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The Taxation and Pricing of Agricultural and Industrial Goods in Developing Economies

Raaj Kumar Sah and Joseph Stiglitz

IN MOST DEVELOPING COUNTRIES governments play an active tole in setting the food prices received by farmers and the food prices paid by city dwellers. They do so through a variety of mechanisms, such as agricultural marketing boards, which often have a monopoly on the purchase of certain goods from farmers and their sale to consumers; through price regulation authorities, which control the prices at which private traders can sell; by explicit food subsidies, sometimes accompanied by rationing; and by export and import taxes and subsidies. Their aims in attempting to alter the prices that would emerge in the absence of government intervention are several. In this chapter, we focus on the following objectives:

- To increase the income of peasants, who are often among the poorest in the economy
- To subsidize the poorer city dwellers. In most developing countries, direct income subsidies are not feasible, and food subsidies may be an effective way of helping the poor
- To generate revenue for financing investments and public expenditure, to attain some level of self-sufficiency in specific goods, and to avoid excessive dependence on the international market[1]
- To counteract the effects of rigidities in the economy, such as price and wage rigidities in domestic markets and the country's lack of access to a free international trade and borrowing environment.[2]

In some cases, the policies adopted seem at variance with the stated objectives. Though the government may claim that food subsidies are meant to help the urban poor, it may subsidize not the grain consumed by the poor (millet, for example) but rather that consumed by those relatively better off (such as rice). In other cases, the government may fail to achieve its objectives because of corruption and incompetence. Though the intended objective of a marketing board may be to help producers and consumers, in some cases it may actually harm both groups by running excessively costly operations.

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Sometimes the stared objectives appear inconsistent or confused. The government attempts to subsidize everyone, to increase the prices received by farmers, and to lower the prices paid by city dwellers, without articulating who is paying for the subsidies and indeed without a clear view of the full incidence of the complicated set of taxes and subsidies that are levied. This confusion is further compounded when many different agencies set the prices of different goods. Often these agencies act independently of one another, under contradictory assumptions about society's objectives and about the constraints facing the economy.[3]

Different agricultural pricing policies have markedly different effects on the welfare of farmers versus city dwellers, on government revenue, on investment, and on the distribution of income within each sector. Similarly, in economies where different commodities are produced or consumed in different regions, or by different ethnic groups, different agricultural policies have different impacts on the welfare of these regions and groups. A study of these effects requires a general equilibrium analysis in which the dependence of demands and supplies on pricing policy is modeled and in which the overall constraints facing the economy (such as those of the balance of trade and government revenue) are also taken explicitly into account.[4] Here we develop such a model, which can be used not only to identify circumstances in which changes in the pricing policy can make each of the groups in the society better off but also to characterize the qualitative aspects of the optimal pricing policy.

This chapter is a part of a research program we have undertaken that examines the reform and the design of taxation and pricing policies in developing countries, using models that reflect not only the institutional features of developing economies but also the limitations on the policy instruments available to the governments of developing countries.[5] Our research makes use of two important strands of economic literature: modern development economics and the recent advances in public economics. We follow much of the modern development economics literature in modeling a developing country as a dual economy in which the forms of economic organization in the agricultural (rural) and industrial (urban) sectors may differ markedly. The specific features of developing countries that we take into account include (1) the presence of widespread urban unemployment, which may be caused by (2) urban wages set above market-clearing levels, inducing (3) migration from the rural sector to the urban sector. Thus, although a central concern of the standard tax theory, which has been developed in the context of economies with full employment, is the effect of tax policies on individuals' labor supply, a more relevant concern in the context of developing countries may be the effect of public policies on unemployment and migration.

The development experience of the past quarter century has also made it abundantly clear that there is no single "model" of a developing country. Although in some countries sharecropping may predominate, in others family farmers may be more typical. Although landless peasants may constitute a large fraction of the agricultural population in some countries, they may not in

others. One of the objectives of our research program has been to ascertain which features of the economy are critical in determining the consequences of changes in prices and taxes. We have succeeded in developing formulas that hold for a variety of institutional arrangements. The values of the parameters within these formulas may differ, of course, from one institutional setting to another.

In analyzing the consequences of alternative institutional features, it is also important to understand the economic forces that may have given rise to them, particularly in the case of high urban wages. Governments may be well aware that the urban unemployment is induced by high urban wages; it may be of little use to tell them once again that their first order of business should be the reduction of urban wages and to predicate all other taxation and pricing policies on the assumption that wages will be cut. It may be no more realistic to assume that, although direct wage cuts are not feasible, indirect wage cuts through increased prices are. Moreover, wage reductions (direct or indirect) may not always be desirable if they lead to a significant decrease in productivity through, for instance, their effects on workers' health, incentives, and turnover (see Stiglitz, 1982*a*, 1982*d*, and Yellen, 1984 and references therein).

The correspondence between the problems of pricing and of taxation has long been recognized (see Atkinson and Stiglitz, 1980). Pricing decisions, like tax decisions, have many indirect effects on the economy; the first question, then, in assessing the impact of any pricing or tax decision is to determine its *incidence*—that is, how it affects each of the variables of interest (the welfare of workers in the rural and urban sectors and the investable surplus, for example). To do so, we construct a two-sector general equilibrium model of the economy. This is like Harberger's (1962) model for analyzing the consequences of a tax on corporate capital, but unlike his model, each of our two sectors contains many different income groups; also, our assumptions—for example, those concerning wage flexibility, factor mobility, and price determination—are different from those of Harberger.

Having described the effects of policy changes, we then develop a framework for evaluating them. This entails first ascertaining circumstances in which there exist Pareto-improving policies, or policies that make all individuals better off. Those taxation (pricing) policies for which there does not exist any possible change (given the limitations on government's policy instruments and given the structure of the economy) that can make someone better off without making someone else worse off are called *Pareto-efficient tax structures* (see Stiglitz, 1982*e*). In choosing among Pareto-efficient tax structures, we follow the approach of modern public finance theory in which the effects on different groups are evaluated by means of a Bergson-Samuelson social welfare function. We develop formulas that can easily be used to show, for example, how views concerning the desirability of any price reform (that is, a small change in policy) as well as the nature of the optimal policy (that is, the policy that maximizes the social welfare function) depend on attitudes toward inequality.

The main differences between a meaningful approach toward the problems of pricing and taxation in developing countries and the approach that has typically been followed in the standard tax literature concern the salient features of the economy (some of which we have indicated above) and the limitations on the instruments available to the government. The governments of most developing countries employ an extremely limited set of instruments, and as we shall see below, these constraints have important consequences for the analysis of pricing and taxation policies.[6]

An important example of the constraints on policy instruments in the context of developing countries is as follows. If the government can set different prices in the two sectors for the goods traded between the sectors, then a change in the prices in one sector has no direct effect on individuals in another sector. If, on the other hand, the government cannot do so for some goods (because, for instance, it is too expensive or difficult to monitor the movement of these goods between the two sectors), or does not wish to do so, then changes in the prices of these goods have simultaneous direct effects on the individuals in both sectors. This situation alters the nature of desirable price reforms as well as the characteristics of optimal prices (see Sah and Stiglitz, 1984*a* and 1985*a* for the corresponding analysis). We assume in this chapter that the government can set different sets of taxes (prices) in the two sectors and that the individuals within the same sector (tax regime) face the same set of prices. The latter assumption (which underlies much of public economics) may not be satisfied in the presence of certain types of market imperfections; their consequences are discussed later.

A practical problem in the implementation of desirable pricing policies in developing countries is that reliable estimates of many of the critical parameters of the economy are not easily available.[7] One would, therefore, like to know what kinds of statements one can make on the basis of qualitative information. Similarly, there is no reason why there should be unanimity, or even consensus, about what social weights to attach to different groups. Thus, one would like to be able to ascertain how differences in welfare judgments would affect one's views concerning the desirability of different policies.[8] We have, therefore, derived a number of qualitative results (for example, identifying situations when some commodity might be taxed and another commodity might be subsidized) that make use only of qualitative information, concerning both the parameters representing the structure of the economy and the welfare weights.

In fact, given the well-known obstacles to reaching a consensus on the social weights to be associated with different groups of individuals, it is important to analyze the properties of Pareto-efficient tax structures; these properties are desirable regardless of one's views concerning the social welfare function. We have devoted considerable attention to such analyses and report here several rules for price and tax reforms that lead to Pareto improvements. Our rules of reform have the additional virtue that they can be implemented with very little information.

We base our analysis on models of the economy that are quite general (of course, these are not the most general models one can construct).[9] Our model of migration and unemployment, for instance, can be specialized to common hypotheses such as no migration, free migration with no unemployment, and the Harris-Todaro hypothesis, in which the expected utility of the marginal migrant is the same in the two sectors; it can also be specialized to other specifications, such as the one in which an individual's utility in one sector is some fixed fraction of that in the other sector (see chapter 15, by Heady and Mitra in this volume). Our model for the determination of agricultural wages and earnings is consistent with a wide variety of competitive as well as noncompetitive rural labor markets. Furthermore, in our general model, we do not impose any restriction on the number of goods in the economy or on the nature of intrasectoral and intersectoral inequality.

Also, we do not assume any functional forms to represent individuals' responses. Not surprisingly, strong special assumptions are typically employed both in econometric estimations of behavioral parameters and in simulation exercises on taxation and pricing policies. The results of such simulations must be interpreted with care because, as is well known, certain types of parameterizations seriously prejudge the optimal tax structure one obtains. (For a dramatic example of the consequences of the LES assumption, together with uniform lump-sum taxes, on optimal commodity taxes, see Atkinson and Stiglitz, 1980.)

We believe that one of the main uses of the kind of formal analysis we present here is to contribute to a more informed policy debate, to identify, for example, those instances in which there is an important equity-efficiency tradeoff from those in which there is not or to help see the full ramifications of any policy decision, ramifications that become apparent only within a general equilibrium model in which careful attention is paid to the institutional structure of the economy. Our research thus provides the conceptual background that is a necessary prelude to empirical attempts to investigate the consequences of taxation and pricing policies.

Outline of the Chapter

This chapter is divided into ten sections. Though it would clearly be possible to begin our analysis by presenting the most general model and then specializing to obtain more specific results, a better understanding of what is at issue is obtained by beginning our analysis with a simple model, in which there is a single commodity produced in each sector. Our concern in these sections is to identify the central tradeoffs in the analysis of pricing and taxation. We then analyze the disaggregated structure of taxes first within the agricultural sector and later within the industrial sector.

Our objective in this chapter is not to present the general formulations that we have analyzed elsewhere but rather to provide an exposition that brings out

as clearly as possible some of the central issues, including the role of alternative institutional structures. We therefore use a simple model to examine the consequences of migration and unemployment on pricing policy. We subsequently discuss several other variations of our model, including alternative agricultural institutions and international trade environment. Furthermore, because there are differences (concerning the salient features of the economy, the feasibility of various policy instruments, and the emphasis of analysis) between our models and those examined in the standard tax literature, we devote one section to an explanation of some of those that are critical. We articulate some of our misgivings with the general approach of this chapter, as well as that of modern public economics, and present concluding remarks at the end of the chapter.

