ordinates of two possibly dependent con-

2. Technically, the argument also requires that the efficiency consequences of the tax change be at least neutral, that is, that the efficiency of the allocation of resources 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.

3. A referee pointed out that this definition of progressivity is less stringent than the one usually found in public finance textbooks: that the marginal tax rate exceed the average tax rate everywhere. Because we are working with cumulative tax payments, it is possible for the marginal rate to fall below the average rate in some ranges and still be progressive by our definition.

centration curves to test for differences in these ordinates (see appendix B). This procedure involves testing for differences at a finite number of ordinates, thus restricting the range of the dominance test. Here, we use 20 evenly spaced ordinates, so that our conclusions are valid for the range 0.05–0.95.

Typically, researchers who apply statistical methods to test for differences between the ordinates of two concentration curves at several abscissa use *t*-tests. They reject the null hypothesis of nondominance when one of the ordinates differs statistically in the direction of dominance and none of the other pairs differs statistically in the opposite direction (see, for example, the recent article by Gouveia and Tavares 1995). Howes (1996) uses both theoretical and simulation arguments to show that this procedure probably rejects the null too frequently, especially when the concentration curves cross. He argues that we can only be sure of the probability of a type I error (that is, the size of the test) if we reject the null hypothesis when the difference in the ordinates of the two curves is nonzero for *every* ordinate tested (and when the difference is of the same sign).

By using more careful statistical procedures, we reduce the power of the test so that we often do not reject the null. When the dominance tests are inconclusive, we can draw conclusions only by being more specific about the importance of each household in the social welfare function. To do this, we rely on cardinal measures of inequality. (Recall that if one distribution is welfare dominant over another, then the first will be preferred to the second under any social welfare function that favors progressivity.) For example, if we rank taxes by the Gini coefficients for their concentration curves, we will always have an ordering, but it comes at a price: by comparing Gini coefficients for different concentration curves, we implicitly accept the social welfare function of the Gini formula. Another welfare function might yield a different ordering. Yitzhaki (1983) 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. He shows that an extended Gini coefficient can adjust the weight given to poorer households and thus better depict how more progressive social welfare functions would rank different taxes. The coefficient is defined as:

$$(1) \qquad G(\nu) = -\nu\,[\mathrm{cov}\{e,[1 - F(y)]^{(\nu - 1)}\} / \bar{e}],\ \nu > 1$$

where e measures households' payment of a tax, $F(y)$ is the cumulative distribution of all households ranked from the poorest to the richest, $\bar{e}$ is the mean of e, and ν is a parameter that affects the weighting of each point on the Lorenz curve. In particular, $G(2)$ yields the traditional Gini coefficient, while values of ν greater than 2 yield measures that give greater weight to poorer households. Thus by calculating the extended Gini coefficient for increasing values of ν, we can gain a sense of how a wide range of increasingly progressive social welfare functions rank the value of a given tax. We calculate Ginis for values of ν from 1.01 to 10, in increments of 0.5. If all pairs of extended Ginis are significantly different in the same direction, then we conclude that one tax "Gini dominates" the other. This concept

clearly is not as general as the ordinal measure, but the implied policy conclusion is similar, even if based on cardinal measures.

Finally, we examine the sensitivity of our results to the choice of household equivalence scale. Much recent poverty literature argues that this choice is arbitrary and that any method of adjusting household incomes for differences in household size and composition reflects the researcher's value judgment more than an empirically testable scale (Deaton and Muellbauer 1980, 1986; Lanjouw and Ravallion 1995; Browning 1992; Blundell and Lewbel 1991; and Coulter, Cowell, and Jenkins 1992). Previous empirical research has shown the importance of the judgments made regarding equivalence on measures of inequality, particularly the range of cardinal measures, but also ordinal measures represented by the Lorenz curve (see, for example, Cutler and Katz 1992; Sahn, Younger, and Simler 1997). In this article we add to those findings by testing the sensitivity of the dominance tests and the extended Ginis to two single-parameter characterizations of the money metric of equivalent income: we set the elasticity with respect to household size initially to 1.0 (the per capita measure) and then to 0.5.

Sensitivity to Assumptions about Tax Incidence

Because concentration curves are based on cumulative shares of the consumption of a particular commodity, they are not sensitive to errors in the assumptions we make about the amount of tax paid per unit of the good consumed as long as the error is the same across households. Such errors are proportional to consumption and thus cancel the share of consumption from both the numerator and the denominator. The same is true of the actual tax rate that applies. If we want to consider the incidence of taxes on several different goods at once, however, then errors in the assumptions about taxes matter, because we add the actual taxes (not a ratio) across commodities. For example, suppose that we undervalue by 50 percent the taxes that households pay for alcohol consumption. The concentration curve for taxes on alcohol is not affected because each household's share of total consumption (and therefore total calculated taxes) remains the same. But problems would arise if we added the tax on alcohol to the tax on tobacco and checked the incidence of the two together. Because the estimated alcohol tax is too low, its weight in the composite commodity comprising alcohol and tobacco is also too low, and the concentration curve for the two together, which is a weighted average of the individual curves, will be weighted too little by the concentration curve for alcohol and too much by the curve for tobacco.

In the case of taxes that fall on many goods, such as the VAT, such problems are unavoidable. Still, we prefer to keep the taxes as disaggregated as possible to avoid the potential errors that composite goods present. In particular, we make no attempt to judge the overall progressivity of the entire tax system. Instead, we stick to individual taxes.

