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Econometric Issues for Tax Design in Developing Countries

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EMPIRICAL WELFARE ECONOMICS attempts to use data on individual or aggregate behavior to infer the consequences for behavior and for welfare of various actual or contemplated policy changes. The examples discussed here relate to the calculation of optimal taxes and of welfare-improving tax changes, but essentially the same tools apply to the analysis of projects, to cost-benefit analysis, or to any other policy measure. In principle, the procedure is straightforward. A model is developed linking prices, taxes, quantities, and welfare, and tax rules or shadow prices are characterized in terms of unknown but potentially observable empirical magnitudes. Econometric analysis then provides estimates of these magnitudes, allowing calculation of the desired tax rates, shadow prices, or directions of reform. In practice, severe problems arise. In particular, tax rules are rarely explicit; they do not yield formulas with tax rates on the left-hand side and empirically determinable quantities on the right-hand side. Instead, conditions are provided that must be satisfied by the configuration of prices and quantities when taxes are at their appropriate levels. This feature complicates the computations, but the real difficulty is that it becomes unclear which empirical magnitudes are important and which are not. Data collection is expensive, econometric estimation is rarely straightforward, and efforts should concentrate on areas in which they can do the most good. Most seriously, however, there is the risk that supplementary assumptions in the econometric work, made for convenience or even unconsciously, can exert a very large effect on the final results. Separability assumptions in particular are widely used in empirical work and tend to have dramatic consequences for the structure of optimal tax or pricing systems.

To fix ideas, I begin with a specific and fairly standard model of taxation. It is not necessarily the most appropriate model for poor countries (indeed, an important task is to develop specific models of public finance to match specific institutional constraints), but by making simple assumptions about produc-

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tion, I am able to focus on the relationship between tax policy and consumer behavior. In my first section, rules for optimal taxation and for tax reform are derived. In the second, I discuss alternative ways of specifying demand functions for estimation and examine the ways in which the specification interacts with the tax rules to determine the answers. I argue that a very delicate balance must be struck between measurement on the one hand and prior assumption on the other if the small amount of existing empirical evidence is to have more than a decorative effect on the results. A final subsection deals briefly with some of the issues that arise in the estimation of the production side, and I discuss ways of using engineering and farm management data to supplement econometric estimation of supply parameters. A third section deals with the availability of relevant data for developing countries and with the econometric problems that arise in using them. I also consider the sort of feasible econometric research program that would make a significant contribution.

A Simple Model of Taxes and Tax Reforms

I use a standard model of commodity taxation in an economy with many consumers (see, for example, Atkinson and Stiglitz, 1980, chap. 14). There are assumed to be constant returns in production (or 100 percent profits taxation), and I treat producer prices as fixed. Not all goods can necessarily be taxed, but the government can pay a uniform cash benefit (positive or negative) to some subset of the population. The government, for example, may be able in urban areas to provide quota amounts of food at below-market prices. If such quotas are lower than actual consumption levels, or if any excess can be sold at the market price, such schemes are equivalent to cash subsidies. Some consumers cannot be reached in this way, however—for example those outside the urban areas or those without fixed addresses.

The government social welfare function is written

$$W = W(u^1, u^2, \ldots, u^h, \ldots, u^H) \tag{4-1}$$

for household utility levels u^h. Household preferences are defined by indirect utility functions:

$$u^h = V^h(w^h T + g, w^h, \mathbf{q}) \tag{4-2}$$

for indirect utility function V^h, wage rate w^h, time endowment T, benefit level (grant) g, and commodity price vector $\mathbf{q}$. Prices are in part fixed producer (or border) prices $\mathbf{p}$ and in part taxes $\mathbf{t}$, that is,

$$\mathbf{q} = \mathbf{p} + \mathbf{t} \tag{4-3}$$

where t_i is zero for goods that cannot be taxed. The government must meet a revenue requirement R and must finance the benefits so that

$$\sum_h \mathbf{t} \cdot \mathbf{x}^h = R + H_u g \tag{4-4}$$

for vector $\mathbf{x}^h$ of household h's consumption levels, with H_u the number of households covered by the benefit scheme (u = urban, for example). Note that the model has no income tax; in the somewhat unlikely event that all goods are taxable, and all households are covered by the benefits, a linear income tax can be replicated by a suitable combination of benefit level and uniform commodity taxes. Nonlinear income taxes are rarely important for more than a small segment of the population in developing countries.

In any given economy at any given time, taxes are likely to be an accretion of ill-fitting parts accumulated over time by the uncoordinated actions of overlapping fiscal authorities. It is therefore sensible to begin by looking at welfare-improving reforms. Increasing the tax on good i will alter social welfare by the amount

$$\frac{\partial W}{\partial t_i} = \sum_h \frac{\partial W}{\partial u^h} \cdot \frac{\partial V^h}{\partial q_i} = -\sum_h \beta^h x_i^h \tag{4-5}$$

with

$$\beta^h = \frac{\partial W}{\partial u^h} \Big/ \frac{\partial V^h}{\partial g} \tag{4-6}$$

so that β^h is the social marginal utility of money to h, and the last equality in equation 4-5 follows from Roy's theorem. Equation 4-5 gives the costs of an increase in t_i. The benefits derive from increased government revenue, and this must be accorded a social welfare "price." Away from a welfare optimum, there is no reason to suppose that all government revenue, however raised or spent, has the same marginal value. Even so, I work with a single social welfare price of government revenue, λ; the problems thereby ignored are not of central concern here. Given λ, the marginal benefits of an increase in t_i are given by

$$B_i = \lambda \sum_h (x_i^h + \mathbf{t} \cdot \partial \mathbf{x}^h / \partial q_i). \tag{4-7}$$

For the benefit g, the corresponding expressions are

$$\partial W / \partial g = \sum_{h \in u} \beta^h \tag{4-8}$$

and

$$B_g = -\lambda \left(H_u - \sum_{h \in u} \mathbf{t} \cdot \frac{\partial \mathbf{x}^h}{\partial g} \right). \tag{4-9}$$

Consequently, social welfare is increased by a small increase in t_i if the following condition holds

$$\mathbf{t} \cdot \left(-\frac{\partial \mathbf{X}}{\partial q_i} \right) < X_i - X_i^{\bullet}, \tag{4-10}$$

where $\mathbf{X}$ is the vector of aggregate demands, whereas $X^{\bullet}$ is the vector of demands weighted by β^h/λ, that is,

$$X_i^* = \sum_h \beta^h x_i^h/\lambda. \tag{4-11}$$

Similarly, benefits should be increased if

$$\bar{\beta}_u + \bar{\rho}_u\lambda > \lambda \tag{4-12}$$

where $\bar{\beta}_u$ is the mean of β^h in the covered sector and $\bar{\rho}_u$ is the mean of $\rho^h = \mathbf{t} \cdot \partial \mathbf{x}^h/\partial g$, the propensity to pay tax from additional benefit.