The Basic Model

Consider an economy in which there are two commodities and two sectors: food and related products, produced in the agricultural sector (sector a) and a generalized industrial good, which can be used either for consumption or for investment, produced in the manufacturing or industrial sector (sector m). Both goods are freely traded; the international price of the agricultural good in terms of the industrial good is denoted by P.

Agricultural Sector

The agricultural sector consists of homogeneous peasants who decide how much labor to supply, given the prices at which they can sell their surplus. We denote this price (in terms of the industrial good) by p. Clearly, the level of utility that peasants can attain is a function of this price, and the utility level of a representative peasant can be written as $V^a(p)$.[10] Some of the agricultural output is consumed within the agricultural sector and the surplus quantity, s per peasant, is sold to the industrial sector or abroad. This quantity is a function of the price that the peasants receive. We denote the price elasticity of the surplus by $\eta_{sp} = (\partial \log s)/(\partial \log p)$. Economic theory puts no constraints on the sign of η_{sp} (there may be a backward-bending supply schedule of the surplus), but it is empirically reasonable to assume that an increase in the price increases the marketed surplus. That is, $\eta_{sp} > 0$. Our formulas can be reinterpreted for the case in which $\eta_{sp} < 0$.

We assume that the government has very few policy instruments to control peasants' behavior; it cannot directly control their output or their consumption. This, we believe, is the correct representation in most developing countries, because much of the farming in these economies is done on numerous small plots, and the ability of the government to monitor and control the actions of peasants seems sufficiently limited that only indirect incentives are administratively feasible. We also assume that complex pricing schemes are

infeasible. Nonlinear pricing schemes, for example, in which the unit price paid to a peasant depends on the amount the peasant sells, typically lead to underground (unaccounted) transactions. Accordingly, we restrict ourselves to schemes that pay a common price to all peasants, regardless of the quantities they transact.[11]

Industrial Sector

We assume that there are many policy instruments in the industrial sector, in contrast to the agricultural sector. In many developing countries, the government not only is the largest industrial producer and employer but also taxes private producers' profits and can sometimes control their prices and quantities. Here we make the polar assumption that the government has sufficient instruments so that the distinction between direct and indirect control can be virtually ignored.[12]

For simplicity, we ignore at present the intrasectoral income distribution and assume that the number of hours for which an industrial worker works is fixed. The government takes the wage, w, it pays workers as given, but it can control the price, q, at which its marketing board sells food in the industrial sector. (The case in which the government can alter w is discussed later.) Thus, we write the welfare of an industrial worker as $V^m(q, w)$. An industrial worker takes his income w and the price q as given and decides how much food to consume. This quantity is represented as $x^m(q, w)$. The price elasticity of the urban consumption of food is $\epsilon^m = -\partial \log x^m / \partial \log q$, which is a positive number, because consumption goods are assumed to be normal.

Investment

Government revenue available for investment is denoted by R. This equals the difference between the value of industrial output and the industrial wage payment, plus the net profit of the marketing board:

$$R = N^m(z - w) + (P - p)N^a s(p) + (q - P)N^m x^m(q, w) \tag{16-1}$$

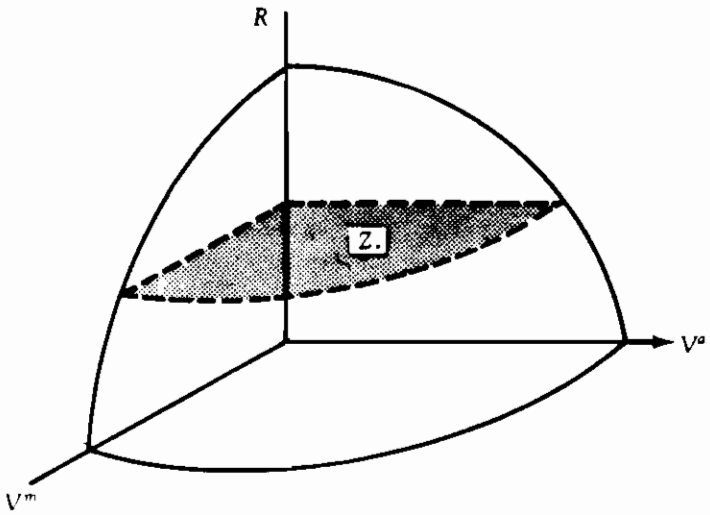
where N^a is the number of peasants, N^m is the number of industrial workers, and z is the output per industrial worker.

A Simple Analysis of Agricultural and Industrial Pricing

Price Reforms for Pareto Improvements

There are three groups in the present model: the peasants, the industrial workers, and the government, which represents future generations through its control of investment. For each value of p and q, we can calculate the feasible

Figure 16-1. *The Utility Possibilities Schedule*



combinations of V^a, V^m, and R (see figure 16-1). We first show that certain price changes can make all groups in a society better off.

The utility possibilities schedule gives the maximum value of revenue for investment consistent with any level of utility of peasants and industrial workers. If the existing prices are at inefficient points such as Z, then a change in prices can make every group in the society better off.

In the above-described model, an increase in the rural food price makes the peasants better off, but it does not affect the industrial workers. Also, investment increases with an increase in p if $dR/dp > 0$. This happens, we see from equation 16-1, if

$$p < P/(1 + 1/\eta_{s,p}) = \bar{p}. \tag{16-2}$$

Thus, if the price of food in the agricultural sector is less than $\bar{p}$, then an increase is unequivocally desirable, because it will increase the government revenue and will also improve the welfare of peasants without affecting the welfare of industrial workers.

Similarly, raising the urban food price makes urban workers worse off and does not affect the peasants. It lowers government revenue if $dR/dq < 0$, or, from equation 16-1,

$$q > P/(1 - 1/\epsilon^m) = \bar{q} \tag{16-3}$$

and $\epsilon^m > 1$. Thus, if $\epsilon^m > 1$, and if the urban food price is above $\bar{q}$, then a price reduction is unequivocally desirable for the society. Though at the aggregate level of analysis in this section, it seems plausible to assume that the demand

elasticity of "food" is less than unity (in which case, Pareto improvement in urban prices is not possible), it is clear that there are particular agricultural commodities for which the demand elasticity may be greater than unity; thus, as the price of rice increases, urban workers may switch to lower-quality grains that face lower taxes; urban workers will be worse off, and the public revenue will decrease. See below for a disaggregated analysis.

These rules of price reform have several virtues. First, they identify a lower limit for the rural food price and an upper limit for the urban food price. Second, the questions of reform in the rural and the urban prices can be addressed independently of one another.[13] Third, the use of these rules requires very little information. Apart from the world price, only the demand and supply elasticities are needed. The rules do not require social weights, which are needed to implement optimal prices, as we shall see later. Moreover, the elasticities that are needed to use these rules of reforms (as well as other rules of reform that we derive later) are those associated with the current equilibrium, which can be calculated from the local properties of the demand and supply functions. These rules should be contrasted with the optimal pricing rules, to be discussed below, in which the elasticities are to be evaluated at the social optimum, for which purpose one needs to know the global properties of the demand and supply functions.

In addition, these rules hold in models much more general than the one considered above. The only conditions required are that

$$\frac{\partial V^a}{\partial p} > 0 \quad \text{and} \quad \frac{\partial V^m}{\partial q} < 0, \tag{16-4}$$

respectively. Interpret, for instance, V^a and V^m as representing the aggregate welfare of the entire group of peasants and industrial workers, respectively. Then expression 16-4 implies that the aggregate welfare of peasants increases if the price of their output is increased and that the welfare of industrial workers decreases if the food price they face is increased. As long as these conditions are satisfied, the above-described rules of price reform continue to hold.

The rule for reform in the urban food price, for instance, holds regardless of the distribution of income among industrial workers. Similarly, the rule for reform in the rural food price may hold no matter how agricultural land is distributed among peasants, provided peasants are not net buyers of food.[14] Moreover, as we shall see later, these rules of reform can be extended in a straightforward manner when prices and wages affect individuals' productivity and when there is migration between the two sectors.

The main point we wish to establish in this section, however, is not that the specific rules of price reform proposed above are valid in every circumstance (of course, they are not if the economy is very different) but that one can often determine a set of rules to identify those price reforms that improve the welfare of all groups in the society.

Other Price Reforms

The approach discussed above weeds out inefficient pricing policies, but it does not distinguish between numerous pricing policies that are efficient. A choice among these policies necessarily entails tradeoffs between the interests of peasants, industrial workers, and future generations. In this section, we show how to analyze these tradeoffs. First, we express the aggregate social welfare as

$$H = N^a W(V^a) + N^m W(V^m) + \lambda R \tag{16-5}$$

in which λ is the social value of marginal investment, $W(V)$ is social welfare defined over an individual's utility level, and H is the value of social welfare as a function of the welfare of peasants and industrial workers, and the level of revenue.[15] Conceptually, this approach allows us to draw social indifference curves, that is, those combinations of V^a, V^m, and R among which the society is indifferent (see figure 16-1).

Differentiation of equation 16-5 with respect to p and q, and a rearrangement of the resulting expressions, yields

$$\frac{dH}{dp} \gtrless 0, \qquad \text{if} \quad p \lesseqgtr P\mu^a \tag{16-6}$$

$$\frac{dH}{dq} \gtrless 0, \qquad \text{if} \quad q \lesseqgtr P\mu^m \tag{16-7}$$

where

$$\mu^a = 1/\left[1 + \left(1 - \frac{\beta^a}{\lambda}\right)\frac{1}{\eta_{sp}}\right] \tag{16-8}$$

$$\mu^m = 1/\left[1 - \left(1 - \frac{\beta^m}{\lambda}\right)\frac{1}{\epsilon^m}\right]. \tag{16-9}$$

$\beta^i = \gamma^i \partial W/\partial V^i$ is the social weight or the social marginal utility of extra income to a worker in sector i, and γ^i is the (positive) private marginal utility of income to a worker in sector i.[16]

Expression 16-6 implies that the social welfare is increased by increasing (decreasing) the rural food price if the current price is lower (higher) than $P\mu^a$. A similar rule for changing the urban food price is given by expression 16-7. These rules are sharper than those we obtained earlier—not surprisingly, because rules 16-6 and 16-7 require more information. Specifically, they need the social weights (at the current equilibrium) associated with the rural and the urban incomes relative to the social weight associated with investment. On the other hand, like the previous rules, they require information about supply and demand elasticities only at the current equilibrium.

Optimal Prices

The optimal prices are those at which the possibilities of reform have been fully exhausted. Using expressions 16-6 and 16-7, thus, the optimum is represented by

$$p = P\mu^a \tag{16-10}$$

$$q = P\mu^m. \tag{16-11}$$

Diagrammatically, the optimum represents that point on the utility possibilities surface (see figure 16-1) that is tangent to the social indifference curve.

