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YALE UNIVERSITY

P.O. Box 1987, Yale Station  
27 Hillhouse Avenue  
New Haven, Connecticut 06520

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THE TAXATION AND PRICING OF AGRICULTURAL AND INDUSTRIAL GOODS IN  
DEVELOPING ECONOMIES

Raaj Kumar Sah

and

Joseph E. Stiglitz  
Princeton University

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## ABSTRACT

This chapter presents an analysis of pricing (and taxation) of agricultural and industrial goods in LDCs. We identify and explain the central tradeoffs involved in changing prices, in reforming prices, and in setting optimal prices. Our analysis is based on a general equilibrium model of a dual (agricultural-industrial) economy in which there is a multitude of goods and income groups in each sector. We present a number of results on price reforms and optimal pricing. For instance, we show how Pareto improving price reforms (which do not hurt anyone in the society, and make the society better off) can be conducted for cash crops and production inputs, based on extremely limited information. Our analysis also leads us to argue that there is a case against taxing some cash crops or agricultural inputs, while subsidizing others, no matter what the society's aversion to inequality is.

Our framework of analysis is not only consistent with a variety of alternative institutional features of LDCs, but it also shows that these features have a marked influence on what the prices should be. An understanding of these influences is important because there is enormous diversity among LDCs in their institutional structures, and in the set of policy instruments they can use. For the same reason, some of the basic prescriptions of the standard tax theory (which is based on special assumptions reflecting the structure of developed economies) turn out to be misleading in the context of LDCs. We also discuss in this chapter some of the issues of political economy from which the standard tax theory has abstracted but which, we believe, may be central in the analysis of taxation and pricing policies.



# THE TAXATION AND PRICING OF AGRICULTURAL AND INDUSTRIAL GOODS IN DEVELOPING ECONOMIES\*

## 1. INTRODUCTION

In most less developed countries (LDCs), governments play an active role in setting the food prices received by farmers and the food prices paid by city dwellers. They do this 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; price regulation authorities, which control the prices at which private traders can sell; explicit food subsidies, sometimes accompanied by rationing; and by export and import taxes and subsidies.<sup>1</sup> Their objectives in attempting to alter the prices which would emerge in the absence of government intervention are several. In this chapter, we focus on the following of their objectives:

- o to increase the income of peasants who are often among the poorest in the economy
- o to subsidize the poorer city dwellers. In most LDCs direct income subsidies are not feasible, and food subsidies may be an effective way of helping the poor.
- o to tax the agricultural sector to capture resources for investment and for public goods creation.<sup>2</sup>
- o to attain some level of self-sufficiency in specific goods, and avoid excessive dependence on the international market.<sup>3</sup>
- o 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.<sup>4</sup>

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In some cases, the stated objectives seem at variance with the policies adopted. Though the government may claim that food subsidies are meant to help the urban poor, it may not subsidize the grain consumed by the poor (millet, for example), but rather the grain consumed by those relatively better-off (rice, for example). In other cases, the government may fail to achieve its objectives due to 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.

In other cases, the stated 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 which are levied. This confusion is further compounded when many different agencies set prices of different goods. Often these agencies act independently of one another, under contradictory assumptions about society's objectives and the constraints facing the economy.<sup>5</sup>

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.<sup>6</sup> A study of these effects requires a general equilibrium analysis in which the dependence of demands and supplies on pricing policy is modelled, and in which the overall constraints facing the economy (such as the balance of trade constraint and the government revenue constraint) are also taken explicitly into account.<sup>7</sup> We develop such a model in this chapter. This model enables us not only

to identify those circumstances in which changes in the pricing policy can make all 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 which examines the reform and the design of taxation and pricing policies in LDCs, using models which reflect not only the institutional features of developing economies, but also the limitations on the policy instruments available to LDC governments.<sup>8</sup> 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 modelling an LDC as a dual economy, in which the forms of economic organization in the agricultural (rural) and industrial (urban) sectors may differ markedly. Among the more specific features of LDCs which we take into account are (i) the presence of widespread urban unemployment, which may be caused by (ii) urban wages which are set above market clearing levels, inducing (iii) migration from the rural to the urban sector.<sup>9</sup> Thus, while 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 policy on individuals' labor supply,<sup>10</sup> a more relevant concern in the context of LDCs may be the effect of these 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 an LDC. While in some countries sharecropping may predominate, in others family farmers may be more typical. While 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. In fact, one of our contributions is the development of formulae which hold for a variety of institutional arrangements.<sup>11</sup> Of course, the values of the parameters within these formulae may differ from one institutional setting to another.