The rules 4-10 and 4-12 are those that I shall use to illustrate econometric and data requirements. They serve also to characterize *optimal* tax and benefit rates if the inequalities are replaced by equalities. Note, however, that expression 4-10 does not give conditions on the taxes themselves. One possible way to obtain such conditions is to invert the matrix $-\partial \mathbf{X}/\partial \mathbf{q}$ through the inequality in order to obtain welfare-improving conditions on the tax rates themselves. In general, of course, it is not legitimate to (pre- or post-) multiply a matrix through a set of inequalities such as expression 4-10. If the inverse of $-\partial X/\partial q$ is a positive matrix, however, the inversion is legitimate, and this will be guaranteed, for example, by restricting cross-price elasticities so that, for each good, the absolute value of one minus the good's own-price elasticity is greater than the sum of the absolute values of the cross-price elasticities. Although this condition would seem to be worth pursuing further, I have not been able to find natural assumptions about preferences that would yield exactly these restrictions. It seems better to pursue preference restrictions directly, and I do so in the next section.

These formulas are sufficient to show what is required of the empirical analysis. It must be possible to obtain data on aggregate quantities and on consumer and producer prices. Disaggregated data on quantities are also required so that the social weighting schemes can be applied to yield all X_i^*. The procedure is relatively straightforward. It is more difficult to obtain information on the price and income responses $\partial \mathbf{X}/\partial \mathbf{q}$ and $\partial \mathbf{X}/\partial g$, the latter being required for calculating the benefit levels via expression 4-12. As is emphasized in other chapters of this book, especially chapters 2 and 11, and by Ahmad and Stern (1984), and provided that only small reforms are considered, the reform approach asks much less of the econometric analysis than does the calculation of optimal taxes. In the formulas above, the tax rates, benefits, price responses, and quantities are actual, observed quantities (or transformations of observed quantities) as they actually exist. In contrast, the inequalities will become equalities only if taxes differ from their current values and if quantities, responses, and so on all adjust. The calculation of the optimum therefore requires that price and income responses be calculated at points possibly quite different from either the current position or anything else previously observed. Tax reform requires knowledge only of the current position and current values of the derivatives of the demand functions. Tax optimization requires knowledge of the demand function over a large range of its arguments. I shall argue in the next sections that even the former is an ambitious requirement relative to the data and techniques actually available.

The Specification of Preferences and Technology

Estimation of price and income responses is accomplished through specification of a system of demand functions. We can choose from many possibilities, and the guiding principle is to select a functional form that allows the data to be used to the best effect in narrowing down good tax reforms. There is no guarantee, of course, that all the parameters required will even be estimable on the best available data. Nature may not be kind enough to perform crucial experiments on our behalf. Consequently, the calculations will always contain a judicious blend of prior restriction and of measurement, and the weaker the data, the stronger the restrictions must be. In the next section I shall discuss data availability in more detail, but here I consider two stylized cases, the first, in which data are scarce (the normal case), and the second, in which data are plentiful and measurement can dominate assumption.

Demand Functions When Data Are Scarce

For many countries, household survey data can be used to provide estimates of total consumption of various commodities as well as of how these consumption levels vary with income and with household socioeconomic characteristics. Measurement of price responses, however, requires data from several time periods, and there will rarely be enough such observations to allow estimation of more than a few price elasticities at best. Restrictions that link the various responses are therefore required, and it is natural to look for reasonable assumptions about consumer preferences that will provide them.

One relatively unrestrictive case, but one commonly used, involves the assumption that goods are separable from leisure and that, within the goods branch of preferences, the demand for each good is a linear function of total commodity expenditures. The linear expenditure system, first estimated by Stone (1954), is such a model, although it also imposes separability between each and every good. It has also been widely estimated for many developing countries; see particularly the volume by Lluch, Powell, and Williams (1977). Consequently, the linear expenditure system is a good benchmark from which to start. Its estimation is known to be feasible with very limited computing technology, and for many countries parameter estimates already exist. Such parameter estimates, however, prove to be of limited usefulness in tax reform or optimal tax calculations. Atkinson (1977) showed, in the model of section 1, with tastes represented by the linear expenditure system, with *all* consumers receiving an *optimal* benefit level, and with *all* goods taxable, that the optimum tax rate is uniform across all goods. (Atkinson discusses this model in chapter 14 below.) In Deaton (1979), I extended this result and weakened the assumptions. In particular, only linear Engel curves and separability of goods from leisure are required, and not all goods need be taxable. Indeed, given an optimal benefit level, any group of taxable goods that is separable (that is, the marginal rates of substitution within the group are independent of consumption levels outside the group) and has within-group linear Engel curves should optimally be taxed at the same rate. In these cases, estimation is not required for optimal tax calculation. There is no point in going to the trouble of estimating the linear expenditure system, because the outcome is determined as soon as the specification has been decided.

It is important to note that the optimality of uniform commodity taxation does not imply that any *movement* toward uniformity will improve social welfare. If the conditions given above about linear Engel curves and separability are true, for example, then it does not follow that a "reform" in which the lowest tax rate is raised to equal the second lowest and the highest tax rate is lowered to equal the second highest will necessarily be an improvement, unless of course this alteration produces uniformity. To extend the uniform optimal tax rule to a "move to uniformity" tax *reform* rule requires further assumptions. Consider the (very restrictive) case of linear Engel curves, separability between each and every good (additive separability), and optimal benefit levels with complete coverage. In this case, which includes the linear expenditure system, the tax reform rule 4-10 takes the form: increase τ_i, the tax *rate* on good i, t_i/q_i, if

$$\tau_i < \mathbf{b} \cdot \mathbf{t} + \alpha(\bar{m} - m^*)/\bar{m} \tag{4-13}$$

where **b** is the vector of marginal propensities to spend, α is a positive constant, $\bar{m}$ is mean expenditure on taxable goods, and m^* is a weighted average of expenditures on taxable goods, the weights for each household being $\beta^h + \rho^h$ normalized to sum to unity. Because the right-hand side of inequality 4-13 is independent of i, the tax reform rule approves of anything that brings commodity taxes closer to uniformity. Once again, there is little need for econometric analysis, and the optimality of uniform taxation extends to the tax reform program. The assumptions required for expression 4-13 are stronger, however, than for the results at the optimum, and in particular the additive separability among goods plays a crucial role.