We have thus obtained optimal pricing formulas, of a remarkably simple form, in terms of the welfare weights and the price elasticities. The optimal price in the agricultural sector depends only on the social weight on the income of peasants (relative to investment) and on the price elasticity of agricultural surplus. Similarly, the optimal price in the industrial sector depends only on the social weight on the income of industrial workers and the price elasticity of their demand for agricultural goods.

The above results have some natural interpretations. In the early stages of development, the social value of investment might be thought to exceed the weights on private incomes, that is, $\lambda > \beta'$. Under such circumstances, peasants should receive less than the international price of food, and city dwellers should pay more than the international price of food. That is, both sectors should be taxed.[17] Also, a higher elasticity of agricultural surplus corresponds to a higher price paid ro peasants, because the marginal increase in the revenue from a price increase is higher, and a higher demand elasticity of food in the industrial sector corresponds to a lower price charged to city dwellers, because the marginal increase in the revenue from a price increase is lower. Furthermore, the smaller the social weight on peasants' income, the lower the price in the agricultural sector; the smaller the social weight on city dwellers' income, the higher the price paid by them.

Implicit Tax Rates

The optimal pricing formulas derived above can also be stated in terms of commodity taxes. Let $\tau = (P - p)/p$. Then τ is the tax rate on the output of peasants; it can also be interpreted as the rate of subsidy on their consumption. Denote the food output and the consumption of a peasant with y and x^a, respectively. Then the marketed surplus per peasant is

$$s = y - x^a. \tag{16-12}$$

Furthermore, define $\eta^a = \partial \log y/\partial \log p$, and $\epsilon^a = -\partial \log x^a/\partial \log p$ as the price elasticities of food output and consumption of a peasant. Then the surplus elasticity can be expressed as $\eta_{sp} = (1 + \alpha)\eta^a + \alpha\epsilon^a$, where $\alpha = x^a/s$ is the ratio of peasants' consumption to their marketed surplus. With these definitions, the optimal tax rate is obtained from equation 16-10 as

$$\tau = \left(1 - \frac{\beta^a}{\lambda}\right)\frac{1}{(1+\alpha)\eta^a + \alpha\epsilon^a} = \left(1 - \frac{\beta^a}{\lambda}\right)\frac{1}{\eta_{sp}}. \tag{16-13}$$

The above expression for the tax rate has some similarities with those in the traditional tax literature, but there are also some differences. According to equation 16-13, the magnitude of the tax rate is inversely proportional to the price elasticities of output and consumption. This dependence is similar to the one suggested in some of the earliest writings on taxation, for example, those by Ramsey and Pigou. There is a basic difference, however, between the present policy problem and the standard taxation problem in which production and consumption decisions are made separately by corporations and consumers. In the latter case, the relative roles played by output and consumption elasticities depend very much on the government's taxation of profits; the output elasticity does not appear in the tax formula, for example, if the profits are entirely taxed away (see Atkinson and Stiglitz, 1980, p. 467, and Stiglitz and Dasgupta, 1971).

In the present problem, it is nearly impossible for the government to distinguish between producers and consumers within the agricultural sector, because peasants are simultaneously producers as well as consumers. The key elasticity is therefore that of marketed surplus. Even though this elasticity can be restated in terms of output and consumption elasticities, as in equation 16-13, it is the combined effect that matters. This statement should not be surprising. In the formulations of standard general equilibrium models, what matters is the individual's net trade; for farmers, this is just their marketed surplus.

Many Income Groups in Agricultural and Industrial Sectors

The formulas derived earlier can be used even when the distribution of income in the agricultural sector is explicitly taken into account. We need only to reinterpret β^a as the "average" social weight corresponding to the agricultural sector. To see this point, consider an agricultural sector in which there is a continuum of land ownership ranging from large landlords to landless workers. Denote an individual by the superscript h, whose land holding is A^h, whose marketed surplus is s^h (which can be negative) and whose net labor supply (labor hours supplied minus labor hours used on his farm) is L^h. $A^h = 0$ for landless workers. The rural wage per hour, w^a, is determined in the rural labor market, and so it depends on the price of agricultural goods, p. We define $\eta_{wp} = \partial \log w^a / \partial \log p$ as the elasticity of rural wage with respect to p. Furthermore, let $\bar{s}$ denote the average marketed surplus, that is, $\bar{s} = \Sigma_h s^h / N^a$. Expression 16-5 is now modified to be: $H = \Sigma_h W(V^{ah}) + \Sigma_h W(V^{mh}) + \lambda R$, where V^{ih} is the utility of person h within sector i.

Then it is easily verified that equation 16-10 still characterizes the optimal pricing rule, with the modification that now

$$\beta^a = \Sigma_h \beta^{ah}\left(s^h + \frac{w^a L^h}{p}\eta_{wp}\right)/N^a\bar{s} \tag{16-14}$$

where β^{ih} is the social weight on the income of individual h in sector i. It is obvious from equation 16-14 that β^a is a weighted average social weight on rural incomes, because $\Sigma_h L^h = 0$ from the rural market-clearing condition, and the sum of the terms multiplying β^{ah} is unity.

An important property of the average social weight derived above is that it takes into account the general equilibrium effects of prices on incomes.[18] Also, our pricing formula, equation 16-10 in combination with equation 16-14, is largely independent of the precise nature of the labor market (for example, on whether or not the labor market is competitive). The relevant parameter is the elasticity of rural wage with respect to price, which would take specific values, depending on the features of the rural labor market.

The same approach applies to the industrial sector. With wage (income) differences among city dwellers, equation 16-11 is the optimal pricing formula, with a modification that

$$\beta^m = \sum_h \beta^{mh} x^{mh} / \sum_h x^{mh} \tag{16-15}$$

where x^{mh} is the food consumption of the city dweller h. Once again, it is obvious from equation 16-15 that β^m is a weighted average of the social weights on the incomes of city dwellers.[19]

It is perhaps important to explain here the difference between applying the rules for optimal prices on the basis of the assumption of homogeneous individuals within a sector versus the rules in which the intrasectoral heterogeneity of individuals is explicit. In both cases the required information on sectoral price elasticities is the same, because the government's budget, equation 16-1, is the same. The application of rules based on heterogeneous individuals requires additional information on the quantities (of goods and net labor supply) and the social weights corresponding to different groups of individuals. If the society cares about the intrasectoral distribution of welfare then, clearly, the government should use the coefficients β^a and β^m from equations 16-14 and 16-15 in its calculations.

The Structure of Prices in the Agricultural Sector

A major issue facing many developing countries is whether fertilizer and cash crops should be subsidized to increase production or should be taxed as a way of raising revenues to finance government services and investment. Sometimes it is argued that cash crops are grown more by the wealthier peasants, and such crops provide a particularly desirable basis for taxation by a government concerned with redistribution.

On the face of it, government policies in this area often seem contradictory. Although the government provides a subsidy on fertilizer, allegedly to encourage production, it taxes the output, which discourages production. Would it not be better to eliminate the subsidy and reduce the tax—in short, to reduce

the extent of government intervention in this market? The model in the preceding section can be extended to give us insights into these issues.

A General Formulation

The range of goods produced in the agricultural sector can be divided into several distinct categories. They include those goods that are consumed by peasants and are also sold to outsiders, like food grains; those that are produced solely for sale, like rubber, fiber, and other cash crops; and those that are inputs to agricultural production itself, like manure. Similarly, the agricultural sector buys some goods from outside for consumption, like textiles and radios, and other goods for use as inputs in production, like fertilizers, pesticides, and tractors (tractors, though, are used occasionally to provide transportation services).

All of these goods can be incorporated within our earlier model by interpreting $\mathbf{s}^h$ as a vector, of which an element s_i^h represents the *net* supply of the ith good from the household h to the rest of the economy. If the peasant is a net seller of this good, s_i^h is positive, and it is negative if the peasant is a net buyer of this good. The per capita surplus of good i is denoted by $\bar{s}_i = \Sigma_h s_i^h / N^a$. For those goods that are produced and utilized solely within the agricultural sector, $\bar{s}_i$ is zero. We assume that the government can influence the prices of only those goods that cross the border between the two sectors and that there are no taxes on trades within the agricultural sector.[20] Naturally, $\mathbf{p}$, $\mathbf{P}$, and $\mathbf{q}$ are now vectors, and z now denotes the value of the entire vector of industrial output, measured at international prices, if we take one of the industrial goods as the numeraire. The effects of a change in the price of good i on an individual's utility and on the government revenue are respectively given by

$$\frac{dV^{ah}}{dp_i} = \beta^{ah}\left(s_i^h + \frac{dw^a}{dp_i} L^h\right) \tag{16-16}$$

$$\frac{dR}{dp_i} = N^a(\mathbf{P} - \mathbf{p}) \cdot \frac{d\bar{\mathbf{s}}}{dp_i} - N^a \bar{s}_i \tag{16-17}$$

where $d\bar{\mathbf{s}}/dp_i$ includes the induced effect due to a change in the rural wage. That is, $d\bar{\mathbf{s}}/dp_i = \partial\bar{\mathbf{s}}/\partial p_i + (\partial\bar{\mathbf{s}}/\partial w^a)(dw^a/dp_i)$, where d and ∂ denote derivatives including and excluding induced wage effects; both exclude the effects of changes in other prices. We can immediately calculate the effect of a change in prices on the social welfare. Expressions 16-5, 16-16, and 16-17 yield

$$\frac{\partial H}{\partial p_i} \gtrless 0 \tag{16-18}$$

if

$$(\mathbf{P} - \mathbf{p}) \cdot \frac{d\bar{\mathbf{s}}}{dp_i} \gtrless \left(1 - \frac{\beta_i^a}{\lambda}\right) s_i \tag{16-19}$$

where

$$\beta_i^a = \Sigma_h \beta^{ah}\left(s_i^h + \frac{w^a L^h}{p_i}\eta_{wi}\right)/N^a\bar{s}_i \tag{16-20}$$

and $\eta_{wi} = \partial \log w^a/\partial \log p_i$ is the elasticity of rural wage with respect to the price of good i. We thus obtain a straightforward modification of our earlier analysis. Note that the above expressions take into account the fact that different commodities will have different distributional effects, depending on the marketed surplus of the commodity for the rich versus the poor. They also emphasize that we need to take into account not only the direct effects (for example, large surplus suppliers are hurt more by a reduction in the prices they receive) but also indirect effects due to price-induced changes in wages, η_{wi}, which would be different for changes in the prices of different goods. A tax on a crop that is largely a cash crop may have deleterious distributional effects if it depresses the labor demand and agricultural wage significantly, because small landholders and the landless, who are net suppliers of labor, may well be hurt more than the large landholders. The above expressions differ from our earlier analysis in a second way: when other taxes are in place, a change in the tax on one commodity may change demands for other commodities, increasing or decreasing tax revenues. These effects are incorporated in the left-hand side of expression 16-19.