In analyzing the consequences of alternative institutional features, it is also important to understand the economic forces which may have given rise to them.<sup>12</sup> This is particularly important in the case of high urban wages. Governments may be well aware that the urban unemployment is induced by high urban wages; and 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 they will do so. And it may be no less realistic to assume that while 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.<sup>13</sup>

Our work employs many of the techniques of modern public finance theory to understand the consequences of taxation and pricing policies in LDCs. We agree with Harberger (1962) that to understand these consequences, one needs to construct simple general equilibrium models. Thus, like Harberger, we construct a two-sector economy but, unlike him, each of our two sectors contains many different income groups. Moreover, our interpretation of the two sectors as well as our assumptions, for example, those concerning wage flexibility, factor mobility, and price determination differ from those of

Harberger. We also follow the literature on taxation in exploiting the close similarity between problems of pricing and taxation, and in balancing out concerns for equity and efficiency by making explicit use of social welfare functions.<sup>14</sup>

The main differences between a meaningful approach towards the problems of pricing and taxation in LDCs 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. We believe that a critical part of the reality of most LDCs is that their governments can employ an extremely limited set of instruments and, as we shall see below, these constraints have important consequences on the analysis of pricing and taxation policies.<sup>15</sup>

An important example of the constraints on policy instruments in the context of LDCs is as follows. If the government can set different prices in the two sectors for the goods traded between the sectors (we assume in this chapter that it can) 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 alters the nature of desirable price reforms as well as the characteristics of optimal prices (see our 1984a and 1985a papers for the corresponding analysis).

A practical problem in the implementation of desirable pricing policies in LDCs is that reliable estimates of many of the critical parameters of the economy are not easily available.<sup>16</sup> One would, therefore, like to know what kinds of statements one can make on the basis of qualitative information.



Similarly, there is no reason that 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.<sup>17</sup> 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) which make use only of qualitative information, both concerning 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.<sup>18</sup> We have devoted considerable attention to such analyses, and report here many rules for price and tax reforms which lead to Pareto improvements; that is, no one is hurt by these reforms, and the society is strictly better off. 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 which are quite general (of course, these are not the most general models one can construct).<sup>19</sup> For instance, our model of migration and unemployment can be specialized to the 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 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 the chapter 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.<sup>20</sup> Further, 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.<sup>21</sup>

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 instance, those instances in which there is an important equity-efficiency trade-off from those in which there is not, or to help see the full ramifications of any policy decision, ramifications which become apparent only within a general equilibrium model in which careful attention is paid to the institutional structure of the economy. It is not, however, the purpose of this chapter to discuss simulation procedures for calculating optimal taxes and prices. Rather, our research provides the conceptual background which is necessary for the 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 the model to obtain more specific results, a better understanding of what is at issue is obtained by beginning our analysis (in Sections 2 and 3) 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. Section 4 then analyzes the disaggregated structure of taxes within the agricultural sector, while Section 5 analyzes the same within the industrial sector.

Our objective in this chapter is not to present the general formulations which we have analyzed elsewhere, but rather to provide an exposition which brings out as clearly as possible some of the central issues, including the role of alternative institutional structures. In section 6, therefore, we use a simple model to examine the consequences of migration and unemployment on pricing policy. In Section 7, we discuss several other variations of our model, including alternative agricultural organizations and international trade environment. Further, 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 Section 8 to explain some of the critical differences.

We follow a long standing tradition of abstracting from political economic considerations in our analysis. Yet such considerations may, in fact, be more important than the concerns which we discuss in the body of this chapter. In Section 9, therefore, we articulate some of our misgivings with the general approach of this chapter, as well as that of modern public economics. Concluding remarks are presented at the end of the chapter.

## 2. 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: Agricultural sector consists of homogeneous peasants who decide on 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 which peasants can attain is a function of this price, and we write the utility level of a representative peasant as  $V^a(p)$ .<sup>22</sup> Some of the agricultural output is consumed within the agricultural sector and the surplus quantity,  $Q$  per peasant, is sold to the industrial sector or abroad. This quantity is a function of the price which the peasants receive. We denote the price elasticity of the surplus by

$$(1) \quad \eta_{Qp} = \frac{\partial \ln Q}{\partial \ln p}.$$

Economic theory puts no constraints on the sign of  $\eta_{Qp}$  (there may be a backward bending supply schedule of the surplus); we focus attention on the case where an increase in the price increases the marketed surplus. That is,  $\eta_{Qp} > 0$ . Our formulae can be reinterpreted for the case in which  $\eta_{Qp} < 0$ .