Another problem we face is that households misreport their consumption, especially of alcohol and tobacco. If underreporting is correlated with household

Table 2. *Dominance Results for Taxes in Madagascar, 1994*
($\theta = 1$)

Variable	*45-degree line*	*Vanilla*	*Kerosene*	*Expenditures*	*Imports*	*Petroleum*	*Value added tax*	*Alcohol*	*Gasoline via transport*[a]	*Excises*	*Tobacco*	*Wages*	*Automobile*	*Transport and gasoline*[b]	*Gasoline*[c]
45-degree line			D	D	D	D	D	D	D	D	D	D	D	D	D
Vanilla			X	X	X	X	X								
Kerosene		X		D	D	D	D	D	D	D	D	D	D	D	D
Expenditures		X					D	D	D	D	D	D	D	D	D
Imports		X						D	D	D	D	D	D	D	D
Petroleum		X										D	D	D	D
Value added tax		X										D	D	D	D
Alcohol												D	D	D	D
Gasoline via transport[a]												D	D	D	D
Excises												D	D	D	D
Tobacco												D		D	D
Wages															
Automobile															
Transport and gasoline[b]															
Gasoline[c]															

Note: D indicates that we reject the null hypothesis in favor of dominance, that is, the item in the column dominates the item in the row. *X* indicates that we reject the null in favor of crossing. The elasticity with respect to household size, θ, is set at 1.0.

a. Gasoline via transport refers to the part of the direct tax on gasoline that falls on users of public transport.

b. Transport and gasoline refers to the combined impact of the direct tax on gasoline and the indirect tax on users of public transport.

c. Gasoline refers to the direct tax on gasoline.

Source: Calculated from Government of Madagascar (1994).

expenditures (over the welfare measure), then our results will be biased. For example, if wealthier households consume more alcohol than poorer households, but they do not report their consumption, perhaps because consuming more than a small amount is frowned on, then our estimate of the tax incidence will be too regressive. A similar problem occurs with tax evasion. We are applying statutory tax rates to observed income and expenditure patterns. But wealthier people may be better at avoiding taxes, especially direct taxes, so that our estimated incidence will be too progressive.

III. Results

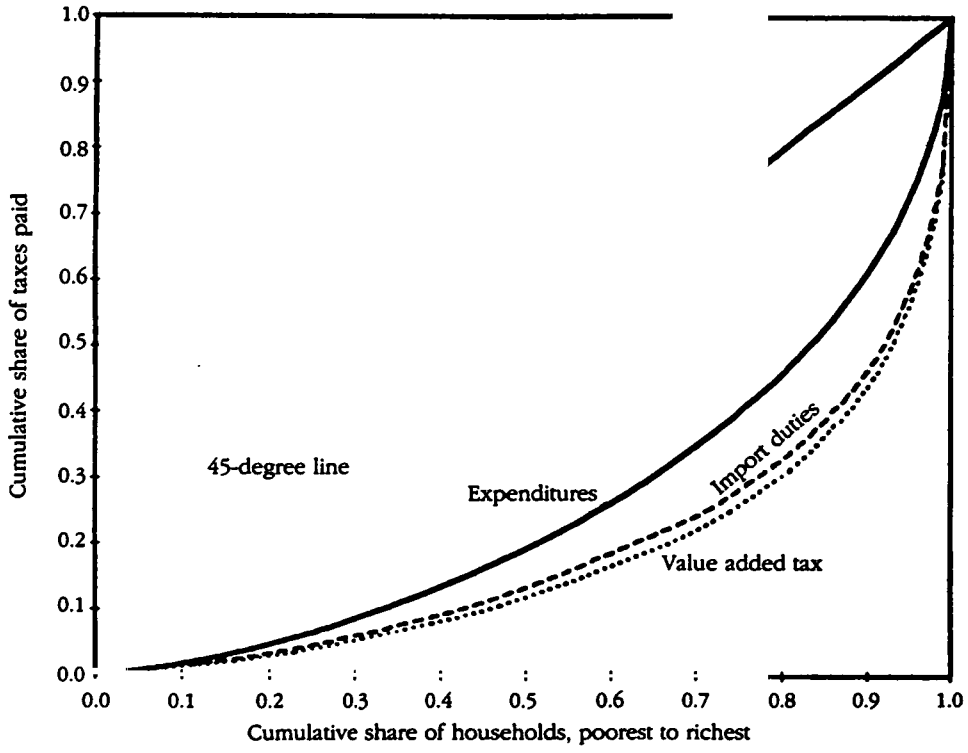
For the most part the results based on the dominance testing and extended Ginis give similar results.[4] Table 2 summarizes the results of statistical tests of the null hypothesis that the concentration curves for two taxes are equal and that they are equal to the expenditure Lorenz curve. Recall that welfare dominance means that a slight increase in the dominant tax, offset by a slight reduction in the dominated tax, will improve social welfare for any welfare function that favors a more equitable distribution of expenditures. Put another way, the dominant tax is more progressive than the other.

The two most important taxes in Madagascar are import taxes (duties and tariffs) and the VAT. The VAT is progressive, while import duties are not, although we cannot reject the null hypothesis that they have the same concentration curves (figure 1 and table 2). However, we cannot reject the null because of one insignificant t-statistic (at 0.05). Tests based on the extended Ginis do reject the null (extended Ginis are listed in table 3). Thus, at first appearance, reforming the tax structure by moving away from import duties and toward the VAT may have a positive, albeit small, impact on the after-tax distribution of welfare in Madagascar. But our analysis has not captured an important difference between these two taxes. We have assumed that import duties increase the price of all goods of the same type, whether imported or not, so that buyers of those goods suffer the incidence of the tax. The offsetting increase in real purchasing power does not go entirely to the government, however. Local producers receive part of the increase because the import protection allows them to charge higher prices. Under the VAT, however, all of the benefits go to the government. While we cannot be sure of the incidence of all the benefits of import taxes, it is reasonable to assume that the benefiting firms are owned by households at the upper end of the expenditure distribution. So, the net effect of the import duties is even less progressive than this analysis indicates, meaning that a shift from import taxes to the VAT is likely to be even more progressive than figure 1 suggests.

The other indirect taxes in Madagascar are excise duties on specific products: alcohol, tobacco, automobiles, and petroleum products (figures 2 and 3). The

4. Ordinate estimates and standard errors for tax concentration curves are given in appendix C. Ordinate estimates, their standard errors, and t-statistics for differences between each transfer and the Lorenz curve are available from the authors.

Figure 1. *Concentration Curves for Import Duties and the Value Added Tax in Madagascar, 1994*



Note: Expenditure and tax data are on a weighted and per capita basis.
Source: Calculated from Government of Madagascar (1994).