As before, the optimal prices are characterized by expression 16-19, in which the inequality is replaced by an equality. This yields a multiperson Ramsey-like optimal rule, with a difference that induced general equilibrium effects on wages and earnings are now taken into account. This rule has the standard interpretation of how the proportional reduction in the quantity of a good should be related to its distributional characteristics (see Atkinson and Stiglitz, 1980, pp. 386–90).

The implementation of this optimum, however, requires more information than might be available. It requires estimates of the values of all the elasticities and of social weights at an equilibrium that may be far removed from the current situation. The use of expressions 16-18 and 16-19 for reform analysis may also be inhibited, because we seldom have good estimates of all the own and cross-elasticities or of the general equilibrium responses of agricultural wages to changes in prices of particular goods. We show now that it is possible to reform prices of certain goods based on much more limited information.

Pareto-Improving Price Reforms That Require Very Little Information

Pareto-improving price reforms can be made for "production goods" (that is, for those agricultural inputs and outputs that are not used for consumption, such as fertilizers, machine inputs, cash crops, and so on) solely on the basis of the elasticities of inputs and outputs (on unit land) with respect to the prices of production goods. In certain circumstances, we do not need any information

concerning consumption responses, the distribution of land, or the social weights.

For the analysis in the remaining part of this section, we assume that there are constant returns to scale in agricultural production when all inputs, including land, are taken inro account, and that all farmers have access to the same production technology. The latter assumption is not required if farmers with different production technologies are in different regions and can be subjected to different sets of taxes (some aspects of pricing policy, when this assumption is not satisfied, are discussed below). We should point out here that the above assumptions not only are made in most of the empirical work on farmers' responses (on which an implementation of price policy must ultimarely be based) but also underlie typical simulation exercises on tax policy (see, for example, chapter 15, by Heady and Mitra in this volume). Though these assumptions are unlikely to be satisfied by every single farmer, the relevant empirical question is whether one can identify systematic differences berween the observed technologies and those with the above assumptions. If the differences are not significant in a statistical sense, then one can use our reform rules with extreme parsimony in information; otherwise, one would need to use expressions 16-18 and 16-19.

Denote the net output vector of the hth household by $\mathbf{y}^h$, such that the outputs are represented as positive quantities and the inputs are represented as negative quantities, and $\mathbf{y}^h = A^h\mathbf{y}$ where $\mathbf{y}$ is the net output vector per unit of land. If the consumption vector of the household h is denoted by $\mathbf{x}^{ah}$, then $\mathbf{s}^h = A^h\mathbf{y} - \mathbf{x}^{ah}$ denotes the surplus vector of household h. Now consider a change in the prices of those goods that are employed in the rural production (as inputs and outputs) but are not consumed. If the good is a production good, then $s_i^h = A^h y_i$. Also, because the prices of production goods affect the consumption quantities only through changes in full income, it follows that $\partial x_j^{ah}/\partial p_i = A^h y_i \partial x_j^{ah}/\partial M^h$, where M^h denotes the full income of the household h, and $\partial M^h/\partial p_i = A^h y_i$ is the change in full income due to a change in p_i. Now assume that the induced wage effect is negligible (this assumption is relaxed below). Then 16-17 can be written as

$$\frac{dR}{dp_i} = (c_i - 1 - B)N^a A y_i \tag{16-21}$$

where $A = \Sigma_h A^h/N^a$ is the per capita land, $\tau_j = (P_j - p_j)/p_j$ denotes the rate of tax or subsidy, $\eta_{ij} = \partial \log y_i/\partial \log p_j$ represents the price elasticities of the production goods per unit of land, $c_i = \Sigma_j \tau_j \eta_{ij}$ is the proportional change (due to taxation) in the quantity of the ith production good per unit of land, and $B = (\mathbf{P} - \mathbf{p}) \cdot [\Sigma_h A^h(\partial \mathbf{x}^{ah}/\partial M^h)]/N^a A$. In deriving equation 16-21, we have also used the standard symmetry property of inputs and outputs that $\partial y_j/\partial p_i = \partial y_i/\partial p_j$. Expression 16-21 provides the basis for the following rules of price reform.

Calculate c_i for all of the production goods. If $c_i > c_k$, and i and k are both

outputs (inputs), then increase (decrease) the price of the ith good by a small amount, say Δp_i, and decrease (increase) the price of the kth good by $(y_i/y_k)\Delta p_i$. On the other hand, if the ith good is an output (input) and the kth good is an input (output), then increase (decrease) the price of the ith good and increase (decrease) the price of the kth good in the same proportion as above. This procedure should be continued until all values of c_i are as close to one another as possible.

The above rules of reform have the property that they increase the government revenue while leaving unchanged the utility level of every individual. The reforms therefore lead to strict Pareto improvements. This can be verified as follows. If Δp_i is the change (positive or negative) in the price of the ith good, then $-(y_i/y_k)\Delta p_i$ is the change in the price of the kth good. From equation 16-16, then, V^{ah} remains unchanged, because $s_i^h = A^h y_i$ for production goods. From equation 16-21, on the other hand,

$$\Delta R = (c_i - c_k)N^a A y_i \Delta p_i. \tag{16-22}$$

Recalling that y_i is positive for an output and negative for an input, it follows from equation 16-22 that our rules of reform increase investment. It is also clear from equation 16-22 that a necessary condition for the optimality of taxes is that values of c_i should be equal for all production goods.

These reform rules are highly parsimonious in their use of information, as should be obvious. The information required consists solely of the current taxes on inputs and outputs, curtent quantities of inputs and outputs on unit land, and the response of these quantities to the changes in the prices of production goods. Also, the above-described reform analysis applies to those cases in which different groups of producers (in different regions, for example) face different sets of prices.

In fact, these reform rules can be applied even when the induced wage effects are significant. If the production goods have the same (but not necessarily constant) elasticiry with respect to the wage, for instance, then not only do our rules of reform hold, but also one does not need to know anything whatsoever concerning the labor supply behavior of households to be able to use them.[21] Though we do not expect the restriction on elasticities noted above to hold in every circumstance, once again the relevant empirical question is: how different are the actual wage effects from those predicted by the technology with the above restrictions? If the difference is not significant in a statistical sense, then our reform rules continue to hold.

Should Some Cash Crops or Production Goods Be Taxed and Others Subsidized?

To gain insight into this question, recall that a necessary condition for the optimality of taxes is that

$$c_i = \Sigma_j \tau_j \eta_{ij} \tag{16-23}$$

should be the same for all production goods. That is, the proportionate change due to taxation in the quantities of production goods per unit of land should be equal for all such goods.

Now assume for a moment that changes in the prices of production goods have negligible cross-price effects on the quantities of inputs and outputs (that is, $\eta_{ij} = 0$ if $i \neq j$) then, from equation 16-23, $\tau_i \eta_{ii}$ is the same for all i. Next, from the standard properties of production functions, $\eta_{ii} > 0$ for an output and $\eta_{ii} < 0$ for an input. Also, from our definition of τ_i, a positive (negative) τ_i implies a tax (subsidy) on an output and a subsidy (tax) on an input. It follows, then, that either all of the production goods (inputs as well as outputs) should be taxed or they should all be subsidized. Also, the taxes (or subsidies) on these goods should be inversely proportional to their own-price elasticities.

These results are important not because we believe that the cross-price effects are negligible or that the induced wage effects are always of the type considered above. They are important because we have isolated the reasons why the sign of taxes might differ among different production goods. Specifically, we ofren find that a fertilizer is being subsidized, whereas a pesticide is being taxed, or vice versa—or that cotton is being subsidized, whereas another cash crop is being taxed. If it is true that farmers use inputs in the same relative proportions, then our analysis suggests that the justification for such taxation must lie in the presence of large cross-price effects or in the presence of specific induced wage effects. If it is found from empirical analysis that input patterns are similar, that there are no large cross-price effects or wage responses, then the existing tax structure is not optimal, and it can be improved upon, regardless of what the social weights might be.

This analysis casts some doubts on the oft-given advice that, on the grounds of equity, some agricultural inputs (like machinery) should be taxed, because they are used primarily by rich farmers, whereas other inputs (like fertilizer) should be subsidized, because they are used by poor as well as rich farmers. The above analysis suggests that all inputs should be used by rich and poor alike and that such policies, when aimed at cash crops and production inputs, cannot be justified on the ground of equity alone; the primary justification for them should reflect the importance of cross-price effects and specific kinds of induced effects of prices on the rural wage.

Given the importance of the results obtained above, it is probably useful to evaluate a central assumption, that of constant returns to scale in production, which underlies these results. As we noted earlier, much of the existing theory of taxation assumes constant returns to scale; our results can thus be viewed as simply indicating one of the important logical implications of this assumption. By the same token, simulation-based models of taxation that begin with a specification of a constant-returns-to-scale production function must necessarily yield results that conform with our analysis. Moreover, a number of empirical studies (see Singh, Squire, and Strauss, 1986, for a review) of farm-household models have found that the hypothesis of constant returns to scale cannot be rejected in most circumstances.

Yet one might feel a certain unease concerning constant returns, in particular because (under the standard microeconomic model of a farm) it predicts identical factor ratios across farmers with different sizes of landholding, whereas casual observation sometimes suggests differences in factor ratios (for example, smaller farmers use more bullocks, whereas larger farmers use more tractors). When such differences are systematically observed (in a reliable statistical sense), then one needs to understand the sources of these differences (whether it is, for instance, deviations from homotheticity, deviations from uniform prices due to credit constraints, or differences in information about best practices), and what the appropriate policy response should be (to attempt to correct price distortions, if that is the reason for differences in input ratios; to provide better information, if lack of information is the source of differences in input ratios). Depending on the source of differences in factor ratios, and depending on the available policy responses to counteract them (if it is desirable to counteract them), then, the model for tax analysis would have to be modified. A full analysis of such modified models is beyond the scope of the present chapter. It is in any case by no means obvious that the results (presented earlier in this section) concerning tax policy would be significantly modified under such extensions; the reason is that constant factor ratios are a *sufficient* but not a *necessary* condition for our results. See "Caveats and Misgivings" for a more complete discussion of the limitations of the model presented here as well as those found elsewhere in the literature.

The Structure of Prices in the Industrial Sector

Urban food subsidies not only are widespread in developing countries but are often also a source of large public deficits. Attempts to cut food subsidies have precipitated riots in more than one country. Modern public finance theory does not give us a clear qualitative picture. As Atkinson and Stiglitz (1972) noted, for instance, and as Deaton illustrates in chapter 4, in the demand systems that are typically estimated in practice, the commodities with a low income elasticity are often also the commodities with low price elasticity. If one ignored distributional consequences, these would be the commodities to tax, but if one focused on distributional considerations, then these would be the commodities to subsidize. Thus, whether a particular consumption commodity should be taxed or subsidized may depend relatively sensitively on the social weights as well as on other critical features of the economy, such as what other instruments for redistribution are available to the government (see Atkinson and Stiglitz, 1980).