We assume that the government has very few policy instruments to control peasants' behavior; it can not directly control their output nor their consumption. This, we believe, is the correct representation in most LDCs, since 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.<sup>23</sup> We also assume that complex pricing schemes

are infeasible. For example, non-linear pricing schemes in which the unit price paid to a peasant depends on the amount he sells typically lead to underground (unaccounted) transactions. Accordingly, we restrict ourselves to schemes which pay a common price to all peasants regardless of the quantities they transact.<sup>24</sup>

Industrial Sector: In contrast to the agricultural sector, we assume that there are many policy instruments in the industrial sector. In fact, we make the polar assumption that the government has sufficient instruments so that the distinction between direct and indirect control can be virtually ignored. In many LDCs, the government is not only the largest industrial producer and employer, but it also taxes private producers' profits, and can sometimes control their prices and quantities.<sup>25</sup>

For simplicity, we ignore at present the intra-sectoral 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. 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

$$(2) \quad \eta_{xq} = - \frac{\partial \ln x^m}{\partial \ln q}$$

which is a positive number, since consumption goods are assumed to be normal.

Investment: The revenue available to the government for investment is

the difference between the industrial output and the industrial wage payment, plus the net revenue of the marketing board:

$$(3) \quad I = N^m(Y - w) + (P - p) N^a Q(p) + (q - P) N^m x^m(q, w)$$

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

### 3. A SIMPLE ANALYSIS OF AGRICULTURAL AND INDUSTRIAL PRICING

Price Reforms for Pareto Improvements: There are three groups in our 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 combinations of  $V_a$ ,  $V_m$ , and  $I$  (see Figure 1). We first show that certain price changes can make all groups in a society better-off.

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Insert Figure 1 Here

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.

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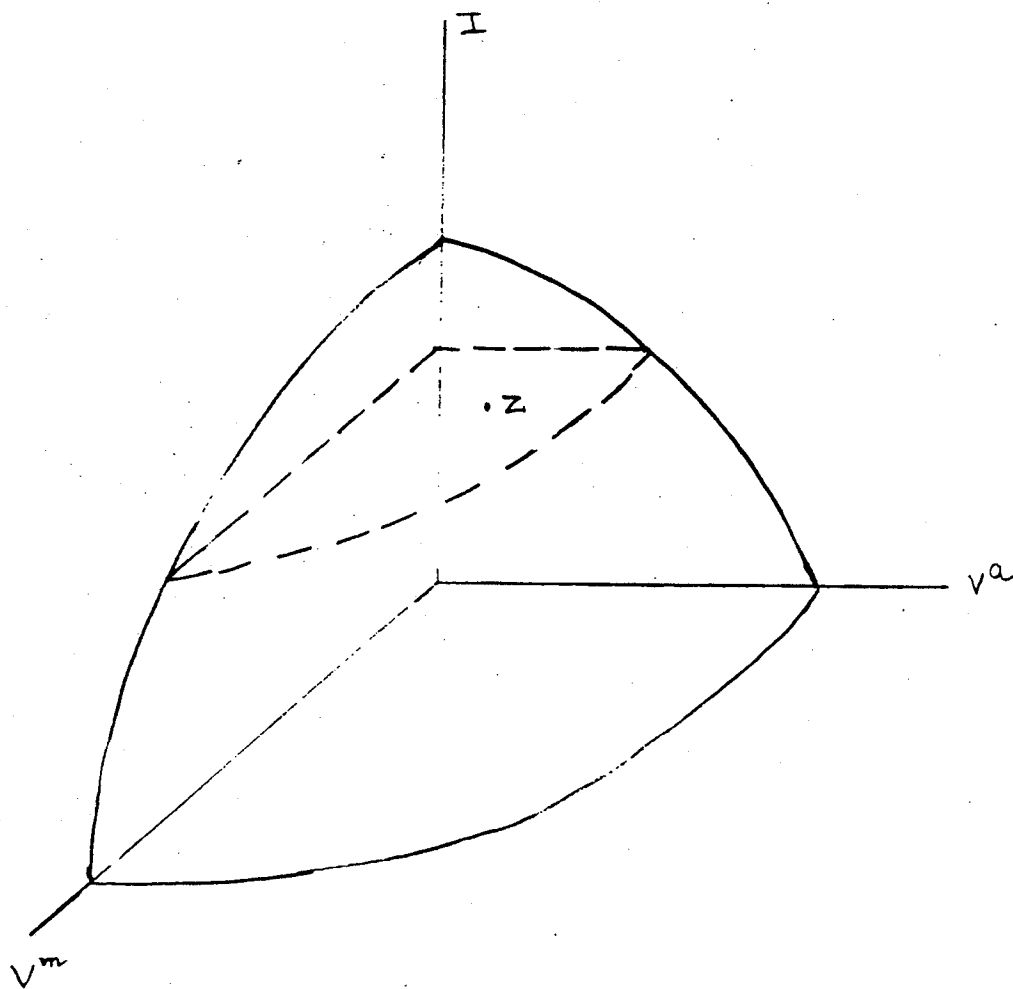