How does the tax reform program change if additive separability is maintained but linearity and optimal benefits assumptions are dropped? Under additivity, the substitution matrix for household h, S^h, must satisfy

$$\begin{aligned} q_i q_j S_{ij}^h &= \phi^h m^h b_i^h b_j^h && \text{for } i \neq j \\ q_i^2 S_{ii}^h &= -\phi^h m^h b_i^h (1 - b_i^h) && \text{for } i = j \end{aligned} \tag{4-14}$$

where ϕ^h is a positive scalar, and b_i^h is household h's marginal propensity to spend on good i; see Frisch (1959) or Deaton and Muellbauer (1980*a*, pp. 138–40). Equation 4-14 gives an expression for $\partial x_i^h/\partial q_j$ for each household and thus for $\partial X_i/\partial q_j$ in total. If this is substituted into the tax reform rule, and the algebra is worked out, it can be shown to be desirable to raise τ_i if the following holds

$$\text{(4-15)} \qquad \frac{1}{H}\sum_h [\phi^h m^h b_i^h(\tau_i - \rho^h)] < q_i\bar{x}_i - \frac{1}{H\lambda}\sum_h (\beta^h + \lambda\rho^h)q_i x_i^h.$$

With parallel linear Engel curves and identical tastes, b_i^h, ϕ^h, and ρ^h are independent of h, $\rho^h = \mathbf{b} \cdot \tau$, so that if the benefits are optimal, formula 4-12 holds as an equality, the right-hand side of expression 4-15 is proportional to $(\bar{m} - m^*)$, and the rule reduces to expression 4-13. With nonoptimal benefits, and other things being equal, a benefit level that is too low (deserving consumers cannot be reached) leads to a tendency to leave tax rates on necessities relatively low and to make it less likely to be beneficial to raise them. In the possibly more usual case where revenue in the hands of the government is at a premium, the benefit level is too high, and there will be pressure to raise taxes on necessities above a uniform rate. Condition 4-15 will also differ from the uniformity prescription because of taste differences and nonlinear Engel curves and therefore offers scope for the incorporation of household budget information about differences among households in consumption patterns and in propensities to consume. From this point of view, the rule is very satisfactory; information that is available is used, and different social weights for different income levels, socioeconomic groups, or regions can be incorporated, whereas information that is not available, that on price responses, is covered by the additivity assumption.

The difficulty here is the suspicion that the rules are not robust to changes in the supplementary assumptions. Additivity is far from being the only way of restricting preferences, and alternative specifications may yield quite different rules for reform. In Deaton (1981), I showed that *optimal* tax rates can be very sensitive to "small" variations in separability assumptions. In particular, it is possible to move from progressive commodity taxation (luxuries taxed at higher rates) to regressive taxation by a small change in assumptions that is unlikely to be detectable with even good, plentiful data. It may, however, be the case that tax reform rules are more robust than optimal tax rates, and this possibility can be examined by deriving rules corresponding to expression 4-15 for alternative preference structures and comparing results. As an example, take a representative consumer with *indirectly* additive preferences (Houthakker, 1960), for whom cross-price elasticities are independent of the good affected. Such a restriction gives

$$\text{(4-16)} \qquad \begin{aligned} \epsilon_{ij} &= -\omega_j(1 - e_j + \xi) && \text{for } i \neq j \\ \epsilon_{ii} &= -1 + (1 - \omega_i)(1 - e_i + \xi) && \text{for } i = j \end{aligned}$$

where ϵ_{ij} is the cross-price elasticity of good i with respect to q_j, e_j is good j's expenditure elasticity, $\xi > 0$ is a scalar with $e_i > \xi$, and w_j is the budget share of good j. If equation 4-16 is inserted into the tax formula, the reform rule is: increase τ_i if

$$\text{(4-17)} \qquad \tau_i < \tau \cdot \mathbf{w} + (e_i - \xi)^{-1}[\tau \cdot \mathbf{w} + (X_i - X_i^*)/X_i].$$

This expression is not the same as that obtained under the assumption of direct additivity and does not in general imply that moves toward uniformity are always desirable. Since, however, $(X_i - X_i^*)/X_i$ is, like e_i, a measure of the expenditure elasticity of good i, the second term on the right-hand side of expression 4-17 has the elasticity in both numerator and denominator. In consequence, for some preferences and configurations of taxes, the rule may not deviate too much from the uniformity prescription. In general, the right-hand side of expression 4-17 will vary from good to good, so that there will be moves toward a uniform tax structure that will *decrease* social welfare. It is of course no good either to assume direct additivity and to prescribe uniformity or to assume indirect additivity and to prescribe something else. Before we can make a sensible recommendation, we must be able to tell which, if either of them, is correct in a particular context.

Separability assumptions are not the only way in which prior information can be used to supplement data insufficiency. Most practitioners would express their priors not in terms of preferences but more directly in terms of the elasticities themselves. My impression is that many people will hazard informed guesses about expenditure and own-price elasticities but rarely about cross-price effects, presumably on the grounds that such effects are of second-order importance. Such ideas can be formalized by asserting that changes in the tax on good i have a negligible effect on the total revenue collected from other goods, so that the reform rule 4-10 becomes: increase τ_i if

$$\tau_i < (-\bar{\epsilon}_{ii})^{-1}(X_i - X_i^*)/X_i \tag{4-18}$$

where $\bar{\epsilon}_{ii}$ is the mean own-price elasticity. At first sight, this seems quite different from the previous rules in that the divisor on the right-hand side is a *price* elasticity and not a *total expenditure* elasticity. Commodities that are both luxuries *and* price inelastic, if they exist, will tend to be penalized by expression 4-18, whereas in the previous rules the income elasticity term always tended to offset the inequality of distribution of the good so as to bring the tax rate more or less into line with those on other goods. Consider, for example, the implications of expression 4-18 for the relative tax rates on gasoline and food. Gasoline tends to be purchased directly only by relatively wealthy individuals in developing countries, so that the numerator on the right-hand side of expression 4-18 will be large. The opposite will be true for food. Food, as a necessity, is supposed to be relatively price inelastic, and in spite of its luxury nature, the same is often thought to be true of gasoline demand, either because rich people once they possess vehicles will stop at nothing to use them or because gasoline is only a component of running costs so that, even if the elasticity with respect to total cost is quite high, the elasticity with respect to the gasoline price alone can be expected to be small. If this chain of informal empiricism is correct, and if indeed cross-price effects are small, then it is clearly desirable to tax gasoline more heavily than food. As was the case when I considered direct versus indirect additivity, an alternative and more or less plausible specification of demand behavior has led to quite different tax and tax reform rules.