Four features of the economy, we would argue, are central in analyzing the structure of urban prices and taxes in developing economies. These are the presence of urban unemployment, intersectoral migration, wage-productivity effects, and the urban wage determination mechanisms. In the presence of significant unemployment, the effect of taxation on the hours of labor that an

individual might hypothetically be willing to supply—a basic feature of the standard tax analysis in developed countries—does not seem to us to be of central importance in the context of the industrial sector in developing countries.

Moreover, the migration between the agricultural and the industrial sector is closely related to the nature of urban unemployment, as has been emphasized in the recent development economics literature, and its implications on tax analysis can be significant. If the agricultural wage is fixed, for instance, then an urban food subsidy would make living in the urban sector more attractive, so that there would be a higher flow of migration from the agricultural to the industrial sector. This effect in turn might mean that there would be an increase in the urban unemployment rate, little or no increase in the welfare of the poor (in terms of their expected utility), and a possible reduction in the funds available for investment.

It has also been argued sometimes that urban food subsidies may be desirable in developing economies, because they may improve the health of workers and, hence, the efficiency of the industrial labor force. This argument is, in fact, a part of a class of hypotheses that postulate a relationship between industrial wages, industrial productivity, and the level of unemployment in the economy. According to these hypotheses, the output per worker of an industrial firm (net of hiring and training costs) depends on the wages paid, because wages affect workers' efficiency, quality, and turnover. Employers (public or private) therefore take these effects into account when setting the wage that, in turn, affects the level of unemployment.

The reason why we believe that the mechanism of industrial wage determination is a key issue in the analysis of taxes in developing countries is that, if the government can control industrial wages, then under certain circumstances (but not always), commodity taxation may be unnecessary in the industrial sector. If, on the other hand, wages are determined endogenously, then one needs to specify the precise mechanism through which industrial wages are determined (such as competitive wage setting by private firms), because a change in the tax policy would result in induced effects on the industrial wages (similar to those discussed earlier in the context of the agricultural sector), and these effects need to be incorporated in the design of tax policy.

Elsewhere (in Sah and Stiglitz, 1984*a*, 1985*a*, 1985*b*), we have developed a framework that provides a unified treatment of unemployment, migration, wage-productivity effects, and the determination of wages and earnings in the two sectors. Using this framework, we have analyzed the consequences of taxation and pricing as well as the determination of shadow prices and wages for cost-benefit analysis. Moreover, this framework can be specialized to many different hypotheses concerning, for instance, migration, wage-productivity effects, and the determination of wages. Limitations of space do not permit us to describe such an analysis here. We therefore present below a highly simplified model that emphasizes wage-productivity effects, whereas the conse-

quences of migration and unemployment are briefly discussed in the next section.

If the wage-productivity hypothesis holds—that is, the hypothesis that the wage rate affects a worker's productivity—then efficiency may entail paying high wages in the industrial sector. Also, real wages may be relatively insensitive, for instance, to the unemployment rate. Wage-productivity effects have typically been studied within models in which prices are fixed. A natural extension, in the present context, is that the productivity of a worker is a function of his (or her) wage as well as the relative prices he (she) faces.

For simplicity, consider the case of homogeneous industrial workers (its extension to the case of heterogeneous workers is discussed later). The wage-productivity effects are represented in a reduced form as

$$z \equiv z(\mathbf{q}, w). \tag{16-24}$$

This representation is consistent with a hypothesis that the productivity depends on the level of worker's utility. It is also consistent with a hypothesis that the productivity may be more closely related to the consumption of certain goods, such as health care and food, than to the consumption of other goods. The standard assumption in the literature is that higher wages lead to higher productivity, that is, $\partial z/\partial w > 0$. The effects of prices on productivity, which have not received attention in the past, are likely to be ambiguous in general. In the special case in which a worker's productivity depends only on his utility level, however, that is,

$$z \equiv z[V^m(\mathbf{q}, w)] \tag{16-25}$$

and $\partial z/\partial V^m > 0$, it is easy to see that higher prices reduce productivity.

Taking expression 16-24 into account, and assuming that the urban wages are fixed and there is no migration, we maximize the aggregate social welfare with respect to prices. The corresponding optimal price structure is given by the solution to

$$\Sigma_j \tau_j \epsilon_{ij}^{mw} = \left[1 - \frac{\beta^m}{\lambda} - (\mathbf{q} - \mathbf{P}) \cdot \frac{\partial \mathbf{x}^m}{\partial w}\right] + b_i \tag{16-26}$$

where $\tau_j = (q_j - P_j)/q_j$ is the tax rate on good j, $\epsilon_{ij}^{mw} = -\partial \log x_i^{mw}/\partial \log q_j$ represents various compensated elasticities, and $b_i = (1/x_i^m)/(\partial z/\partial q_i)$.

As is well known, the left side of equation 16-26 represents the (tax-induced) proportional reduction in the compensated consumption of good i. The standard result that this reduction should be equal for all goods, however, does not hold here, because of the wage-productivity effects, which are captured in the last term, b_i, of equation 16-26. This term can be interpreted by noting that $b_i = -\epsilon_{zi} z/q_i x_i^m$, where $\epsilon_{zi} = -\partial \log z/\partial \log q_i$. Therefore b_i is a larger negative number for a good if an increase in the price of this good decreases the productivity to a larger extent (that is, ϵ_{zi} is larger), and if the worker's expenditure, $q_i x_i^m$, on this good is smaller. Obviously, from equation 16-26, the proportional reduction corresponding to such goods should be smaller.

Moreover, a basic prescription of standard tax theory, that there should be no commodity taxation if the government can set the wages, also does not hold in the present context. To see this point, we first obtain the expression for optimal wage, taking prices as fixed. The optimal wage is characterized by $1 - \beta^m/\lambda - (\mathbf{q} - \mathbf{P})\partial \mathbf{x}^m/\partial w = b_w$, where $b_w = \partial z/\partial w$. Next, if both the prices and the wage are set optimally, then by substituting the last expression into equation 16-26 we obtain

$$\Sigma_j \tau_j \epsilon_{ij}^{mw} = b_w + b_i. \tag{16-27}$$

Now, in the absence of wage-productivity effects, the right side of equation 16-26 is zero. Hence $\tau_j = 0$, and

$$q_i = P_i. \tag{16-28}$$

That is, there should be no commodity taxes in the industrial sector. This, however, is not the optimal policy if the wage-productivity effects are significant.

A special case in which the standard results are restored, even though the wage-productivity effects are present, is when a worker's productivity depends on the level of his utility. In this case, $b_i = -\beta^m \partial z/\partial V^m$, which is the same for all goods, and therefore, from equation 16-26, the proportional reduction should be equalized across goods. Also, the right side of equation 16-27 is zero (because $b_w = -b_i$), which implies that commodity taxation in the urban sector is unnecessaty if the government sets the wages.

In fact, the above results concerning the desirability or undesirability of urban commodity taxation may hold even if the government does not entirely control industrial wages. Consider a situation, for instance, in which wages are determined through bargaining between the government and a trade union that does not suffer from money illusion. That is, the union knows that an increase in the price of food represents a worsening of workers' welfare in the same way that a reduction in their wage does. Now, if the wage-productivity effects are of the type represented in expression 16-25, then it is better to have no urban commodity taxation, as in equation 16-28, whereas the wages should be the instrument of bargaining. The substitution of a lump-sum (or wage) tax subsidy for an equal utility distortionary tax subsidy, in this case, generates increased revenues for the government. On the other hand, if the wage-productivity effects are more general, as in expression 16-24, then it is desirable to have urban commodity taxation.[22]

The above-described model is easily generalized to incorporate heterogeneity of individuals in the industrial sector. The main implication of this extension is that, in general, various goods will differ not only in their productivity effects (b_i) but also in their distributional effects. Goods such as food may have larger distributional effects (because the welfare of the poor is more sensitive to the food prices) as well as larger productivity effects (because of the effect of food consumption on workers' health, for example), and if this is the case, then the (tax-induced) proportional reduction in food consump-

tion should be smaller than in other goods. Furthermore, it can be verified that this extension does not alter our earlier results concerning the desirability or undesirability of urban commodity taxes or subsidies.

Migration and Unemployment

Recent research has drawn attention to the importance of labor mobility across sectors. In particular, it has been noted that migration from the agricultural to the industrial sector might increase industrial unemployment indirectly, because only some of the migrants can find industrial employment. This possibility has important consequences for tax policy, as the following extension of the basic model illustrates.

Consider three population groups: peasants, industrial workers, and unemployed workers. For brevity, we abstract from the heterogeneity of individuals within each of these groups and also assume that there is a single agricultural good and a single industrial good. One would expect that, for peasants who are net sellers of food, a lower rural food price will decrease the attractiveness of living in the agricultural sector, compared with living in the industrial sector. The same effect would arise if the urban food price is lower. On the other hand, additional migration to the industrial sector will tend to increase the level of unemployment in this sector, which in turn will discourage further migration.

We therefore need to calculate the consequences of the induced migration due to price changes. First, we need to redefine the elasticity of the agricultural surplus to account for the fact that the size of the rural population itself is sensitive to prices; this also affects the government revenue from taxation. Second, an outward migration from the agricultural sector reduces the population pressure on agricultural land, which in turn increases the welfare of those living in this sector. Third, migration has direct welfare effects as well, because workers move from one group to another that, in general, has a different level of utility.

In a general model of migration that we have proposed elsewhere, the rural population is represented as: $N^a = N^a(p, q, w, N^m)$, and the number of unemployed is given by: $N^u = N - N^a - N^m$. If V^u denotes the utility of an unemployed worker, then equation 16-5 is replaced by $H = N^aW(V^a) + N^mW(V^m) + N^uW(V^u) + \lambda R$. The optimal rural food price is characterized by

$$p = \frac{P + \phi}{1 + \left(1 - \frac{\beta^a}{\lambda}\right)\frac{1}{\bar{\eta}_{sp}}} \tag{16-29}$$

where $\bar{\eta}_{sp} = \partial \log(N^a s)/\partial \log p$ is the redefined price elasticity of agricultural surplus (taking into account the effect of price on rural population), and ϕ represents the welfare effects of price-induced migration.[23] If there is no migration, then $\bar{\eta}_{sp} = \eta_{sp}$, and $\phi = 0$. Not surprisingly, equation 16-29 is the

same equation as 16-10 in this special case. When there is migration, $\bar{\eta}_{sp}$ exceeds η_{sp}, and ϕ is positive, under plausible circumstances.

Now compare the above expression for the optimal price, equation 16-29, to the special case equation 16-10 when there is no migration. The effect of migration, then, is to increase the numerator and decrease the denominator in equation 16-29 if investment is more valuable than consumption. Heuristically, the implication is that migration increases the price that should be paid to peasants for their surplus. This notion makes sense, because by paying a higher price to peasants, the government can reduce the pressure of migration to cities and can hence reduce the resulting urban unemployment that otherwise lowers society's welfare. This insight appears to be particularly relevant in the context of some cities (for example, Bangkok, Cairo, and Mexico City) in which the inmigration from the rural sector has led to serious social degradation.