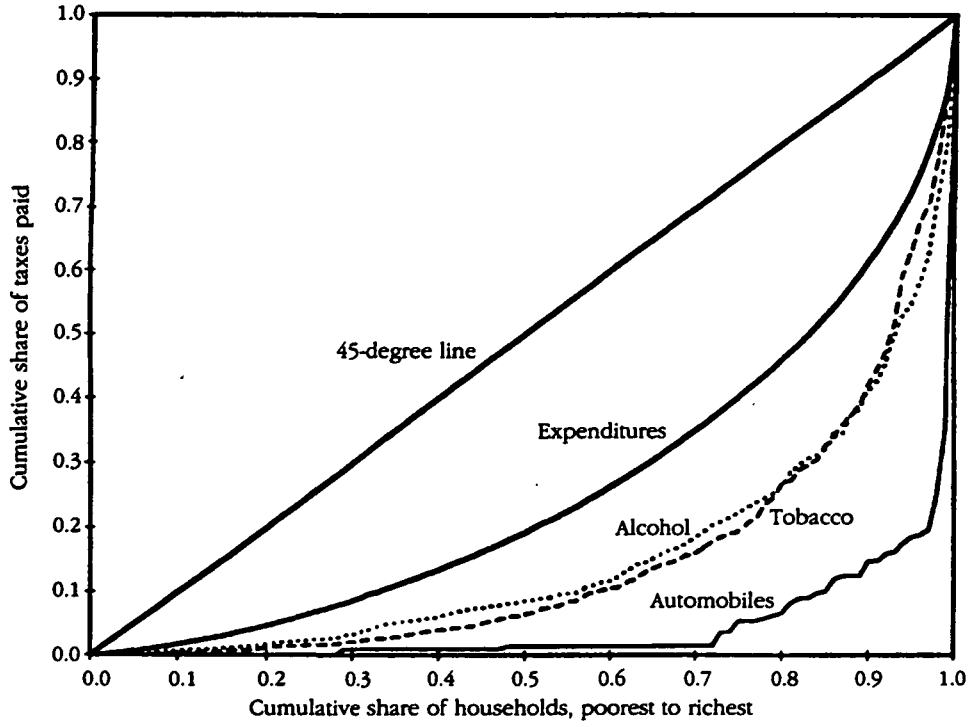
concentration curves for excise taxes on tobacco and alcohol are statistically indistinguishable from the concentration curve of the VAT but dominate that of import taxes. Taxes on automobiles are more progressive than import duties, the VAT, and other excise taxes (table 2). Taxes on direct consumption of gasoline are also more progressive than all other taxes except automobile duties. Nevertheless, most gasoline is consumed as an intermediate input to other services, predominantly transport. We try to capture at least part of this indirect impact by assuming that gasoline accounts for 20 percent of the cost of intracity and intercity transport. (That is the input-output coefficient for petroleum in the transport sector.) We then assume that part of the gasoline tax falls on users of public transport, and we construct a concentration curve for that part of the tax, as well as one for the combined effect of direct purchases of gasoline and indirect purchases through public transport (figure 3). The results show that even the tax on public transport is progressive (although less so than the direct consumption of gasoline), mostly because it is concentrated among urban households. The combined tax (transport and gasoline) dominates both the VAT and import taxes.

Table 3. *Extended Gini Coefficients for Taxes in Madagascar, 1994*

v[a]	*45-degree line*	*Vanilla*	*Kero-sene*	*Expen-ditures*	*Imports*	*Petro-leum*	*Value added tax*	*Alcohol*	*Gasoline via transport*[b]	*Excises*	*Tobacco*	*Wages*	*Auto-mobile*	*Transport and gasoline*[c]	*Gasoline*[d]
1.5	0.000	0.0711	0.1915	0.3283	0.3429	0.4138	0.4538	0.4911	0.4813	0.4972	0.5017	0.6698	0.7646	0.8559	0.8700
2.0	0.000	0.1551	0.2838	0.4569	0.4795	0.5092	0.5911	0.6496	0.6561	0.6707	0.6861	0.8482	0.8923	0.9638	0.9701
4.0	0.000	0.4353	0.4369	0.6347	0.6624	0.6230	0.7426	0.8132	0.8437	0.8502	0.8770	0.9679	0.9755	0.9956	0.9973
10.0	0.000	0.6650	0.5759	0.7589	0.7801	0.7157	0.8278	0.8967	0.9273	0.9267	0.9485	0.9929	0.9942	0.9963	0.9969

a. A parameter that affects the weighting of each point on the Lorenz curve.
b. Gasoline via transport refers to the part of the direct tax on gasoline that falls on users of public transport.
c. Transport and gasoline refers to the combined impact of the direct tax on gasoline and the indirect tax on users of public transport.
d. Gasoline refers to the direct tax on gasoline.
Source: Calculated from Government of Madagascar (1994).

Figure 2. *Concentration Curves for Alcohol, Tobacco, and Automobile Excises in Madagascar, 1994*