My essential point here is that, within the class of models considered in this and the previous section, the data typically available in developing countries are simply not adequate to indicate what the tax rates ought to be or how they ought to be reformed. Tax rules depend in an essential way on parameters that we can hope to measure only with the help of good and plentiful data. Calculated optimal tax rates for developing countries or calculated directions of reform should therefore be viewed with great circumspection. Although their derivation involves parameter estimation and the use of actual data, it remains true that variation in essentially untestable prior assumptions is capable of radically changing the numbers.

Such a conclusion has positive as well as negative aspects. No recommendation can be fully supported with the available data. Still, we can reasonably consider which positions it might be reasonable to occupy for the time being and which, by contrast, can readily be dismissed as implausible. Within the current class of models, my own personal position would be to opt for a lump-sum subsidy together with uniform tax rates. I believe that such a prescription cannot be shown to be incorrect, given current knowledge. First, I do not think that it is even possible in most developing countries to disprove the linear Engel curve and additivity assumptions that formally give rise to the proposition, at least for broad categories of goods. Engel curves from cross-section data are typically not linear, but the curvature is typically not supported by such time-series evidence as exists, and at a conceptual level, the comparison of different households with different income levels cannot tell us what will be the effects of increasing income for a given household or group of households. The latter effect enters into the calculations, and the long-standing contradictions between cross-section and time-series estimates suggests that the distinction is an important one (see, for example, Kuznets, 1962). Second, my interpretation of the alternative formulas 4-15 and 4-17 is that they are not in gross violation of the lump-sum subsidy/uniformity result. Clearly, further work is required to support or to disprove this contention, but the deviations of these formulas from this result seem to me to be second-order effects. We are left with formula 4-18 and the example involving food and gasoline. We should note, however, that this is a very special case. It is a common example that is produced in response to the uniformity claim but one that is remarkably difficult to replicate. The words "necessity" (something that is hard to do without) and "luxury" (something that one can easily forgo) by their very meaning suggest that price and income elasticities are generally believed to be directly related across goods. This notion is formalized by separability. I find this as good a source of casual empiricism as any, and it leads to the lump-sum subsidy/uniformity results. Although there undoubtedly do exist informal estimates and beliefs about price and income elasticities, it seems incorrect to accord them much weight without tracing their sources. In the gasoline example, there is "technical" information about the share of gasoline in running costs, and this is obviously relevant, but such information is the exception rather than the rule for consumer behavior, though, as I shall argue below, there is much more scope for such devices in estimating supply responses. In many cases, however, a widely believed price elasticity proves to have come from an earlier empirical study, and that study has to be evaluated directly, not given enhanced status because of its priority in time.

A further positive feature of the focus on lump-sum subsidies and uniform rates is the prominence given to the lump-sum subsidies themselves. Their role in the analysis and conclusion, together with the widespread use in developing countries of policies that in important respects resemble lump-sum subsidies, suggests that the evaluation of changes in these subsidies should be a central part of reform analysis. Thus, for example, when the marginal cost of funds is calculated for a number of different goods, we should ask how these compare with the marginal benefit of increasing a lump-sum subsidy. Such subsidies occur, for example when commodities such as foodstuffs are publicly supplied and with some forms of public goods (but should not be confused with subsidies to prices without rationing). Once again we have seen in tax analysis the importance of carefully examining the tools that are available to the government and of considering taxes and expenditures simultaneously. A narrow view of the tax problem and options available may be very misleading.

I should end this section with some disclaimers about cases in which lump-sum subsidy/uniformity clearly does not apply. The framework used here assumes that *all* goods are taxable, and that is clearly not true in most developing countries. Given additive separability, as well as the linearity assumption, of course, goods that can be taxed ought to be taxed uniformly. If very narrowly defined goods are being considered, however, and sometimes nothing else is administratively feasible, then both additivity and the linearity of Engel curves become implausible, and there is no predisposition in favor of uniformity. An important theoretical issue for tax design in developing countries is how the conflicting demands of feasibility and separability should be reconciled. If it is possible to tax only goods produced in the formal sector, or only goods that are traded, and yet these goods are companions in separable groups with untaxable goods, then it is far from clear what tax rates should be.

Demand Functions with Plentiful Data

Provided that data are plentiful and of the right type, the difficulties of the previous section can be avoided by estimating sufficiently *general* systems of demand functions. The crucial property required is that preferences be represented by a *flexible functional form.* The basic idea is that the specification of preferences, whether by means of a utility function, an indirect utility function, a cost function, or whatever, should have sufficient parameters so configured that, at any given point in price and income space, the derivatives of the demand functions can take on any values consistent with the theory. Such specifications ensure at least the possibility of a local approximation to whatever the demand functions happen to be, and they guarantee that, at least as far as income and the matrix of price elasticities are concerned, our measurements are indeed measurements and not prior assumptions in disguise. This order of approximation, a second-order flexible functional form, is probably sufficient for evaluating tax reform proposals but is not accurate enough to calculate optimal taxes. For the latter, we need to know how elasticities change with changes in taxes and with redistribution, so knowledge of at least the second derivatives of demands is required. This in turn would require third- or higher-order flexible functional forms for the preference representation functions.

There currently exists a fair selection of second-order flexible functional forms that could be used in this context. Best known is perhaps the *translog*—see, for example, Christensen, Jorgenson, and Lau (1975)—in which the indirect utility function is expressed as a quadratic in the logarithms of price-to-income ratios, namely

$$V(m, \mathbf{p}) = \alpha_0 + \Sigma\, \alpha_k \log \frac{p_k}{m} + \tfrac{1}{2} \sum_k \sum_j \beta_{kj} \log \frac{p_k}{m} \log \frac{p_j}{m} \tag{4-19}$$

where α_0, α_k, and β_{kj} are parameters with $\beta_{kj} = \beta_{jk}$ and m denotes household "full income," $wT + g$. By Roy's identity, the demand functions are

$$\frac{p_i x_i}{m} = \frac{\alpha_i + \sum_j \beta_{ij} \log \frac{p_j}{m}}{\sum_k \alpha_k + \sum_k \sum_j \beta_{kj} \log \frac{p_j}{m}} \tag{4-20}$$

which can be estimated subject to an arbitrary (and harmless) identifying restriction such as $\Sigma\alpha_i = -1$. An alternative second-order flexible functional form is provided by Deaton and Muellbauer's (1980*b*) Almost Ideal Demand System (AIDS), which specifies the cost function as

$$\log c(u, \mathbf{p}) = \mu_0 + \Sigma \mu_k \log p_k + \tfrac{1}{2} \sum_k \sum_j \gamma_{kj} \log p_k \log p_j + u \prod_k p_k^{\theta_k} \tag{4-21}$$

where μ_0, μ_k, θ_k, and γ_{kj} are parameters. Shepherd's lemma yields the demands

$$\frac{p_i x_i}{m} = (\mu_i - \theta_i \mu_0) + \sum_j \gamma_{ij} \log p_j + \theta_i \log (m/P) \tag{4-22}$$

where $\log P$ is given by

$$\log P = \mu_0 + \Sigma \mu_k \log p_k + \tfrac{1}{2} \sum_k \sum_j \gamma_{jk} \log p_k \log p_j. \tag{4-23}$$

Under favorable data conditions, P can be accurately approximated by a parameter-independent price index, so that equation 4-23 becomes an effectively linear system with consequent benefits for estimation. Otherwise, both AIDS and translog models are equally flexible and are equally suited (or unsuited) to the estimation of the required responses.