Figure 1

In the above 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  $\frac{dI}{dp} > 0$ . This happens, from (3), if

$$(4) \quad p < P/(1 + 1/\eta_{Qp}) = \bar{p}.$$

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

Similarly, a decrease in the urban food price makes the industrial workers better-off, and it does not affect the peasants. It increases government revenue if  $\frac{dI}{dq} < 0$ , or, from (3), if

$$(5) \quad q > P/(1 - 1/\eta_{xq}) = \bar{q}, \text{ and } \eta_{xq} > 1.$$

Thus, if the urban food price is above  $\bar{q}$ , then a decrease is unequivocally desirable for the society.<sup>26</sup>

These rules of price reform have many 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.<sup>27</sup> 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 which are needed to use these rules of reforms (as well as other rules of reform which we derive later) are those associated with the current equilibrium, which can be calculated from the local properties of the demand and supply functions. This should be contrasted with the optimal pricing rules, to be discussed below, in which the elasticities are to be evaluated at the social optimum. To do this, 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

$$(6) \quad \frac{\partial V^a}{\partial p} > 0, \text{ and } \frac{\partial V^m}{\partial q} < 0,$$

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 (6) 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. So long as these conditions are satisfied, the above rules of price reform continue to hold.

For instance, the rule for reform in the urban food price 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.<sup>28</sup> 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 which improve the welfare of all groups in the society.

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

$$(7) \quad H = N^a W(V^a) + N^m W(V^m) + \delta I,$$

in which  $\delta$  is the social value of marginal investment,  $W(V)$  is the 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 investment.<sup>29</sup> Conceptually, this allows us to draw social indifference curves, that is, those combinations of  $V^a$ ,  $V^m$ , and  $I$  among which the society is indifferent (see Figure 1).

Differentiation of (7) with respect to  $p$  and  $q$ , and a rearrangement of the resulting expressions yields<sup>30</sup>

$$(8) \quad \frac{dH}{dp} > 0, \text{ if } p < P_\mu^a,$$

$$(9) \quad \frac{dH}{dq} > 0, \text{ if } q < P_\mu^m, \text{ where}$$

$$(10) \quad \mu^a = 1/[1 + (1 - \frac{\beta^a}{\delta}) \frac{1}{\eta_{Qp}}],$$

$$(11) \quad \mu^m = 1/[1 - (1 - \frac{\beta^m}{\delta}) \frac{1}{\eta_{xq}}],$$

$\lambda^i$  is the (positive) private marginal utility of income to a worker in sector  $i$ , and  $\beta^i = \lambda^i \partial W / \partial V^i$  is the social (weight) marginal utility of income to a worker in sector  $i$ .

Expression (8) 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 (9). These rules are sharper than those we obtained earlier. This should not be surprising, since the rules (8) and (9) 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.