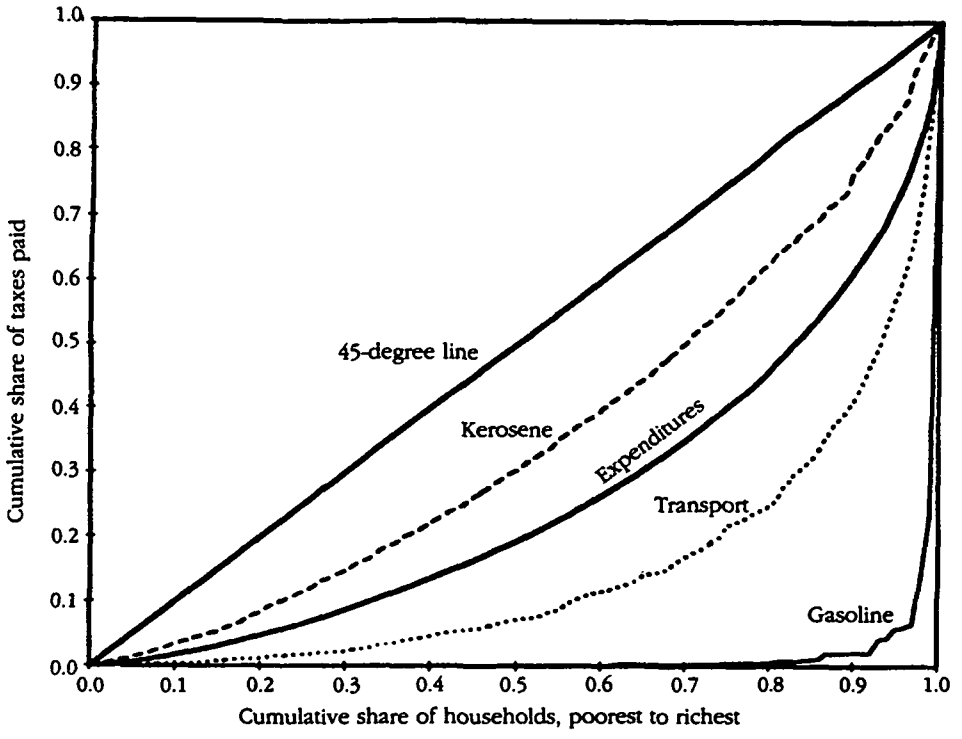


Note: Expenditure and tax data are on a weighted and per capita basis.
Source: Calculated from Government of Madagascar (1994).

Thus policymakers can rest assured that taxes on gasoline are not falling disproportionately on the poor. Rather, they are quite progressive. In contrast, taxes on kerosene, widely used as a fuel for lighting and cooking, are regressive. To the extent that it is both technically and practically feasible, it would be preferable to concentrate duties on gasoline and to reduce duties on kerosene. This result is similar to those in Younger (1996) and Yitzhaki and Lewis (1996).

The last two taxes we examine are the direct tax on wage earnings and the export duty on vanilla (figure 4). The tax on wages, which makes up a little less than half of direct taxes (the rest comes from corporations), is highly progressive, as we would expect, because it falls entirely on workers in the formal sector. For vanilla duties, even though the concentration curve is well above all others, we find no statistical difference between it and the concentration curves for other taxes and between it and the Lorenz curve. This finding is due to the small number of vanilla producers in the sample, 103, which makes rejection of the null difficult. Statistical comparisons of the extended Ginis support this view (table 4). By this criterion vanilla taxes are more regressive than many other types of taxes, particularly excises and taxes on wages and salaries. But the statistical

Figure 3. *Concentration Curves for Petroleum Excises in Madagascar, 1994*



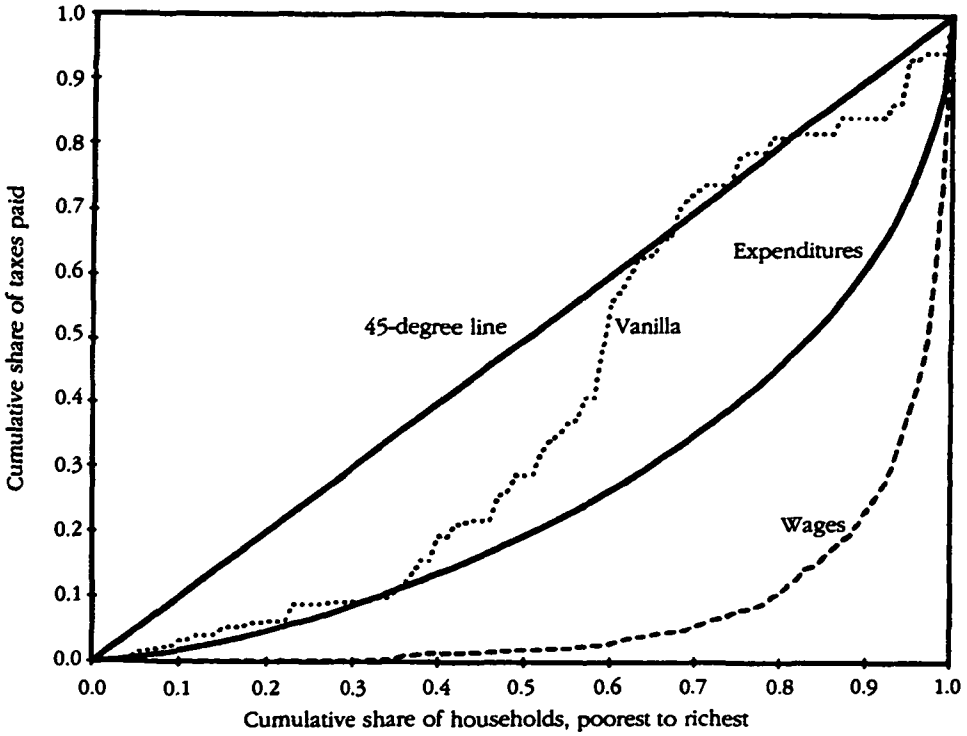
Note: Expenditure and tax data are on a weighted and per capita basis.
Source: Calculated from Government of Madagascar (1994).

comparisons still fail to show that vanilla taxes are regressive or that they are more regressive than the VAT or import duties. If we had a larger sample, we would expect to see that vanilla producers, who are rural farmers, are not as wealthy as the population in general. Thus the government's movement away from export duties probably has a positive distributional impact.

Next we examine the extent to which the results presented above are sensitive to the scale factor used in adjusting household incomes. The results continue to show that most of the taxes we examine are progressive (tables 5 and 6). Likewise, the general ordering of the taxes does not depart dramatically from that generated when we used the per capita equivalence unit, although there are fewer cases of dominance. This lack of sensitivity to household scale is unusual. As discussed, most other studies found that their results were not at all robust to size elasticity. One possible explanation is that the taxes we study in this article are not designed to be correlated with household size, while transfer payments studied in other articles usually are. Thus our results are less sensitive to household scaling than others found in the literature.

Finally, the extended Gini comparisons of progressivity are even more robust to assumptions about adjusting income for household size. In fact, there are only

Figure 4. *Concentration Curves for Vanilla Duties and Wages in Madagascar, 1994*



Note: Expenditure and tax data are on a weighted and per capita basis.
Source: Calculated from Government of Madagascar (1994).

four differences in the pair-wise comparisons of progressivity when using the different equivalence units. Not only do the Ginis imply a clearer ordering of the progressivity of different types of taxes, but the results are less sensitive to different equivalence scales.