Both translog and AIDS provide integrated models of demand and preferences so that the welfare and empirical analyses are properly tied together. It is notable, however, that the tax reform formulas as presented in the previous section involve only aggregate price responses. There is therefore no obvious need for a utility-consistent analysis. In consequence, we might even consider estimating demand functions using a constant-elasticity, or Rotterdam, demand system (see Theil, 1965), neither of which is utility consistent except in trivial cases. As long as tax reform alone is being considered, such models may be adequate; they are flexible functional forms, and both are capable of providing consistent estimates of income and price elasticities at a point. Their use to calculate optimal taxes, however, is inadvisable. The theory of optimal taxation makes sense only in a world where consumers have well-behaved preferences and demand functions, so that taxes can be set to accomplish the social purpose of raising revenue and redistributing income at minimum cost in terms of distortion. If the estimated demand functions are preference inconsistent, calculated "optimal" tax rates are likely to make no sense whatever. In contrast, optimal taxes from the AIDS or the translog may be wrongly calculated because true preferences may be globally representable by neither one, but the calculations will at least be internally consistent.

A number of other points should be noted about systems such as the translog and AIDS. Estimation on time series by nonlinear least squares or by full-information maximum likelihood does not automatically lead to estimates that are fully consistent with the theory. The demand systems must be zero-degree homogeneous in prices and income. This feature is automatic for the translog in equation 4-20 but for the AIDS requires imposition of $\Sigma_j \gamma_{ij} = 0$ for all i. Symmetry of the substitution matrix (a property used by all the usual optimal tax results) is ensured by the symmetry of β_{ij} in the translog and of γ_{ij} in the AIDS. This symmetry can be achieved by standard linear restrictions within a nonlinear regression procedure. There is another, more awkward property, however. If equation 4-19 is to represent preferences legitimately, it must be quasi-convex in prices, and similarly the AIDS cost function 4-21 must be both concave and strictly quasi-concave in prices. In general, it is not possible to impose these restrictions globally. Instead, it is possible to estimate the models subject to the restriction that the estimated Slutsky matrix be negative semidefinite at a point, say the sample mean or, more usefully, at the point from which tax reform is to be considered. Note once again that this procedure works satisfactorily for the analysis of tax reform but is not really sufficient for optimal tax calculation. At nonrestricted points, we risk a nonconcave estimated cost function with attendant absurdities such as *negative* deadweight loss or positive responses to compensated price increases.

Some Issues in the Estimation of Supply Responses

The model that I have used so far, with the assumption of constant producer prices, essentially removes production from consideration. Developing countries have many tax and price reform problems, however, with regard to which this assumption is quite inappropriate. Many developing countries have agricultural procurement schemes of one kind or another, so that assessment of the effects of price reforms depends heavily on knowledge of own- and cross-price supply responses for the agricultural produce under consideration. Models of this type are discussed elsewhere in this volume (see chapters 13–18), and I shall confine myself to a brief discussion of the similarities and differences between modeling supply and demand.

The same general techniques apply to both. Demands are modeled using consumer cost or utility functions, whereas supplies are modeled with the aid of profit or cost functions. Both provide representations of technology that are particularly convenient for modeling price changes, because factor demands and commodity supplies and their derivatives can be obtained quickly and easily by straightforward differentiation. The translog profit function, for example, takes the same form as equation 4-19, with "profit" replacing "utility" and with the price-to-income ratios representing the prices of inputs and outputs relative to one of the inputs/outputs that is chosen as numeraire. Data are probably less scarce on the production side than on the demand side, though with regard to the latter, long time series with relative price variation are rarely available. Good data are, however, available from farm management surveys on the operation of individual farms, and there is information of an "engineering" or technical variety relating inputs and outputs. It is not difficult to obtain rough orders of magnitude on yields, on feed costs per animal, and so forth. It is more difficult to know how to incorporate these data into the representations of technology that are useful for the analysis, that is, the cost and profit functions. These "dual" representations are immensely convenient for market analysis, because they focus immediately on *prices*. The technical information, however, is typically about *quantities* and the relationships between them. To illustrate the issues, I discuss a model of land allocation that is loosely based on the work of Braverman, Hammer, and Jorgenson (1984) on agriculture in Cyprus. The model shows how restrictions similar to additivity on the demand side can arise in the analysis of production, so that, as for demand, cross-price effects can be simply and effectively restricted.

Consider an agricultural economy where three agricultural crops compete for a limited supply of land. I assume that all inputs *other* than land are available in infinitely elastic supply at fixed prices, so that, given the allocation of land to each crop, efficient production is attained by having each sector independently efficient without regard to the others. If land, like the other inputs, were also available in unlimited quantities at fixed price and quality, then the three sectors would be independent, and the profit function for the crop sector as a whole would be simply the sum of the three separate profit functions for the three sectors. Because the output price of each crop would appear only in the profit function for its own sector, the cross-price supply responses, for example the effect of a change in the wheat price on the output of barley, would all be zero. The presence of land in fixed supply, however, means that this is no longer the case. If the output price of barley is increased, land will be reallocated from other crops to barley production, so that the output of the other crops will fall. If this is the only effect, and I shall assume that it is, then although the cross-supply responses are not now zero, they are still heavily restricted.