The optimal prices are those at which the possibilities of reform have been fully exhausted. The optimum, thus, is represented by

$$(12) \quad p = P\mu^a$$

$$(13) \quad q = P\mu^m$$

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

We have thus obtained optimal pricing formulae, 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 weight on investment might be thought to exceed those on private incomes, that is,  $\delta > \beta^i$ . 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.<sup>31</sup> Also, a higher elasticity of agricultural surplus corresponds to a higher price paid to 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. Further, 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 formulae derived above can also be stated in terms of commodity taxes. Let  $t = (P - p)/p$ . Then  $t$  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 by  $X$  and  $x_a$  respectively. Then the marketed

surplus per peasant is

$$(14) \quad Q = X - x^a$$

Further, define  $\eta_{Xp} = \partial \ln X / \partial \ln p$ , and  $\eta_{xp} = -\partial \ln x^a / \partial \ln p$  as the price elasticities of food output and consumption of a peasant.<sup>32</sup> Then the surplus elasticity can be expressed as  $\eta_{Qp} = (1 + \alpha)\eta_{Xp} + \alpha\eta_{xp}$ , where  $\alpha = x^a/Q$  is the ratio of peasants' consumption to their marketed surplus. Using these definitions, the optimal tax rate is obtained from (12) as

$$(15) \quad t = \left(1 - \frac{\beta^a}{\delta}\right) \frac{1}{(1 + \alpha)\eta_{Xp} + \alpha\eta_{xp}} = \left(1 - \frac{\beta^a}{\delta}\right) \frac{1}{\eta_{Qp}}$$

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 (15), the magnitude of the tax rate is inversely proportional to the price elasticities of output and consumption. This dependence is similar to the one which was suggested in some of the earliest writings on taxation, for example, those by Ramsey (1927) and by Pigou.<sup>33</sup> However, there is a basic difference 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 Stiglitz and Dasgupta (1971) and Atkinson and Stiglitz (1980, p. 467)].

In the present problem, it is nearly impossible for the government to distinguish between producers and consumers within the agricultural sector, since 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 (15), it is the combined effect that matters.<sup>34</sup>

Many Income Groups in Agricultural and Industrial Sectors: The formulae derived earlier can be used even when the distribution of income in the agricultural sector is explicitly taken into account. We only need to reinterpret  $\beta^a$  as the 'average' social weight corresponding to the agricultural sector. To see this, 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  $Q^h$  (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  $\eta_{wp} = \partial \ln w^a / \partial \ln p$  as the elasticity of rural wage with respect to  $p$ . Further, let  $Q$  denote the average marketed surplus, that is  $Q = \sum_h Q^h / N^a$ .

Then it is easily verified that (12) still characterizes the optimal pricing rule, with the modification that now

$$(16) \quad \beta^a = \sum_h \beta^{ah} (Q^h + \frac{w_a L^h}{p} \eta_{wp}) / N^a Q$$

where  $\beta^{ih}$  is the social weight on the income of individual  $h$  in sector  $i$ . It is obvious from (16) that  $\beta^a$  is a weighted average social weight on rural incomes.<sup>35</sup>

An important property of the average social weight derived above is that it takes into account the general equilibrium effects of prices on incomes.<sup>36</sup> Also, our pricing formula, (12) and (16), is largely independent of the precise nature of the labor market (for example, on whether the labor market is competitive or not). 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. We further discuss the organization of the agricultural sector in a later section.

The same approach applies to the industrial sector. With wage (income) differences among city dwellers, (13) is the optimal pricing formula, with a modification that

$$(17) \quad \beta^m = \sum_h \beta^{mh} x^{mh} / \sum_h x^{mh} ,$$

where  $x^{mh}$  is the food consumption of the city dweller  $h$ . Once again, it is obvious from (17) that  $\beta^m$  is a weighted average of the social weights on the incomes of city dwellers.<sup>37</sup>

It is perhaps important to explain here the difference between applying the rules for optimal prices based on the assumption of homogenous individuals within a sector (such as (12)) versus the rules in which the intrasectoral heterogeneity of individuals is explicit (such as (12) in conjunction with (16), and those to be discussed later). In both cases the required information on sectoral price elasticities are the same since the government's budget, (3), is the same. The application of rules based on heterogenous

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  $\beta^a$  and  $\beta^m$  from (16) and (17) in its calculations.<sup>38</sup>

#### 4. THE STRUCTURE OF PRICES IN AGRICULTURAL SECTOR

A major issue facing many LDCs is whether fertilizer and cash crops should be subsidized, to increase the production, or 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. While 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, reduce the extent of government intervention in this market? The model we have developed in the preceding section may easily 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. Among them are those goods which are consumed by peasants and also sold to outsiders (like food grains), those which are produced solely for sale (cash crops like rubber and fibers), and those which 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 their use as inputs in production (like fertilizers, pesticides and tractors).<sup>39</sup>