IV. Conclusions

The progressivity of the taxes we examine is striking. In Ghana, the only other African country for which we have a comparable analysis, the broad-based consumption taxes are neutral, and the income tax, while progressive, is less so than in Madagascar. This contrast is all the more impressive given the high concentration of per capita consumption in Madagascar. (Madagascar's Gini for per capita expenditures is 0.48 compared with 0.36 for Ghana.) It is interesting to note that the only regressive taxes in Madagascar, those on kerosene and (probably) agricultural exports, are also the regressive taxes in Ghana.

Our analysis informs the debate on tax reform in Madagascar in several ways. First, economists usually argue that tax reform should shift the tax structure

Table 4. *Gini Dominance Results for Taxes in Madagascar, 1994*
($\theta = 1$)

Variable	*45-degree line*	*Vanilla*	*Kero-sene*	*Expen-ditures*	*Imports*	*Petro-leum*	*Value added tax*	*Alcohol*	*Gasoline via transport*[a]	*Excises*	*Tobacco*	*Wages*	*Auto-mobile*	*Transport and gasoline*[b]	*Gasoline*[c]
45-degree line			D	D	D	D	D	D	D	D	D	D	D	D	D
Vanilla								D	D	D	D	D	D	D	D
Kerosene				D	D	D	D	D	D	D	D	D	D	D	D
Expenditures							D	D	D	D	D	D	D	D	D
Imports							D	D	D	D	D	D	D	D	D
Petroleum												D	D	D	D
Value added tax											D	D	D	D	D
Alcohol												D	D	D	D
Gasoline via transport[a]												D	D	D	D
Excises												D	D	D	D
Tobacco												D	D	D	D
Wages															D
Automobile															
Transport and gasoline[b]															
Gasoline[c]															

Note: D indicates that we reject the null hypothesis in favor of dominance, that is, the item in the column dominates the item in the row. X indicates that we reject the null in favor of crossing. The elasticity with respect to household size (θ) is set at 1.0.

a. Gasoline via transport refers to the part of the direct tax on gasoline that falls on users of public transport.

b. Transport and gasoline refers to the combined impact of the direct tax on gasoline and the indirect tax on users of public transport.

c. Gasoline refers to the direct tax on gasoline.

Source: Calculated from Government of Madagascar (1994).

Table 5. *Dominance Results for Taxes in Madagascar, 1994*
($\theta = 0.5$)

Variable	*45-degree line*	*Vanilla*	*Kero-sene*	*Expen-ditures*	*Imports*	*Petro-leum*	*Value added tax*	*Alcohol*	*Gasoline via transport*[a]	*Excises*	*Tobacco*	*Wages*	*Auto-mobile*	*Transport and gasoline*[b]	*Gasoline*[c]
45-degree line		X	D	D	D	D	D	D	D	D	D	D	D	D	D
Vanilla	X		X			X									
Kerosene		X		D	D	D	D	D	D	D	D	D	D	D	D
Expenditures						X	D	D	D	D	D	D	D	D	D
Imports						X		D	D	D	D	D	D	D	D
Petroleum		X		X	X							D	D	D	D
Value added tax												D	D	D	D
Alcohol															
Excises												D	D	D	D
Gasoline via transport[a]												D	D	D	D
Tobacco												D	D	D	D
Wages															
Automobile															
Transport and gasoline[b]															
Gasoline[c]															

Note: D indicates that we reject the null in favor of dominance, that is, the item in the column dominates the item in the row. *X* indicates that we reject the null in favor of crossing. The elasticity with respect to household size (θ) is set at 0.5, which is near the lower end of scales found in the literature.

a. Gasoline via transport refers to the part of the direct tax on gasoline that falls on users of public transport.

b. Transport and gasoline refers to the combined impact of the direct tax on gasoline and the indirect tax on users of public transport.

c. Gasoline refers to the direct tax on gasoline.

Source: Calculated from Government of Madagascar (1994).

Table 6. *Gini Dominance Results for Taxes in Madagascar, 1994*
($\theta = 0.5$)

Variable	*45-degree line*	*Vanilla*	*Kero-sene*	*Expen-ditures*	*Imports*	*Petro-leum*	*Value added tax*	*Alcohol*	*Gasoline via transport*[a]	*Excises*	*Tobacco*	*Wages*	*Auto-mobile*	*Transport and gasoline*[b]	*Gasoline*[c]
45-degree line			D	D	D	D	D	D	D	D	D	D	D	D	D
Vanilla			X						D	D	D	D	D	D	D
Kerosene		X		D	D	D	D	D	D	D	D	D	D	D	D
Expenditures							D	D	D	D	D	D	D	D	D
Imports							D	D	D	D	D	D	D	D	D
Petroleum												D	D	D	D
Value added tax												D	D	D	D
Alcohol												D	D	D	D
Excises												D	D	D	D
Gasoline via transport[a]												D	D	D	D
Tobacco												D	D	D	D
Wages															
Automobile															
Transport and gasoline[b]															
Gasoline[c]															

Note: D indicates that we reject the null in favor of dominance, that is, the item in the column dominates the item in the row. *X* indicates that we reject the null in favor of crossing. The elasticity with respect to household size (θ) is set at 0.5, which is near the lower end of scales found in the literature.

a. Gasoline via transport refers to the part of the direct tax on gasoline that falls on users of public transport.

b. Transport and gasoline refers to the combined impact of the direct tax on gasoline and the indirect tax on users of public transport.

c. Gasoline refers to the direct tax on gasoline.

Source: Calculated from Government of Madagascar (1994).

toward broad-based taxes, such as a VAT or income tax, on economic efficiency grounds. In industrial countries such taxes tend to be less progressive than other more specific taxes concentrated on luxury goods, because their breadth of coverage, which makes them less distortionary, also brings their distribution close to the overall income or expenditure distribution. In Madagascar, however, that is not the case. Both the VAT and the tax on wage and salary income are progressive. At first sight this result is comforting for those who favor a move to the traditional broad-based taxes. But it also reveals that these taxes are not nearly as broad-based as they are in an industrial economy, because the formal sector, to which they apply, is relatively small in Madagascar. Although the taxes are progressive, they may be more distortionary than is typically supposed.