Another special case of the above formulation is the Harris-Todaro hypothesis (discussed by Fields in chapter 10), in which migration continues to the point where the expected utility of the marginal migrant (taking into account the probability of being unemployed) is equal in the two sectors and the marginal productivity of a worker in the rural sector is fixed. Then our pricing formula becomes

$$p = \frac{P}{1 + \left(1 - \frac{N\gamma^a}{N^a\lambda}\right)\frac{1}{\bar{\eta}_{sp}}} \tag{16-30}$$

where recall that γ^a is the marginal utility of income to a rural worker.[24]

This expression has an interesting implication. In the early stages of development, when the relative social weight on investment, λ/γ^a, is expected to be quite large and when the fraction of the population in the agricultural sector is expected to be large, the price paid to peasants should be less than the international price. As the economy develops, however, the price paid to peasants should increase, and it could quite possibly even exceed the international price.[25]

Further Extensions

The major components of our models of developing economies involve (1) the organization of the agricultural sector, (2) the organization of the industrial sector, (3) the mechanism of migration and unemployment, and (4) the international trade environment. In our basic model, the agricultural sector consisted of homogeneous owner-peasants, the industrial sector had homogeneous workers receiving a rigid wage, and there was no induced migration. This basic model was extended to include such features as the heterogeneity of individuals within the two sectors, migration and unemploy-

ment, and endogenous determination of industrial and agricultural wages. These features are clearly important in many developing countries. In this section, we illustrate ways of extending the model further to incorporate additional features that might be important in certain economies.

Sharecropping in Agriculture

In some economies, sharecropping is important. In such cases, all we need to do is to interpret s^h as the net surplus of an individual after the landlord's share has been paid or after the share has been received from the tenant. Furthermore, if the share contract is endogenously determined (see Stiglitz 1974*b*), then the individual's surplus elasticity will be based in part on the elasticities of equilibrium shares with respect to price. Clearly, the values of price elasticities might differ between economies with sharecropping and with peasant holdings even if the underlying utility functions and production functions were identical.

Composition of Households

This aspect, though ignored in much of the standard tax literature, is important, because we know that households have heterogeneous demographic characteristics, particularly when we contrast rural and urban households or rich and poor households in the agricultural sector as well as in the industrial. This affects the social weights, β^{ih}, which depend not only on the income of the households and on the social aversion to inequality but also on the demographic composition of the households. Moreover, the households' response to prices would implicitly depend on their demographic characteristics. (See Sah, 1983*b*, regarding a methodology for analyzing intrahousehold allocations.)

International Trade Environment

So far we have assumed that all goods can be exported or imported. Some goods, however, have such high transportation costs that neither alternative is attractive, whereas in other cases, even though it may be economically attractive to export a good, the country may face quantity restrictions and quotas from potential importers. In yet other cases, the government may restrict imports of certain goods because of self-sufficiency considerations. In addition, there may be constraints on international borrowings, restricting the level of trade a country can sustain. These and other similiar situations entail additional constraints within which pricing policies need to be determined.

Suppose that the government wishes to achieve a certain degree of self-sufficiency in food (a self-sufficiency objective for other goods can be treated similarly). One way to express this objective is as a constraint that the quantity of food imported cannot exceed a certain prespecified fraction of the domestic

production. Obviously, such a constraint influences pricing decisions only when it is binding. Once it is binding, however, the government's flexibility in setting prices decreases. In the simple model described in our second section, for instance, the two prices (p and q) can no longer be varied independently of one another.

Self-sufficiency objectives may also result in higher food prices for both the peasants and the city dwellers, because the government, with self-sufficiency in mind, may use price policy to increase the surplus from peasants and also to curtail urban food consumption. In this case, then, peasants would be relatively better off, and city dwellers relatively worse off, compared with a situation in which there were no self-sufficiency objectives.

Goods such as infrastructure and inputs into human capital formation are nontraded. Also, a large number of ordinary consumption and industrial goods produced in developing countries have virtually no international markets, in part because of quality considerations, even though these goods are traded domestically. For the purpose of tax policy, these goods must also be viewed as nontraded goods. If, in addition, it happens that a developing country faces export constraints on goods that it sells abroad, then the actual traded quantities would be nearly insensitive (at the margin) to the pricing policies. In determining prices and taxes, therefore, such an economy should be treated like a closed economy.

The difference in the treatment of a traded versus a nontraded good is simple. The shadow price for a traded good is its international price, whereas the shadow price of a nontraded good is determined, in our model, endogenously (and simultaneously with the determination of optimal prices) on the basis of its social marginal value. Specifically, those elements of the vector $\mathbf{P}$ that correspond to nontraded goods are replaced by the vector $\mathbf{P}^*/\lambda$, where elements of the vector $\mathbf{P}^*$ are the Lagrange multipliers to the market-clearing conditions of various nontraded goods. Now recall that we had defined taxes for traded goods as the difference between the international price and the price faced by consumers and producers. Taxes for nontraded goods can be defined correspondingly with respect to their shadow prices. This redefinition, however, does not change the expressions for the optimal tax rates that we have derived earlier. Our discussion of the qualitative properties of optimal taxation thus applies to the traded goods as well as to the nontraded goods.

Rigidities in the Economy

An important rigidity on which we have focused is the one in the labor market. The urban wage influences the output through labor productivity and other effects, and the migration decisions are based on expected utility, which includes a probability of remaining unemployed. The equilibrium market wage (that is, the wage that private or public employers would choose to pay) is therefore such that there is unemployment. An important consequence of this approach is that the market wage would change if the tax policy changes, and

that the government would not, in general, be able to eliminate unemployment through taxes and subsidies.

This point has been missed in some of the earlier literature, which has assumed that some government policies capable of eliminating unemployment always exist. This supposition, in turn, has sometimes led to a belief that, because the government can eliminate unemployment, it would do so. Consequently, unemployment must necessarily be a short-run phenomenon that can be ignored in a long-run policy analysis. These views are clearly misleading if the endogeneity of wages is taken into account.

Our analysis has also abstracted from the possibility that the adjustments in the economy, particularly in the labor market, might be lagged. In such a case, there are possible intertemporal consequences of taxation policies (for example, wage subsidies today may lead to higher wages and higher unemployment in the future), and a myopic taxation policy (based on this period's consequences alone) might differ from the one in which the dynamics of adjustment is taken into account.

Tax Analysis for Developing versus Developed Economies

Often policy analysts show a temptation to borrow results from the standard tax literature and to prescribe them in the context of developing countries without examining the premises on which these results are based. Such an approach overlooks what we consider to be two fundamental differences between developing countries and developed economies: one concerns the tax instruments that the government can or cannot use, and the other concerns the salient features of the economy. A related issue, discussed in the next section, is the possible unwillingness of the government to use certain policy instruments even if it is economically feasible to do so.

The constraints on the government's ability to employ particular instruments of taxation are, in turn, related to the information available and to the administrative costs associated with different tax instruments. In developing country agriculture, for example, it is virtually impossible to tax labor transactions. This inability to tax can be viewed as an information problem: though the concept of labor transaction is a perfectly well-defined economic concept, a tax system must be based only on those variables that are quantitatively ascertainable (at a reasonable cost) by an outside party. Our assumption that the labor transactions cannot be taxed in the agricultural sector of a developing country with heterogeneous individuals, we therefore believe, is more realistic than the one made in the standard tax model (Diamond and Mirrlees, 1971, for example) that the government can tax all trades that an individual undertakes.

Moreover, in many versions of the standard tax model, all profits are taxed away. Its counterpart in the agricultural sector requires the government to

impose a 100 percent tax on land rent. For obvious reasons (such as the government's inability to distinguish between the returns from land and those from other inputs), such a tax is almost certainly infeasible. The issue of land taxation, in fact, provides a good example of the constraints on tax instruments. This tax has been recommended by conventional economic theory since David Ricardo, but it faces the following problem. If the land tax is based on land area, irrespective of the quality, then it is viewed as unfair. On the other hand, it is inherently difficult to base a land tax on land quality: a direct measurement of land quality requires, once again, disentangling the effect of land quality from that of other inputs, whereas the absence of good land markets makes it difficult to obtain an indirect measure of land quality. It is perhaps not surprising that negligible use is made of the land tax in most developing countries and that its use has steadily declined over time. The reason is possibly that the coercion required to administer such a tax is less feasible today than it was earlier.

These differences have important consequences for tax policy. Oft-quoted results (Diamond and Mirrlees, 1971) that the producer prices should be the same as the shadow prices and that there should be no tax on international trade, for instance, need to be interpreted with considerable caution. The former result not only requires the government to be able to impose taxes on all trades, as well as 100 percent tax on profits but also is based on the standard definition of firms that purchase all of their inputs and sell all of their output. Firms by definition do not consume, and their transactions can be monitoted. Under this definition, the farms of our model are not firms, because farmers are both producers and consumers (at least for certain goods, like food grains), and it is virtually impossible to implement different producers' and consumers' prices, because the transactions (of food, for example) within a household and across households cannot easily be monitored.

Also, by this definition, those establishments are not firms where an owner-manager's effort has an effect on the outcomes, and that effort cannot be monitored. Such establishments are in this formal sense just like the farms in our model (see Stiglitz, 1974*b*), in which a direct tax on labor (effort) cannot be imposed. It is impossible to separate out that fraction of an owner-manager's income which is due to his efforts from the fraction that represents pure profits. Thus the standard results may be almost as inapplicable to developed economies as they are to developing countries.

Caveats and Misgivings

We indicated above several important directions in which our model could be extended, to reflect better the variety of institutions and economic environments found in developing countries. The analysis presented in this chapter (as well as in other chapters on taxation in this volume), however, has several

limitations that cannot so easily be remedied. Though we are currently engaged in research on these problems, it is only fair to warn the reader and to present some of our thoughts on their consequences.

The first limitation has to do with market imperfections. Though our model incorporates several types of rigidities, it has abstracted from those market imperfections that may cause different individuals (within the same sector and region) to face different *effective* prices for goods, even though the market prices they face are the same. To assess the consequences of such imperfections on pricing policy, one first needs to ascertain their sources. Among the examples are differential credit constraints faced by different individuals due, for instance, to the problems of imperfect information (note, however, that the effects of credit constraints may be considerably ameliorated by rental markets in capital goods) and to the incomplete access of particular ethnic groups to specific markets. Unfortunately, the available empirical work does not adequately characterize the importance of such imperfections or the precise nature of the underlying mechanisms. If these imperfections are important in a given economy, then one must take them into account in the analysis of taxation and pricing policies.