I work with restricted profit functions for each sector in which the amount of land a_i is taken as fixed. Let p_i be the output price for crop i, and w be the vector of input prices taken to be common across sectors. The sector i restricted-profit function is then written $\pi(p_i, \mathrm{w}, a_i)$ and the profit function for the entire crop sector as $\Pi(\mathbf{p}, \mathrm{w}, A)$, where A is the (fixed) total amount of land available and we have

$$(4\text{-}24) \qquad \Pi(\mathbf{p}, \mathrm{w}, A) = \max_{\mathbf{a}} [\Sigma \pi_i(p_i, w, a_i); \Sigma a_i = A]$$

so that $\Pi(.,.,.)$ embodies an efficient allocation of land between crops. If the rental price of land, either actual or shadow, is r, then equation 4-24 can be rewritten as

$$(4\text{-}25) \qquad \Pi(\mathbf{p}, \mathrm{w}, A) = \Sigma\, \pi_i^*(p_i, w, r)$$

where π_i^* is the *un*restricted profit function for sector i. The restrictions on output responses can be seen straightforwardly from equation 4-25. Given the additive structure, the output y_i of crop i depends only on its own price, on the input prices, and on the rental rate r. Hence changes in the output prices of other crops work only through their effects on r, which in turn adjusts so that the land market clears. Because y_i is the partial derivative of Π and thus π_i^* with respect to p_i, the derivative of y_i with respect to p_j for i not equal to j is given by

$$(4\text{-}26) \qquad \frac{\partial y_i}{\partial p_j} = \frac{\partial^2 \pi_i^*}{\partial p_i \partial r} \cdot \frac{\partial r}{\partial p_j} = \frac{\partial^2 \pi_j^*}{\partial p_j \partial r} \cdot \frac{\partial r}{\partial p_i}$$

where the last equality follows by the symmetry of the cross-price derivatives. Rearranging the last two terms gives

$$(4\text{-}27) \qquad \frac{\partial^2 \pi_i^*}{\partial p_i \partial r} \div \frac{\partial r}{\partial p_i} = \frac{\partial^2 \pi_j^*}{\partial p_j \partial r} \div \frac{\partial r}{\partial p_j}.$$

Because the left-hand side is independent of j, and the right-hand side is independent of i, both are independent of either and of all indexes. Hence for some scalar ψ that is independent of i, we have

$$(4\text{-}28) \qquad \frac{\partial^2 \pi_i^*}{\partial p_i \partial r} = \psi \frac{\partial r}{\partial p_i}.$$

Hence, substituting back in the original expression for the cross-price derivative 4-26, for i not equal to j,

(4-29)
$$\frac{\partial y_i}{\partial p_j} = \psi \frac{\partial r}{\partial p_i} \cdot \frac{\partial r}{\partial p_j}.$$

The quantity ψ can readily be determined from the market-clearing condition for land. Because a_i is minus the partial derivative of π_i^* with respect to r, the market-clearing condition is

(4-30)
$$\sum_k \frac{\partial \pi_k^* (p_k, \mathbf{w}, r)}{\partial r} = -A.$$

Differentiating with respect to p_j gives

(4-31)
$$\left(\Sigma \frac{\partial^2 \pi_k}{\partial r^2}\right) \cdot \frac{\partial r}{\partial p_j} = -\frac{\partial^2 \pi_j}{\partial r\, \partial p_j}.$$

Comparison of equations 4-31 and 4-28 shows that ψ is the bracketed expression on the left-hand side of equation 4-31. It is minus the sum of the derivatives of acreage for each crop, with respect to the rental, and it can be regarded as the total additional land that would be made available in response to a change in the rental price.

Note first that, if the responses of rent to each of the output prices are known, and if the total response of land use to rent changes is known, then all the cross-price supply elasticities can be directly calculated. I think it unlikely that such things *would* be known in practice, but even without any such knowledge, the restrictions embodied in equation 4-29 are likely to be useful if there are a large number of outputs. Note that without such restrictions, there are $n(n-1)$ cross-price responses when there are n crops, and half of these can be inferred by symmetry. Given equation 4-29, only $(n+1)$ responses are required. Hence, if $\frac{1}{2}n(n-1)$ is greater than $n+1$, equation 4-29 is helpful even without knowledge of the quantities on the right-hand side.

In cases where there are fewer than four crops, so that the restrictions themselves are not useful, it is nevertheless possible to rewrite equation 4-29 in a form that uses quantities that might more realistically be available. The trick, as usual, is to try to convert information about prices, for example, the response of land rent to an increase in the support price of a crop, into information about quantities, for example the marginal productivity of land in growing that crop. Some of this conversion can be accomplished using the *restricted* profit function with which I started and which I have not yet really used. The link between the restricted and unrestricted profit functions is the first-order condition for the allocation of land, that is,

(4-32)
$$\frac{\partial \pi_i (p_i, \mathbf{w}, a_i)}{\partial a_i} = r.$$

From this the derivatives of a_i with respect to both r and p_i can be obtained in terms of the derivatives of the restricted profit functions π_i. The derivatives of a_i, however, are the double derivatives of the *un*restricted profit functions π_i^*, which, via equation 4-31 above, yield the rent price derivatives that appear in equation 4-29. Hence if we differentiate equation 4-32 with respect to r and p_i in turn, equate the derivatives of each a_i to the double derivatives of the π_i^*s, and finally use equation 4-31 to substitute in equation 4-29, we have

$$\frac{\partial y_i}{\partial p_j} = \frac{\partial y_i / \partial a_i}{\partial^2 \pi_i / \partial a_i^2} \cdot \frac{\partial y_j / \partial a_j}{\partial^2 \pi_j / \partial a_j^2} \div \left(\Sigma\, 1 \Big/ \frac{\partial^2 \pi_k}{\partial a_k^2} \right). \tag{4-33}$$

This may or may not be easier to evaluate than equation 4-29, but there seems to be a better chance. The marginal productivities of land are taken with output and other input prices considered fixed, so the complementary or substitutable inputs are allowed to adjust. The double derivatives of profit with respect to acreage are, of course, the reciprocals of the derivatives of acreage with respect to the rental price and provide another way of evaluating that quantity.

Data and Estimation

The most important source of data in developing countries is the *household expenditure survey*. The commonest type of survey is a general-purpose household inquiry, with a sampling proportion of perhaps 1 in 2,000 and containing (among other things) questions on household characteristics, demographic structure, and expenditures on a typically lengthy list of consumption items. Income and labor supply may or may not be included, but it is relatively uncommon for a single survey to contain both detailed expenditure information and data on sources of income, including hours and wage rates. Many expenditure surveys also collect data on quantities purchased as well as on expenditures, at least for goods that come in well-defined units. Hence we find numbers of eggs or kilos of fruit together with expenditures on them, but only expenditures on clothing or entertainment. I discuss below what use, if any, we can make of this sort of information.