Import duties are less progressive than the VAT, although not dramatically so, probably because the formal sector produces few goods that are not also imported, so the tax bases for the two are not as different as one might expect. This does not mean that the two can be substituted, however. Import duties still distort incentives, favoring a closed economy. Also, some of the benefits of import duties go to local firms, or more precisely, their owners, who are almost surely from the top end of the income distribution, whereas all of the benefits of a VAT go to the government, whose expenditures are probably more progressive.

The export duty on vanilla has the highest concentration curve, yet we cannot reject the null of equality between it and all other taxes or between it and the expenditure distribution. This indeterminate result is likely due to the small number of producers in our sample. Yet the striking shape of the concentration curve offers tentative support for reductions in export duties on equity grounds. Of course, to the extent that Madagascar enjoys substantial market power in the world market for vanilla, there may be an optimum export duty on vanilla that helps to keep world prices high by restricting Madagascar's supply to the market. But the loss of market share to other exporters, especially Indonesia, casts doubt on the degree of market power that Madagascar really has.

Finally, taxes with narrow bases are concentrated in three areas in Madagascar: petroleum duties, export duties, and "sin" taxes on alcohol and tobacco. The major rationale for these taxes is that they provide good tax handles, even if they are distortionary. There is also an argument in favor of using these taxes to discourage consumption of alcohol and tobacco for health reasons, and petroleum products for environmental reasons. Because taxes on alcohol and tobacco are progressive, it is difficult to criticize them, and there is not much policy interest in reducing them. The petroleum taxes are much more controversial, with the controversy focusing on their purported adverse effect on distribution. Our results suggest, however, that taxes on gasoline are highly progressive, even after including the indirect impact on public transport. For these products, then, the critics are mistaken, and the government should consider gasoline taxes as an attractive possibility for further revenue increases. The same cannot be said of kerosene, however. Used primarily for cooking and as a source of light in house-

holds that do not have electricity, a duty on kerosene is the one clearly regressive tax in Madagascar.

It is important to remember that progressivity is not the only measure of a good tax. Policymakers must also consider the tax's impact on economic efficiency (distortions to the allocation of resources), its administrative efficacy (whether it is a good tax handle), and, of course, the utility of corresponding government expenditures. Nevertheless, progressivity does matter, not least at a political level, where arguments that a tax hurts the poor are often more persuasive than considerations of economic and administrative efficiency. Our results should contribute to the debate over policy reform in Madagascar.

Appendix A. Calculation of Households' Tax Payments

This appendix describes our calculations of indirect and direct taxes in greater detail.

Indirect Taxes on Expenditure Items

Table A-1 lists the expenditure items included in the EPM survey and indicates which indirect taxes we have assumed are included in purchasing these items. To estimate the tax base for each tax, we first assume that:

- The VAT is levied on the c.i.f. value of imports plus all import duties paid.
- Import duties and tariffs are levied on the c.i.f. value of imports.
- Commodity-specific excises are levied on the c.i.f. value of imports (if the goods are imported) or the value of domestic sales.
- 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. But for multi-item taxes (import duties and the VAT), errors across items with different tax rates could change the incidence calculations.

Other Indirect Taxes

The only other indirect tax we examine is the export duty on vanilla. We apply the duty rate (25 percent) to each household's sales of vanilla (in Madagascar francs) to estimate its tax payments for vanilla exports. This assumes that farmers pay only a part of the total duty, equal to their share in the total price of vanilla, that is, they share the tax incidence with middlemen who buy their vanilla output and sell it to the Vanilla Marketing Board. As with expenditure

Table A-1. *Assumed Taxes on Expenditure Items in Madagascar*
(percent)

Expenditure item	*Import duties*	*Value added tax*	*Others*
Adults' clothing	50	20	
Children's clothing	50	20	
Underwear	50	20	
Cloth for clothing	50	20	
Accessories	50	20	
Other clothing	50	20	
Sewing materials	50	20	
Adults' shoes	50	20	
Children's shoes	50	20	
Electricity	0	20	
Candles	0	20	
Water	0	20	
Kerosene[a]	0	0	FMG133 per liter
Natural gas	0	0	FMG50 per kilo
Candles	0	20	
Water	0	20	
Furniture	0	20	
Household accessories	0	20	
Household linen	0	20	
House furnishings	0	20	
Household appliances	40	20	
Kitchen appliances	40	20	
Cooking appliances	40	20	
Glassware	40	20	
Kitchen utensils	40	20	
Household utensils	40	20	
Home maintenance products	0	20	
Home maintenance tools	0	20	
Other home maintenance	0	20	
Sports and cultural events	0	20	
Hotels, vacations	0	20	
Radios and videocassette recorders	40	20	
Cameras	40	20	
Sports equipment	40	20	
Other durable equipment	40	20	
Books, magazines, and newspapers	0	20	
Leisure accessories	0	20	
Medicine	10	0	
Personal care articles	50	20	
Automobiles	50	50	15
Motorcycles	40	50	
Bicycles	20	20	
Gasoline and lubricants	0	0	FMG480 per liter
Transportation in cities	0	20	FMG20 of FMG480 per liter[b]
Intercity transportation	0	20	FMG20 of FMG480 per liter[b]
Mail and telecommunications	0	20	
Watches	40	20	