Market imperfections may either decrease or increase the ability of the government to tax. Improvements in the capital markets in developed countries have enabled smart investors to engage in tax arbitrage and have thus impaired governments' ability to impose capital taxation to the point where there is a widespread belief that capital taxation is not feasible. At the other extreme, in general, it is difficult for governments to tax transactions that do not pass through formal markets. Such transactions are undoubtedly of greater importance in developing countries than in developed countries. Moreover, tax policy affects the extent to which transactions occur in formal versus informal markets: tax-induced shifts in the "choice" of markets have both efficiency and equity effects that have not yet been studied.

Individuals not only make decisions about the extent to which they participate in formal (taxed) versus informal markets; they also decide on the extent to which they participate in tax avoidance activities. Such activities range widely, from those that are legal loopholes to those that involve outright corruption (including bribery of tax officials). Again, the tax structure may have a marked effect on the extent to which individuals participate in these activities, with consequences not only for equity and efficiency but also for the political process itself.

The second limitation has to do with differential knowledge and learning. It has been argued that many farmers may be uninformed about the best available practices, and diffusion of new technologies may be quite slow. It has also been argued that pricing policies can be used to help overcome peasants' resistance to the adoption of new techniques or to "protect them" while they learn the new technology. (The analogy with the infant industry argument should be obvious.) If this argument is correct, then it suggests that the equity-efficiency

tradeoff in taxation analysis has another dimension: subsidizing tractors may indeed provide greater benefit (in the short run) to faster learners (those who adopt the new technology more quickly), but subsidizing bullocks may simply serve to perpetuate inefficient technologies. On the other hand, it is plausible that extension services provide a better (more economical) instrument of policy to spread technological information than incentives through pricing and taxation policies.

The third limitation has to do with the political economy of pricing and taxation. Here we have provided a technical answer to the question "what 'advice' would you give if the government were to ask you what the Pareto-improving reforms are and what the structure of optimal prices is (for any social welfare function), given a set of policy instruments?" We have not asked how the government would arrive at the particular social welfare function it uses or whether it will use (or misuse) the economist's advice to pursue its own political objectives; nor have we asked whether the constraint on the set of available instruments is caused by economic (technical) or "political" factors.

Concerning the last question, it is apparent that some of the constraints on the available instruments may have primarily economic reasons. As we argued earlier, for instance, progressive land taxes may be precluded in developing countries because of the government's lack of information concerning the quality of land at different locations and the prohibitive costs of acquiring such information. A similar argument may preclude the use of progressive income taxation in some (but not all) cases if the quality of information concerning individuals' income is low. On the other hand, a uniform lump-sum subsidy (directly or indirectly through tradable food rations) or land reforms may be feasible on technical and economic grounds, in which case, the government's unwillingness to use them would reflect a "political" choice.

The issues noted above may have fundamental consequences for the study of taxation and pricing. Assume, for a moment, that redistribution (from the rich to the poor) is indeed a key government objective. A basic question we then need to ask is: how much redistribution is *possible*, given the set of instruments? Note that this is a positive question (in contrast to the normative question "how much redistribution is *desirable*?") and that it can be examined quantitatively by devising appropriate measures of the redistribution achieved. Suppose it turns out that very little improvement in the welfare of the poor can be achieved, say, through taxation and pricing of goods (which happen to be the only instruments the government can employ or wishes to employ); then the discourse on tax policy is modified in at least two ways. First, the redistributive objective of government loses much of its practical relevance because given the set of instruments, very little redistribution can be achieved regardless of what the government desires. By the same token, it becomes clear that, if the government indeed wants redistribution, then it must enlarge the set of instruments.

Sah (1983*a*) has examined the maximum extent to which the welfare of the

poorest can be improved (when the only instruments are taxation and pricing of goods) and has shown that the achievable redistribution can indeed be quite small. There are at least four reasons for this result. First, if there are significant substitution possibilities, then there is a limit to how much revenue can be collected by taxing luxuries; this, in turn, restricts the extent to which necessities can be subsidized. Second, the (marginal) deadweight losses associated with commodity taxation are often large, and therefore, even if a (marginal) change in taxes imposes a large burden on the rich, it may not be of any help to the poor. Third, if the poor consume even small amounts of luxuries and if the rich consume some amounts of necessities, then an excessively high tax on luxuries can be quite damaging to the poor, and large subsidies on necessities would, to some extent, benefit the rich. Fourth, the extent to which differential commodity taxation can achieve redistribution also depends on how finely one can differentiate among commodities. Differences in the consumption of particular types of grains across income groups may be larger than the differences in the total consumption of grains, but informational requirements and enforcement costs are likely to increase rather rapidly with the degree of differentiation. This analysis clearly suggests that there might be hitherto unrecognized limitations on the redistributive capabilities of commodity taxation and pricing.

Now, assume that redistribution from the rich to the poor is *not* the objective of taxation. Instead, taxation is used by the more powerful groups in the society for their own advantage. It is obvious that the analytical apparatus developed in this chapter can be applied with these objectives as well. If the city dwellers control the political system and they maximize their own welfare, for example, then the prices they will set will correspond to the rules we developed earlier, where the social weights on the income of peasants are set at zero.

Empirical studies have not so far provided much guidance on which one of these two polar assumptions concerning the government's objective is more realistic or what particular combination of these two cases is most plausible. Casual observation suggests that the latter objective (in which tax policies are employed by some groups against others) might be playing an important role. Some of the most important historical conflicts have been associated with one group of individuals attempting to use discriminatory policies against other groups. Among the landmarks are: the conflicts associated with corn laws in England, the discord between the North and the South in the United States leading to the Civil War, and the conflicts between the advocates of peasants and the proponents of industrial workers in the precollectivization U.S.S.R.

It is quite plausible, then, that the domination of one group by another is an important factor determining pricing policies in present-day developing countries. Whether an analysis such as the present one would serve to improve the equity and efficiency in an economy, or whether it will be used by some groups to enhance their ability to discriminate against others, is a question of concern to us.

Conclusions

Developing countries display an enormous variety of institutional arrangements, and these arrangements critically influence the impact of taxation and pricing policies and hence the design of these policies. Clearly, then, no single model, no single prescription, is applicable to all countries. We have therefore constructed a general framework that can be adapted to the special circumstances facing individual countries. For the agricultural sector, for example, we have considered family farms (which can hire in or hire out labor), landless workers, and sharecropping. Plantations are important in some countries, and our framework can easily be adapted to take that importance into account. Our framework also incorporates the effects that pricing and taxation have on the distribution of agricultural earnings and on land congestion and the consequences that these effects have in turn on the welfare of those in the agricultural sector.

At the same time, we have shown that one cannot simply transfer the policy conclusions reached for developed economies—no matter how sophisticated the reasoning—to developing countries. Developing economies face fundamental restrictions on their ability to levy certain taxes (which in part are due to the administrative costs and informational constraints, which can be severe in many developing countries), and also the salient features of these economies are different. Our framework is sensitive to the restrictions on the feasibility of various tax instruments, and we show how these restrictions cause many of our results to differ from those in the standard tax literature.

Concerning the salient features of the developing countries, we have emphasized the dependence of taxation and pricing policies on the nature of wage-productivity effects, on the nature of migration and unemployment, and on the nature of wages (and earnings) determination mechanisms in the agricultural and the industrial sectors. The government may not always be able to eliminate industrial unemployment, even if it wishes to do so, because of the endogeneity of industrial wages. Moreover, it may not even wish to do so if it considers the corresponding costs (due to the wage-productivity effects, for example) to be too high. A change in taxes and prices would then affect unemployment, which in turn has output effects as well as welfare effects. This concern of ours with unemployment differs markedly from the central concern of standard tax theory, which assumes full employment and focuses on the deleterious effect of reductions in labor supply.

Finally, in most developing countries there is only limited information on the parameters of the economy (such as various elasticities and social weights). We have therefore derived rules for price reform that can be applied on the basis of qualitative (and local) information. Moreover, agreements on the relative magnitudes of social weights corresponding to different groups of individuals are often difficult to achieve. We have therefore proposed rules that lead to Pareto improvements, reforms that increase not only the welfare of each individual in the economy but also the investable surplus.

Notes

1. A long tradition that cuts across ideological boundaries views the agricultural sector as the desirable source of public revenue. In the Marxist tradition, this approach was advocated by many leaders of the October Revolution in what came to be known as the "Soviet industrialization debate" and the "scissors problem." Sah and Stiglitz (1984*a*, 1985*a*) analyze this problem both in the context of the Soviet debate and in the context of present-day developing countries. In the classical laissez-faire tradition, similarly, the agricultural sector has been viewed as an ideal source of public revenue, at least since David Ricardo claimed that the land tax is the best form of taxation. We discuss the issue of land taxes later. Economists are often reluctant to deal with so-called noneconomic objectives such as self-sufficiency. The fact of the matter is that, in many countries (for example, India and Korea), self-sufficiency is an unambiguously stated national policy. We show how these objectives may be incorporated into a policy analysis while noting the associated economic costs.

2. The objectives include the stabilization of prices faced by consumers and producers (see Newbery and Stiglitz, 1981) and to redistribute income away from middlemen toward consumers and producers or from one region to another.

3. The above remarks apply outside developing countries as well. Not only are farm price interventions widespread in developed economies, but so is the confusion associated with them. Some of the most bitter controversies among the members of the European Economic Community have arisen in the past, for example, because of their disagreements on farm price policies.

4. These issues have not received much attention in the literature. See, however, Dixit (1969, 1971), and Dixit and Stern (1974). Some researchers have analyzed agricultural pricing with approaches based on consumer and producer surplus; for example, Tolley, Thomas, and Wong (1982). Sah (1982*b*) notes the limitations of such approaches and provides an empirical framework to implement an approach such as the one developed in this chapter.

5. For a more detailed discussion of the issues treated, see Sah (1978, 1982*b*, 1983*a*), Stiglitz (1982*c*), and Sah and Stiglitz (1984*a*, 1985*a*, 1985*b*).

6. The fact that limitations on the instruments available to the government may have significant effects on tax policy has long been recognized. Stiglitz and Dasgupta (1971), for instance, showed that the Diamond-Mirrlees (1971) result on the desirability of productive efficiency and its corollary, the undesirability of taxes on intermediate goods and imports and exports, depended critically on the assumption that the government could impose 100 percent taxes on profits and could levy taxes on all commodities and labor, assumptions that are even less persuasive in the context of developing countries than in the context of developed countries. Similarly, Atkinson and Stiglitz (1980) show that the structure of optimal commodity taxes depends critically on whether income taxation is feasible or not.

7. The problem may be almost as severe in developed countries. Calculation of optimal tax rates requires knowledge of all cross-elasticities, both in consumption and in production. It appears virtually impossible to obtain reliable estimates of these; most estimating procedures impose considerable structure on the demand and supply systems, which implicitly constrain the values of some of the cross-elasticities.