All of these goods can be incorporated within our earlier model. What one needs to do is to interpret  $Q^h$  as a vector, of which an element  $Q_i^h$  represents the net supply of the  $i$ th good from the household  $h$  to the rest of the economy.  $Q_i^h$  is positive if the peasant is a net seller of this good, and it is negative if he is a net buyer of this good. The per capita surplus of good  $i$  is denoted by  $Q_i = \sum_h Q_i^h / N^a$ . For those goods which are produced and utilized solely within the agricultural sector,  $Q_i$  is zero. We assume that the government can influence the prices of only those goods which cross the border between the two sectors, and that there are no taxes on trades within the agricultural sector.<sup>40</sup> Naturally,  $p$ ,  $P$  and  $t$  are now vectors.<sup>41</sup> The effects of a change in the price of good  $i$  on an individual's utility and on the investment are respectively given by

$$(18) \quad \frac{dv^h}{dp_i} = \lambda^{ah} \left( Q_i^h + \frac{dw^a}{dp_i} L^h \right)$$

$$(19) \quad \frac{dI}{dp_i} = N^a (P - p) \frac{dQ}{dp_i} - N^a Q_i$$

Where  $\frac{dQ}{dp_i}$  includes the induced effect due to a change in the rural wage.

That is,  $\frac{dQ}{dp_i} = \frac{\partial Q}{\partial p_i} + \frac{\partial Q}{\partial w^a} \frac{dw^a}{dp_i}$ . We can immediately calculate

the effect of a change in prices on the social welfare. Expressions (7), (18) and (19) yield

$$(20) \quad \frac{\partial H}{\partial p_i} \begin{cases} > \\ < \end{cases} 0 \text{ if}$$

$$(21) \quad (P - p) \frac{dQ}{dp_i} \begin{cases} > \\ < \end{cases} (1 - \frac{\beta_i^a}{\delta}) Q_i, \text{ where}$$

$$(22) \quad \beta_i^a = \sum_h \beta^{ah} (Q_i^h + \frac{w^a L^h}{P} \eta_{wp_i}) / N Q_i^a$$

and  $\eta_{wp_i} = \partial \ln w^a / \partial \ln p_i$  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 (e.g., 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,

$\eta_{wp_i}$ , which would be different for changes in the prices of different goods. A tax on a crop which is largely a cash crop may have deleterious distribution effects if it depresses the labor demand and agricultural wages significantly, because the 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 there are other taxes 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 (21).

Following our earlier analysis, it is obvious that the optimal prices are characterized by (21) in which the inequality is replaced by an equality.<sup>42</sup> 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 which may be far removed from the current situation. The use of (20) and (21) for reform analysis too may be inhibited, since 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. What we show now is that it is possible to reform prices of certain goods based on much more limited information.

Pareto improving price reforms which require very little information:

Pareto improving price reforms can be made for 'production goods' (that is, those agricultural inputs and outputs which are not used for consumption, such as fertilizers, machine inputs, cash crops, etc.) solely on the basis of the elasticities of inputs and outputs (on unit land) with respect to the prices of production goods. We do not need any information whatsoever concerning consumption responses, distribution of land, or the social weights. The only limitation of this price reform analysis is that the induced wage effect should be negligible. Even this limitation disappears under certain circumstances, as we will see below.

Denote the net output vector of the  $h$ th household by  $X_h$ , such that the

outputs are represented as positive quantities and the inputs are represented as negative quantities. 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 into account.<sup>43</sup> Thus,  $X^h = A^h z$ , where  $z$  is the net output vector per unit of land. If the consumption vector of the household  $h$  is denoted by  $x^h$ , then  $Q^h = A^h z - x^h$  denotes the surplus vector of household  $h$ .<sup>44</sup> Now consider a change in the prices of those goods which are employed in the rural production (as inputs and outputs) but are not consumed. If  $i$ th good is a production good, then  $Q_i^h = A^h z_i$ . Also, since the prices of production goods affect the consumption quantities only through the full income, it follows that  $\partial x^{ah} / \partial p_i = A^h z_i \partial x^{ah} / \partial M^h$ , where  $M^h$  denotes the full income of the household  $h$ , and  $\partial M^h / \partial p_i = A^h z_i$  is the change in full income due to a change in  $p_i$ . Now, if the induced wage effect is negligible, then (19) can be written as