Table A-1. *(continued)*

Expenditure item	*Import duties*	*Value added tax*	*Others*
Jewelry	0	20	
Education and training fees	0	20	
All foods except those listed below	0	0	
Milled rice	30	0	
Rice flour	30	0	
Wheat[c]	20	0	
Other cereals	20	0	
Cheese	30	0	
Other dairy products	30	0	
Peanut oil	20	0	
Coconut oil	20	0	
Soybean oil	20	0	
Butter	20	0	
Margarine	20	0	
Lard	20	0	
Marinated or salted vegetables	40	20	
Other canned vegetables	40	20	
Jams and jellies	40	20	
Canned fruits	40	20	
Canned meats	40	20	
Canned fish	40	20	
Other canned food	40	20	
Condensed or powdered milk	40	20	
Baby food	0	20	
Fruit juice	50	20	
Syrup and soda	50	20	
Bottled water	50	20	
Meals in restaurants	0	20	
Rum	50	20	170
Beer	50	20	70
Wine and liquor	50	20	120
Cigarettes	50	25	60
Parakay (chewing tobacco)	0	15	
Chairs[d]	0	20	
Tables[d]	0	20	
Beds[d]	0	20	
Other furniture[d]	0	20	
Sewing machine[d]	40	20	
Gas store[d]	40	20	
Refrigerator[d]	40	20	
Television[d]	40	20	

a. There was no excise tax on kerosene in 1994. In order to say something 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.

b. For transport we assume that 20 percent of the cost is due to taxes on petroleum products.

c. Includes wheat in bread.

d. For durable items we use 10 percent of the value of the items owned, found in section 11, part B, rather than the expenditure information in section 8.

Source: Calculated from Government of Madagascar (1994).

taxes, this assumption does not affect the concentration curve for vanilla duties, but it probably underestimates the nominal amount that farmers pay.

Direct Taxes

The only direct tax included in this article is the income tax on wages. We have assumed that only workers who are employed by the public sector or formal enterprises pay income taxes on their wages and benefits (question 13, section 4, part B responses 1 or 2, and analogously for other jobs). We use the 1994 tax tables to be consistent with the nominal value of salaries earned in those years.

Appendix B. Calculation of the Estimator

This appendix presents the estimator that we use for the covariance matrix of the ordinates of two concentration curves that may be dependent. Davidson and Duclos (1997) develop the estimator, and our exposition depends almost entirely on their work.

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 (such as per capita income) and X as a tax. Let $p = [p(1),p(2), \ldots p(k)]$ be a vector of abscissa on the x-axis of a Lorenz or concentration curve, and define $\gamma_{p(j)}$ 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 $p(j)[\gamma_{p(j)} / \gamma_1]$, where $\gamma_{p(j)} = E[X \mid F(Y) \leq p(j)]$, that is, the expected value of X (the tax) conditional on the household being found in the lowest $p(j)$ quantile of the income distribution. Note that γ_1 is just the mean value of the tax for all households. If we repeat the same argument for another tax, say W, and another welfare variable, Z, and we define $\delta_{p(j)} = E[W \mid F(Z) \leq p(j)]$, then we have $p(j)[\delta_{p(j)} / \delta_1]$ as an estimator for the ordinate of W's concentration curve, and $\lambda_j = p(j)[(\gamma_{p(j)} / \gamma_1) - (\delta_{p(j)} / \delta_1)]$ is the difference between the two at abscissa $p(j)$. For our work Y and Z are always the same variable, such as per capita income.

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

$$\text{(B-1)}\quad \omega = [\, p(1)\gamma_{p(1)}(1),\ldots, p(k)\gamma_{p(k)}(k), \gamma_1, p(1)\delta_{p(1)}(1),\ldots, p(k)\delta_{p(k)}(k), \delta_1]^T.$$

Using Gaussian kernel estimates (see, for example, Silverman 1986, ch. 3) for the conditional means $\gamma_{p(k)}$ and $\delta_{p(k)}$, Davidson and Duclos prove that $N^{-0.5}(\hat{\omega} - \omega)$ is asymptotically normal with mean zero and an asymptotic covariance matrix that can be estimated without knowledge of the population distribution. We have used the same estimators here.

Finally, Davidson and Duclos note that, by a result in Rao (1973: 388–89), we can generate the covariance matrix for λ by pre- and post-multiplying ω's covariance matrix with the Jacobian for λ with respect to the vectors γ and δ. Formally,

let $\theta = [\gamma_{p(1)}, \ldots, \gamma_1, \delta_{p(1)}, \ldots, \delta_1]^T$, and let $\frac{\partial \lambda_i}{\partial \theta_j} = [S(\gamma) \mid S(\delta)]$ be the Jacobian for ω's covariance matrix, where

$$S(\gamma) = \begin{pmatrix} \frac{1}{\gamma_1} & & -p(1)\frac{\gamma_{p(1)}}{\gamma_1^2} \\ \vdots & & \vdots \\ \frac{1}{\gamma_1} & & -p(k)\frac{\gamma_{p(k)}}{\gamma_1^2} \end{pmatrix} \tag{B-2}$$

and $S(\delta)$ is defined similarly. Then the k by k matrix $\left(\frac{\partial \lambda_i}{\partial \theta_j}\right)\omega\left(\frac{\partial \lambda_i}{\partial \theta_j}\right)^T$ is the covariance matrix for λ.

Appendix C. Ordinate Estimates and Standard Errors for Tax Concentration Curves in Madagascar, 1994

This appendix presents estimates of the ordinates and standard errors of the concentration curves used in this paper.

(Tables begin on the following page)