Household expenditure surveys are widely available around the world, and few countries have not carried one out at least occasionally. Only a relatively small proportion of these are publicly available—household budget surveys have always been politically sensitive—and are in a form that permits use. Still, a number of developing countries (India, Indonesia, Malaysia, Sri Lanka, and Thailand, for example) have the ability to conduct high-quality surveys and have considerable experience in doing so. Moreover, the countries listed undertake surveys on a more or less regular basis, not every year, but at variable intervals. Although the design of the questionnaire changes (usually gradually) over time, such repeated surveys allow the integration of cross-section and time-series evidence. These regular surveys draw new random samples each time, so that the households are not the same from survey to survey, as would be the case with panel data. Genuine panel data are even scarcer in the developing world than in the developed countries and for good reason. It is difficult to track any given household over an extended period of time, so that the panel, through attrition, becomes seriously unrepresentative over time. Second, if the quality of responses is poor, then with panel data, where the main interest lies in changes between one response and the next, the ratio of noise to signal may become unacceptably high. This is not a disadvantage if the purpose is only to measure the changes themselves, because reporting errors are common across panels and cross sections, but it becomes a serious issue in econometric estimation (see Ashenfelter, Deaton, and Solon, 1985). Even so, there is scope for experimentation with relatively short-lived "rolling" panels, in which each household is interviewed on four or five occasions and is then replaced, with one-quarter or one-fifth of the respondents dropping out and being replaced at each round.

The second major source of relevant data is information on aggregate consumption of various items and on prices over time. Some of these data are not independent of the household survey data, because for some items the only method of estimating aggregate consumption is to "blow up" the survey estimate. For many items, however, there are other sources of information, usually import and export returns from ports and border posts together with returns from large-scale enterprises, sources that are either controlled by the state or large enough to be willing to cooperate with state data collection. Although coverage from these sources is at best partial, especially in largely rural subsistence economies, such data are likely to be particularly useful for tax purposes because the goods that are covered by these data overlap significantly with the goods that are actually or potentially taxable. If it is possible to collect data on production and distribution of a product, it is usually also possible to tax it. The *price* data in the aggregate time series are likely to be genuinely independent of the survey evidence. Prices are calculated from separate surveys, from standardized items at various locations, or, where data permit, by repricing the volume of consumption at base prices and then deriving an implicit price deflator by comparison with the expenditure series. Note that such prices, like the consumption figures, are averaged over the whole population; they provide no information on who gets what or on who pays what.

These sources are likely to be adequate for tax reform calculations as described in our discussion of demand functions when data are scarce, although not for estimating the flexible functional forms that were subsequently discussed. Consider the tax reform condition 4-15, that is,

$$\frac{1}{H}\sum_h [\phi^h m^h b_i^h(\tau_i - \rho^h)] < q_i\bar{x}_i - \frac{1}{H\lambda}\sum_h (\beta^h + \lambda\rho^h)q_i x_i^h.$$

On the right-hand side, the β^h weights are likely to vary with income [for example, in the Atkinson, 1970, version $\beta^h = (m^h)^{-\epsilon}$ for total expenditure m^h and some number $\epsilon > 0$] but also with region and with family size and/or composition. Given ρ^h (see below), the whole can be evaluated either by direct computation from the household survey or by parametrizing $q_i x_i^h$ as a function of the factors determining the weights and estimating from the survey data. The quantities ρ^h are the tax rates weighted by household h's vector of marginal propensities to consume and can be estimated in a number of ways. One possibility is to fit a nonlinear flexible Engel curve. For example, the form

$$q_i x_i = \beta_{i0}\, m + \beta_{i1}\, m \log m + \beta_{i2}\, m\, (\log m)^2 \tag{4-34}$$

often fits the data well and is utility consistent. An alternative much used in studies in India is to fit separate Engel curves for consumers in different income groups; this procedure certainly allows a wide range of b_i^h values, though it is unclear why the marginal propensities should be discontinuous at arbitrary income boundaries. Whenever possible, estimates of the slopes of Engel curves should be compared with similar results from time-series data. Ever since Kuznets's (1962) work it has been clear that estimates of income elasticities based on time series and household surveys tend to differ, with the latter tending to be much more dispersed from unity than the former. The root cause is presumably the inability to control completely in the cross section for those factors that are correlated with income and vary from household to household but are relatively constant over time, education and *relative* incomes being the obvious examples. The ρ^h parameters of the theory are those revealed from time series, ideally panel data. Nevertheless, judicious use of cross-section estimates, modified by such time series as are available, should be adequate. The parameter ϕ^h in expression 4-15 links price elasticities to income elasticities for household h; for goods whose budget share is small, it is the ratio of the (absolute values of) price elasticity to income elasticity. For broad groups of goods, a household-invariant number of about one-half is reasonable, whereas for more narrowly defined commodities, larger figures should be used. If estimates of price elasticities are available, their comparison with income elasticities yields values for ϕ using expressions such as 4-14.

The procedure is straightforward, certainly more so than the estimation of the fully flexible functional forms discussed earlier in this chapter. The standard data for estimating such models are aggregate time series, though it is also possible to use disaggregated data from several different household surveys. If prices are the same for all households in the cross section, then an n good demand system requires *at least* $(n - 1)$ time periods to estimate a matrix of price elasticities that is unrestricted (except in the case of homogeneity). Many more periods are required if the estimates are to be at all precise. India through the National Sample Survey has been collecting consumers' expenditure data for longer than any other developing country. Of the nearly forty "rounds" so far completed, some two dozen contain consumer expenditure data. If all of these were available for analysis (as they most certainly are not), a flexible system could be estimated with some confidence for perhaps six or eight commodity groups. If such limitations are accepted, there is no reason to suppose that the results would not be useful. Many important issues about the general balance of taxation, and such matters as food subsidy policy, depend on the split of consumers' expenditure into food and nonfood or on the distinction between cereals and meat. For some developing countries, at least, flexible function forms can be estimated to illuminate these issues.

An apparently attractive alternative is to recognize that, within a survey, prices vary from location to location and to use this spatial variation in prices to estimate price elasticities. Because prices are not directly measured, the temptation is to take the expenditure and quantity information and to derive a price by division. Quantities can then be regressed on incomes and prices in the usual way, and apparently sensible results are usually obtained. Unfortunately, I do not believe that this technique is satisfactory, because the estimates that it produces are not estimates of price elasticities. The root of the problem is that expenditure divided by physical quantity yields, not price, but unit value. For some commodities—for example, gasoline—prices and unit values may be very close to one another over a household survey. For most commodities and virtually all foodstuffs, however, unit values reflect quality variations as much as price variations. Rich households, for example, buy more expensive cereals, fruits, vegetables, and meats than do poor households, and unit values so calculated are systematically and positively related to household income. This characteristic, it turns out, can be dealt with. The insuperable problem comes with the likelihood that quality is also likely to be negatively related to price, so that in times of high price, or in areas of high price, quality will tend to be lower. In such circumstances, it is not possible to identify both the price elasticity of demand and the price elasticity of quality.