$$(23) \quad \frac{dI}{dp_i} = [c_i - 1 - B] N^a A z_i$$

where  $A = \sum_h A^h / N^a$  is the per capita land,  $t_j = (P_j - p_j) / p_j$  denotes the rate of tax or subsidy,  $\varepsilon_{ij} = \partial \ln z_i / \partial \ln p_j$  represents the price elasticities of the production goods per unit of land,  $c_i = \sum_j t_j \varepsilon_{ij}$  is the proportional change (due to taxation) in the quantity of the  $i$ th production good per unit of land, and  $B = (P - p) \left[ \sum_h A^h \frac{\partial x^{ah}}{\partial M^h} \right] / N^a A$ . In deriving (23), we have also used the standard symmetry property of inputs and outputs that  $\partial z_j / \partial p_i = \partial z_i / \partial p_j$ . Expression (23) provides the

basis for the following rules of price reform.

Calculate  $c_i$ 's 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  $i$ th good by a small amount, say  $\Delta p_i$ , and decrease (increase) the price of the  $k$ th good by  $(z_i/z_k)\Delta p_i$ . On the other hand, if the  $i$ th good is an output (input) and the  $k$ th good is an input (output), then increase (decrease) the price of the  $i$ th good and increase (decrease) the price of the  $k$ th good in the same proportion as above. This procedure should be continued until all of the  $c_i$ 's 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  $\Delta p_i$  is the change (positive or negative) in the price of the  $i$ th good, then  $-(z_i/z_k)\Delta p_i$  is the change in the price of the  $k$ th good. From (18), then,  $V^h$  remains unchanged since  $Q_i^h = A^h z_i$  for production goods. From (23), on the other hand,

$$(24) \quad \Delta I = (c_i - c_k) N^h A z_i \Delta p_i$$

Recalling that  $z_i$  is positive for an output and negative for an input, it follows from (24) that our rules of reform increase investment. It is also obvious from (24) that a necessary condition for the optimality of taxes is that  $c$ 's should be equal for all production goods.

The above rules of reform are highly parsimonious in their use of information, as should be obvious. The required information consists

solely of the current taxes on inputs and outputs, current 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 reform analysis applies to those cases in which different groups of producers (in different regions, for example), face different sets of prices.

In fact, our rules of reform can be applied even when the induced wage effects are significant. For instance, if the production goods have the same (but not necessarily constant) elasticity with respect to the wage<sup>45</sup> 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.<sup>46</sup> Surely, we do not expect the above restriction on elasticities to hold in every circumstance, but the relevant empirical question is how different are the actual induced wage effects from those predicted by the technology with the above restriction? If the difference is not significant, then our rules of reform can be employed with extreme parsimony in information.

Should some cash crops or production goods be taxed and others subsidized? To obtain insights on this question, recall that a necessary condition for the optimality of taxes is that

$$(25) \quad c_i = \sum_j t_j \varepsilon_{ij}$$

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,  $\varepsilon_{ij} = 0$  if  $i \neq j$ ) then, from (25),  $t_i \varepsilon_{ii}$  is the same for all  $i$ . Next, from the standard properties of production functions,  $\varepsilon_{ii} > 0$  for an output and  $\varepsilon_{ii} < 0$  for an input. Also, from our definition of  $t_i$ , a positive (negative)  $t_i$  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 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 often find that a fertilizer is being subsidized, while a pesticide is being taxed, or vice-versa. Or, that cotton is being subsidized while another cash crop is being taxed. It is obvious from our analysis 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 such is not the case, then the existing tax structure is not optimal and it can be improved upon, regardless of what the social weights might be.<sup>47</sup>

This analysis casts some doubts on an oft given advice that, on the grounds of equity, some agricultural inputs (like tractors) should be taxed since they are used primarily by rich farmers, while other inputs (like fertilizer) should be subsidized since they are used by poor as well as rich farmers. The above analysis suggests 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 come from the

importance of cross price effects and from specific kinds of induced effects of prices on the rural wage.

## 5. THE STRUCTURE OF PRICES IN THE INDUSTRIAL SECTOR

Urban food subsidies are not only widespread in LDCs, but they 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, as it has been formulated in the context of developed countries, while providing us with rules which allow the calculation of the optimal tax-subsidy rates, given precise information concerning all the elasticities of demand (including cross elasticities) and the social weights to be associated with each individual, does not give us a clear qualitative picture. For instance, as Atkinson and Stiglitz (1972) have pointed out, in the demand systems which are typically estimated in practice, the commodities with a high income elasticity are often also the commodities with low price elasticity. If one ignored distributional consequences, these are the commodities to tax; but if one focussed on distributional considerations, then these are 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.