Table C-1. *Ordinate Estimates*

Ordinate	45-degree line	Vanilla	Kero-sene	Expen-ditures	Imports	Petro-leum	Value added tax	Alcohol	Gasoline via transport[a]	Excises	Tobacco	Wages	Auto	Transport and gasoline[b]	Gasoline[c]
0.05	0.050	0.000	0.018	0.007	0.006	0.012	0.006	0.001	0.002	0.001	0.002	0.000	0.000	0.000	0.000
0.10	0.100	0.032	0.037	0.019	0.018	0.025	0.014	0.009	0.004	0.006	0.003	0.000	0.000	0.000	0.000
0.15	0.150	0.054	0.059	0.034	0.030	0.040	0.024	0.016	0.008	0.010	0.006	0.000	0.000	0.000	0.000
0.20	0.200	0.071	0.085	0.052	0.046	0.056	0.035	0.022	0.016	0.016	0.011	0.000	0.000	0.000	0.000
0.25	0.250	0.085	0.123	0.072	0.066	0.082	0.049	0.032	0.026	0.023	0.017	0.003	0.000	0.000	0.000
0.30	0.300	0.151	0.156	0.095	0.085	0.104	0.065	0.041	0.034	0.030	0.022	0.003	0.000	0.000	0.000
0.35	0.350	0.155	0.194	0.119	0.109	0.129	0.083	0.053	0.042	0.039	0.030	0.003	0.015	0.000	0.000
0.40	0.400	0.164	0.231	0.146	0.135	0.154	0.101	0.077	0.057	0.056	0.040	0.006	0.015	0.000	0.000
0.45	0.450	0.234	0.271	0.176	0.163	0.181	0.122	0.094	0.073	0.071	0.054	0.016	0.015	0.000	0.000
0.50	0.500	0.353	0.314	0.208	0.193	0.210	0.145	0.115	0.090	0.087	0.067	0.020	0.015	0.000	0.000
0.55	0.550	0.415	0.360	0.242	0.224	0.240	0.171	0.129	0.112	0.107	0.091	0.024	0.022	0.002	0.001
0.60	0.600	0.502	0.406	0.280	0.259	0.271	0.200	0.147	0.134	0.129	0.115	0.030	0.022	0.002	0.001
0.65	0.650	0.594	0.455	0.323	0.301	0.305	0.232	0.173	0.175	0.157	0.146	0.038	0.022	0.003	0.001
0.70	0.700	0.713	0.504	0.369	0.350	0.340	0.265	0.210	0.205	0.193	0.180	0.055	0.022	0.014	0.007
0.75	0.750	0.842	0.567	0.422	0.400	0.382	0.302	0.248	0.240	0.231	0.219	0.071	0.025	0.014	0.007
0.80	0.800	0.854	0.625	0.481	0.463	0.421	0.350	0.305	0.297	0.289	0.277	0.103	0.059	0.014	0.007
0.85	0.850	0.906	0.686	0.550	0.538	0.465	0.409	0.361	0.353	0.357	0.355	0.163	0.114	0.025	0.014
0.90	0.900	0.910	0.749	0.635	0.627	0.512	0.495	0.459	0.492	0.455	0.452	0.235	0.202	0.044	0.022
0.95	0.950	0.936	0.838	0.747	0.741	0.602	0.611	0.599	0.629	0.597	0.596	0.376	0.295	0.062	0.085
1.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

a. Gasoline via transport refers to the part of the direct tax on gasoline that falls on users of public transport.
b. Transport and gasoline refers to the combined impact of the direct tax on gasoline and the indirect tax on users of public transport.
c. Gasoline refers to the direct tax on gasoline.
Source: Calculated from Government of Madagascar (1994).

Table C-2. *Standard Errors*

Ordinate	45-degree line	Vanilla	Kero-sene	Expen-ditures	Imports	Petro-leum	Value added tax	Alcohol	Gasoline via transport[a]	Excises	Tobacco	Wages	Auto	Transport and gasoline[b]	Gasoline[c]
0.05	0.000	0.001	0.002	0.000	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000
0.10	0.000	0.017	0.003	0.001	0.001	0.004	0.001	0.003	0.001	0.001	0.001	0.000	0.000	0.000	0.000
0.15	0.000	0.020	0.004	0.001	0.001	0.006	0.002	0.003	0.001	0.002	0.001	0.000	0.000	0.000	0.000
0.20	0.000	0.023	0.005	0.001	0.002	0.008	0.002	0.004	0.002	0.002	0.002	0.000	0.000	0.000	0.000
0.25	0.000	0.024	0.006	0.002	0.002	0.012	0.003	0.005	0.003	0.003	0.003	0.001	0.000	0.000	0.000
0.30	0.000	0.035	0.007	0.002	0.003	0.015	0.004	0.006	0.004	0.003	0.003	0.001	0.000	0.000	0.000
0.35	0.000	0.035	0.009	0.003	0.003	0.018	0.005	0.007	0.005	0.004	0.004	0.001	0.008	0.000	0.000
0.40	0.000	0.035	0.010	0.004	0.004	0.022	0.006	0.010	0.006	0.006	0.005	0.003	0.008	0.000	0.000
0.45	0.000	0.042	0.012	0.004	0.005	0.025	0.007	0.012	0.008	0.006	0.006	0.007	0.008	0.000	0.000
0.50	0.000	0.052	0.013	0.005	0.005	0.029	0.008	0.014	0.009	0.008	0.007	0.007	0.008	0.000	0.000
0.55	0.000	0.057	0.015	0.006	0.006	0.034	0.009	0.015	0.011	0.009	0.009	0.007	0.011	0.002	0.001
0.60	0.000	0.061	0.016	0.006	0.007	0.038	0.011	0.017	0.012	0.010	0.011	0.007	0.011	0.002	0.001
0.65	0.000	0.064	0.018	0.007	0.008	0.043	0.012	0.019	0.016	0.012	0.013	0.008	0.011	0.002	0.001
0.70	0.000	0.060	0.020	0.008	0.009	0.048	0.014	0.024	0.018	0.014	0.015	0.010	0.011	0.008	0.004
0.75	0.000	0.055	0.022	0.009	0.010	0.053	0.016	0.027	0.021	0.017	0.018	0.011	0.012	0.008	0.004
0.80	0.000	0.054	0.024	0.010	0.011	0.059	0.018	0.032	0.026	0.020	0.021	0.015	0.029	0.008	0.004
0.85	0.000	0.047	0.026	0.012	0.012	0.065	0.021	0.038	0.030	0.024	0.025	0.023	0.044	0.015	0.009
0.90	0.000	0.047	0.028	0.013	0.013	0.071	0.024	0.046	0.040	0.029	0.029	0.029	0.067	0.023	0.012
0.95	0.000	0.043	0.030	0.014	0.014	0.083	0.029	0.056	0.049	0.034	0.034	0.041	0.094	0.031	0.047
1.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

a. Gasoline via transport refers to the part of the direct tax on gasoline that falls on users of public transport.
b. Transport and gasoline refers to the combined impact of the direct tax on gasoline and the indirect tax on users of public transport.
c. Gasoline refers to the direct tax on gasoline.
Source: Calculated from Government of Madagascar (1994).

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