The algebra is simplest in a constant-elasticity model. Such models are not theoretically satisfactory, but the issues are clear in this case and carry through to better models, albeit in a more complicated form. Imagine a commodity for which quantity is well defined and readily measured and to which quality can be added variably. Purity is the obvious example; sugar can vary from a rough substance full of impurities through an infinitely variable spectrum to 100 percent pure refined sugar. Schematically, imagine the following true model

$$y_h = \beta_0 + \beta_1 x_{1h} + \beta_2 x_{2h} + u_h \tag{4-35}$$

$$x_{3h} = \gamma_0 + \gamma_1 x_{1h} + \gamma_2 x_{2h} + w_h \tag{4-36}$$

where all variables are measured in logarithms, y_h is quantity purchased by household h, x_{1h} is income, x_{2h} is price, and x_{3h} is quality. β_1 and β_2 are the income and price elasticities of demand, γ_1 and γ_2 the income and price elasticities of quality, and both γ_2 and $\beta_2 < 0$. The terms u_h and w_h are random errors. Quality is measured in such a way that unit values are the product of a quality and price, so that, in logs, unit value z_h is given by

$$z_h = x_{3h} + x_{2h}. \tag{4-37}$$

Price is not observed, only unit value z_h. By substitution of equations 4-37 and 4-36 and rearrangement,

$$x_{2h} = (1 + \gamma_2)^{-1}(z_h - \gamma_0 - \gamma_1 x_{1h} - w_h) \tag{4-38}$$

so that we have the following correct equation

$$(4\text{-}39)\qquad y_h = [\beta_0 - \beta_2\gamma_0/(1+\gamma_2)] + [\beta_1 - \beta_2\gamma_1/(1+\gamma_2)]x_{1h} + \beta_2 z_h/(1+\gamma_2) + u_h - w_h/(1+\gamma_2).$$

Hence, if we mistakenly interpret unit value as price, and regress quantity on income and unit value, we estimate, not the price elasticity β_2, but the quantity $\beta_2/(1 + \gamma_2)$. Because γ_2 plausibly lies between 0 and -1, we would expect this procedure to yield "price elasticities" that are correct in sign but much too large in magnitude. This expectation seems to me to be consistent with the evidence that I have seen. Note also that, under the same conditions, income elasticities will also be severely overestimated if γ_1 is at all large.

Quality variations are of course not explicitly recognized in the optimal tax model, and the quantities in the latter are probably most sensibly interpreted as physical quantities *plus* the quality. If so, then the elasticity we require is that of $(y_h + x_{3h})$ with respect to x_{2h}. Substitution in the above equations shows that this is $\beta_2 + \gamma_2$, which is only equal to $\beta_2/(1 + \gamma_2)$ in the entirely fortuitous situation when the sum of the price elasticities is unity, that is, $1 + \beta_2 + \gamma_2 = 0$. Once again, $(\beta_2 + \gamma_2)/(1 + \gamma_2)$ is the parameter that is identified, not $(\beta_2 + \gamma_2)$ itself.

Consistent estimation of the price elasticity requires some means of splitting z_h into its price and quality components. One possibility is to gather genuine price data on homogeneous commodities. Because most countries do so by separate surveys for the purpose of calculating general price levels, it is unclear why such data could not be collected in a way that is integrated with the household surveys themselves. Unfortunately, the fact is that the information is not gathered in this way, perhaps because of the difficulty of identifying homogeneous commodities in different locations. The other possibility, an econometric one, involves finding an instrumental variable (or set of variables) that is orthogonal to quality variations but not to price variations. Regressing z_h on these instruments will "purge" the x_3 component, allowing consistent estimation of the effect of x_2 on y_h. If equation 4-36 is really correct, however, such instruments do not exist. Consider dividing the sample into regions, and assume that prices are the same within regions but vary across regions. A possible "between-regions" estimator is that formed by a regression involving regional averages of quantities on incomes and unit values. This device does not work, however, because the interregional price variation induces interregional quality variation, which is therefore present in the averaged regression just as it was in the original micro version. In contrast, we might look at the *within*-regions estimator. Because prices are constant within the region, a regression of z on x_1 yields an estimate of γ_1, the income elasticity of quality, which can be used to construct a consistent estimate of the income elasticity β_1. γ_2 cannot be estimated on a sample where prices do not vary, however, and so consistent estimation of β_2 is not possible. It seems therefore that only genuine price information can allow estimation of price elasticities from cross sections.

Conclusions

I have examined the possibilities of calibrating a simple model of tax reform and optimal taxation in the context of the data typically available in developing countries. Many such countries have rich data in the form of household surveys. These are excellent sources for the documentation of all kinds of distributional issues, for measuring consumption expenditures and their distribution over households of differing socioeconomic characteristics. They are poor sources, however, for the measurement of the ways in which quantities respond to price changes, and most developing countries do not have adequate time-series data to permit the estimation of own- and cross-price elasticities for more than a small number of interacting goods. Assumptions about preference structure, however, can be used to link price with income elasticities so as to allow essentially complete evaluation of tax reform proposals using only survey data. Perhaps not surprisingly, different assumptions about preferences lead to different rules for tax reform, and data are unlikely to be sufficient to let us distinguish between the different assumptions. I have argued in favor of uniform commodity taxation together with lump-sum subsidies and have advocated reforms that move in this direction but other positions could also be argued. More empirical work needs to be done to discover whether the lump-sum subsidy/uniformity prescription can seriously be threatened as a broad guide to policy. Price data, unlike survey data, are scarce and must be used sparingly. They are perhaps best used to estimate price elasticities for very broad groups so that, in conjunction with the survey evidence, broad sectoral tax policies can be assessed, for example on cereals versus meat or food versus manufactured goods. It is also possible that, within subsectors, price elasticities can be estimated, for example for a group of travel modes. The separability needed to validate the method, however, correspondingly limits the usefulness of the results, because it is frequently desirable to tax goods within separable groups at the same rate.

All of this discussion applies to *tax reform*. The global knowledge of demands and of preferences required for optimal taxation is simply not obtainable in developing countries nor probably in developed countries. It might be argued that, in an uncertain world, a gradualist approach is desirable in any case, so that the identification of desirable directions of reform is all that a policymaker can reasonably expect. Real reforms always involve finite, not infinitesimal changes, however; there are costs to the *process* of tax reform, so that it is not obviously desirable to change taxes a little every year, and governments often phrase their reform objectives in terms of the elimination of deficits, so that analysis should concentrate on minimizing the social costs of raising substantial amounts of extra revenue. Nevertheless, the quality of our empirical knowledge clearly decreases as we move the economy away from previous experience, and advisers would be wise to recognize that fact when they tender advice. I do not say that brave and visionary economists should not offer "optimal" solutions to fiscal problems, but they should always make clear that these solutions are based on untested deductive reasoning and that, without the relevant empirical evidence, it will be even more than usually hazardous to follow such advice.