8. It is important to note here, however, that different social welfare functions, although giving rise to different sets of optimal taxes, may not always lead to significant differences in the total amount of taxes that an individual pays or in the resulting levels of welfare of different individuals. A simulation of optimal commodity taxes for India, for example, based on heterogeneous individuals in the two sectors, showed that the amounts of taxes paid by different individuals were quite insensitive to the society's inequality aversion (see Sah, 1978). This result is consistent with the argument we

present later that commodity pricing and taxation may be rather inadequate instruments for a significant redistribution from the rich to the poor.

9. In particular, we do not examine all of the potentially important features of the economy, and it is conceivable that some features to which we have given insufficient attention may prove to be important in subsequent research. It should be noted, however, that we have analyzed a much wider variety of considerations than those reported here. We do not discuss here the consequences of capital allocation and mobility between the two sectors, for instance, and of private savings, which, in the long run, may indeed be important. These aspects can easily be incorporated within our general framework. See Sah and Stiglitz (1984*b*), an earlier version of this chapter, for a discussion of some of these aspects.

10. We are at present abstracting from migration and capital flows. With migration, the utility of a peasant is also a function of the number of persons in the agricultural sector. If there are capital flows, then the utility is also a function of the interest rates at which peasants can borrow and lend.

11. It should be obvious that nonlinear tax-subsidy-pricing schemes, if administratively feasible and not too expensive, are better (in a Pareto sense) than the standard (linear) pricing. The reason is simply that a nonlinear scheme provides "more" instruments to the government than the standard pricing, and the government cannot do worse by having more instruments. Also, restricted nonlinear schemes, such as those entailed by (nontradable) quotas and rations, are desirable additions to standard pricing because, once again, one cannot do worse by having more instruments. Still, these schemes are not necessarily desirable alternatives to standard pricing. See Sah (1982*a*) for an analysis. Also note that some simple schemes, such as the provision of fixed tradable rations below market prices, are often feasible. Such schemes may provide a way of implementing a uniform lump-sum subsidy.

12. This assumption is not completely satisfactory. Though the government can, for instance, tax profits, it can seldom impose a 100 percent profits tax. There are numerous discussions of the problems that developing countries have in controlling multinationals. In fact, questions may even be raised whether the government controls nationalized industries. Our assumption that the government can control the industrial sector is partly to simplify the analysis, partly to dramatize the difference between the urban and rural sectors. As we note later, the analysis can be modified for those cases in which the government's control on the industrial sector is limited and indirect.

13. This independence is partly because the economy is open to external trade. In a closed economy, a Pareto-improving price reform typically involves simultaneous changes in both the rural price and the urban price, because corresponding to a value of p there is a value of q that clears the market for the agricultural good.

14. In an agricultural sector in which individuals buy and sell labor services, an additional requirement for the above-mentioned rule of price reform to hold is that the rural wage should not be significantly sensitive to the tural food price. A disaggregate analysis of the agricultural sector with heterogeneous individuals is presented later in this chapter.

15. W is increasing and concave in V. H is the Hamiltonian representing the current value of the time-discounted social welfare. The results presented in this chapter hold at every point in time. The same formulation can also be employed to trace the path of optimal prices and other variables over time; this, however, is beyond the scope of the present chapter. For a discussion of the alternative uses of the investable surplus, see the earlier version (Sah and Stiglitz, 1984*b*) of this chapter.

16. To obtain these expressions we have used Roy's formula: $\partial V^a/\partial p = \gamma^a s$, and $\partial V^m/\partial q = -\gamma^m x^m$. Also, we assume that μ^a and μ^m are positive. From equation 16-8, μ^a is positive if $\eta_{sp} > \beta^a/\lambda - 1$. We expect this condition to be met in developing countries at early stages of development, because the social weight on investment is likely to be higher than that on the rural income. From equation 16-9, $\mu^m > 0$ if $\epsilon^m > 1$

$- \beta^m/\lambda$. This condition may not always be met, especially if the urban demand elasticity of food (with respect to price) is very small and if the government does not care about the industrial workers. If $\mu^m < 0$, then the urban price should be increased. Note, however, that the present model abstracts from effects such as that of consumption and wages on workers' productivity, which we discuss later. Increasing the urban price beyond some level would not be desirable when these effects are taken into account even if the government does not care about the welfare of industrial workers.

17. The observed pattern in many developing countries in which the urban food price is often lower than the international price thus seems inconsistent with equalitarian social welfare. Note, however, that our results need to be qualified by concerns such as intrasectoral inequality, and wage-productivity effects. See below.

18. The social weights proposed in the earlier literature have often abstracted from these general equilibrium effects, as in Feldstein (1972), Diamond (1975), and Atkinson and Stiglitz (1976). The difference arises because these papers assume that the government can impose wage taxes, so the wages received by individuals need not depend on commodity taxes.

19. The wage elasticity term does not appear in equation 16-15, whereas it does in equation 16-14. The reason is simply that at present we are assuming industrial wages to be fixed. In more general models, such as those that we discuss later, wage elasticity terms would appear in the expressions analogous to equation 16-15. Also, though we are considering here a single type of labor, its generalization to a multitude of skill types is straightforward.

20. In practice, there are some ambiguities in the precise geographical definition of such a border, because agricultural activities are sometimes undertaken on the ftinge areas of cities that fall under cities' tax jurisdiction. Also, out assumption that trades within the agricultural sector cannot be taxed somewhat overstates the constraints on the government. What is crucial for our purpose is whether a transaction can be monitored, so thar a tax can be imposed. If a farmer can sell directly to another farmer, then a tax can probably not be collected. The developing country governments can (and frequently do) attempt ro impose taxes and marketing controls on transactions within the agricultural sector. One of the implications of such interventions is to encourage individuals to avoid making use of formal markets, so that the taxes can be avoided. This implication is discussed later.

21. This happens if the profit function (on unit land) is separable between prices of the production goods and other prices. Denote the unit profit function as $G = G[G^1(\mathbf{p}^1, \omega^a), G^2(\mathbf{p}^2)] = \mathbf{py} - \omega^a L_d$, where $\mathbf{p}^2$ is the vector of production goods' prices and L_d is the labor applied to unit land. Then, for the production good i, $\partial y_i/\partial \omega^a = -\partial L_d/\partial p_i = g_1 y_i$, where $g_1 = \{(\partial G^2/\partial G^1 \partial G^2)(\partial G^1/\partial \omega^a)\}/(\partial G/\partial G^2)$. Therefore, the elasticity $\partial \log y_i/\partial \log \omega^a = g_1 \omega^a$ is the same for all i. For details on the underlying production technologies, see Lau (1978). Next, the labor market–clearing condition is $\Sigma_h L^h(\mathbf{p}, \omega^a) = 0$, which, upon differentiation, gives $d\omega^a/dp_i = -(\Sigma_h \partial L^h/\partial p_i)/(\Sigma_h \partial L^h/\partial \omega^a)$. Next, $L^h = L^h_s - A^h L_d$ where L^h_s is the labor supply of the household h. Because the prices of production goods affect the labor supply only through full income, $\partial L^h/\partial p_i = A^h y_i \partial L^h_s/\partial M^h - A^h \partial L_d/\partial p_i$. Now, recall from above that $-\partial L_d/\partial p_i = g_1 y_i$. It follows that $d\omega^a/dp_i = g y_i$, where $g = -\Sigma_h A^h (g_1 + \partial L^h_s/\partial M^h)/\Sigma_h \partial L^h/\partial \omega^a$. Using these equations, the earlier reform analysis can be reproduced, with a difference that now $B = (\mathbf{P} - \mathbf{p})\{\Sigma_h s[A^h(\partial x^{ah}/\partial M^h) - g(\partial s^h/\partial \omega^a)]\}/N^a A$. One special case, of course, is when there are no induced wage effects. For this case, simply substitute $g = 0$.

22. An alternative institutional setting is the one in which private firms ser wages to maximize their profits, taking into account wage-productivity effects. The resulting wage, in general, would differ from the one that the government would set (to maximize H) and thus, in certain cases, commodity taxes may be used for a partial "correction" of private decisions.

23. Here we are ignoring the consumption of unemployed workers and are assuming that the industrial wage is fixed in terms of industrial goods. Also, the level of industrial employment is fixed because it is derived from an equalization of the industrial wage and the marginal product of labor. These assumptions are being made solely to simplify the exposition. $\phi = [W(V^a) - W(V^u) - \beta^a p Y_A A] m_p / \lambda s \bar{\eta}_{sp}$, where A is the agricultural land per peasant, $Y_A = \partial Y / \partial A$ is the marginal output (per peasant) of land, and $m_p = \partial \log N^a / \partial \log p$ is the elasticity of tural population with respect to the rural price. We assume $V^m > V^a > V^u$, that is, the industrial workers are better off than peasants, who in turn are better off than those who are unemployed. We also assume that agricultural land is not too scarce (that is, Y_A is small) and that ($\eta_{sA} = \partial \log s / \partial \log A$), which is the elasticity of agricultural surplus per peasant with respect to the land per peasant, is smaller than one. Next, note in the expression for ϕ that the expression in square brackets represents the net welfare gain if one unemployed worker migrates to the agricultural sector. Specifically, $W(V^a) - W(V^u)$ is the direct welfare gain, and $\beta^a p Y_A A$ is the welfare loss due to the congestion effect of migration on others in the agricultural sector. This net gain is positive, as we see from the above assumptions. Furthermore, $\bar{\eta}_{sp} = \eta_{sp} + (1 - \eta_{sA}) m_p$. We assume that the agricultural population increases if the price of agricultural surplus is higher, that is, $m_p > 0$. (This assumption is automatically satisfied under the Harris-Todaro migration hypothesis, which we discuss below.) Thus, $\phi > 0$, and $\bar{\eta}_{sp} > \eta_{sp}$.

24. For simplicity, we assume here that the social welfare function is utilitarian, that is, $\beta^a = \gamma^a$. The main implication of the Hartis-Todaro hypothesis then is that $H = NV^a + \lambda R$ rather than equation 16-5. The corresponding results thus hold, regardless of the migration mechanism, in all those circumstances in which the government is concerned with the rural welfare alone. Other migration hypotheses can be similarly obtained as special cases of our formulation. If it is posited that there is free migration and no unemployment, for instance, but the utility of a worker in one sector is a fraction of the utility in another sector (see chapter 15 by Heady and Mitra), then we have a special case of our formulation in which N^u is set at zero and the expression $N^a = N^a(p, q, w, N^m)$ is implicitly defined by $V^a(p, N^a) = eV^m(p, w, N^m)$, where e is a parameter. A further special case is $e = 1$, which implies the standard neoclassical assumptions that there is no unemployment and that free migration equalizes workers' utilities across sectors.

25. Pricing in the industrial sector in the presence of endogenous migration can be analyzed similarly. Also note that the rules of price reform derived earlier apply with some modifications in the present case as well. The rule for reform in the rural food price, equation 16-2, for example, applies in the present case if η_{sp} is replaced by $\bar{\eta}_{sp}$.