There are four features of the economy which we would argue are



central in analyzing the structure of urban prices and taxes in developing economies. These are: the presence of urban employment, 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 LDCs.

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. For instance, if the agricultural wage is fixed, then an urban food subsidy would make living in the urban sector more attractive, leading to a higher flow of migration from the agricultural to the industrial sector. This 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 since 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 which 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, since wages affect workers' efficiency, quality

and turnover. Employers (public or private), therefore, take these effects into account when setting the wage which, 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 LDCs 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), since a change in the tax policy would result in induced effects on the industrial wages (similar to those discussed earlier in the context of agricultural sector) and these effects need to be incorporated in the design of tax policy.

Elsewhere, we have developed a framework which provides a unified treatment of unemployment, migration, wage-productivity effects and wage determination; within which one can analyze 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 and wage-productivity effects.<sup>48</sup> Space limitation does not permit us to describe such an analysis here. We therefore present below a highly simplified model which emphasizes wage-productivity effects, while the consequences of migration and unemployment are briefly discussed in the next section.

Wage-Productivity Effects: If the wage-productivity hypothesis holds, that is 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 been typically 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 wage as well as the relative prices he faces.

For simplicity, consider the case of homogenous industrial workers (its extension to the case of heterogenous workers is discussed later). The wage-productivity effects are represented as<sup>49</sup>

$$(26) \quad Y \equiv Y(q, w)$$

The standard assumption in the literature is that higher wages lead to higher productivity, that is,  $\partial Y / \partial w > 0$ . The effects of prices on productivity, which have not received attention in the past, are likely to be ambiguous in general. However, in the special case in which a worker's productivity depends only on his utility level, that is

$$(27) \quad Y \equiv Y(V^m(q, w))$$

and  $\partial Y / \partial V^m > 0$ , it is easy to see that higher prices reduce productivity.<sup>50</sup>

Taking (26) 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

$$(28) \quad \sum_j r_j \eta_{ij}^{mu} = \left[ 1 - \frac{\beta^m}{\delta} - (q - P) \frac{\partial x^m}{\partial w} \right] + b_i$$

where  $r_j = (q_j - P_j)/q_j$  is the tax rate on good  $j$ ,  $\eta_{ij}^{mu} = -\partial \ln x_i^{mu} / \partial \ln q_j$  represents various compensated elasticities, and  $b_i = \frac{1}{x_i^m} \frac{\partial Y}{\partial q_i}$ .

As is well known, the left hand side of (28) 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 (28). This term can be interpreted by noting that  $b_i = -\epsilon_{Yi} Y/q_i x_i^m$ , where  $\epsilon_{Yi} = -\partial \ln Y / \partial \ln q_i$ .  $b_i$  is therefore 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  $\epsilon_{Yi}$  is larger), and if the worker's expenditure,  $q_i x_i^m$ , on this good is smaller. Obviously, from (28), the proportional reduction corresponding to such goods should be smaller.

Moreover, a basic prescription of the 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, we first obtain the expression for optimal wage, taking prices as fixed. The optimal wage

is characterized by:  $1 - \frac{\beta^m}{\delta} - (q - P) \frac{\partial x^m}{\partial w} = b_w$ , where  $b_w = \partial Y / \partial w$ .

Next, if both the prices and the wage are set optimally, then by substituting the last expression into (28), we obtain

$$(29) \quad \sum_j r_j \eta_{ij}^{mu} = b_w + b_i$$

Now, in the absence of wage-productivity effects, the right hand side of (28) is zero. Hence  $r_j = 0$ , and

$$(30) \quad q_i = P_i$$

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,  $b_i = -\lambda^m \partial Y / \partial V^m$ , which is the same for all goods and therefore, from (28), the proportional reduction should be equalized across goods. Also, the right hand side of (29) is zero (because  $b_w = -b_i$ ), which implies that commodity taxation in the urban sector is unnecessary 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. For instance, consider a situation in which wages are determined through a bargaining between the government and a trade union which 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 (27), then it is better to have no urban commodity taxation, as in (30), while 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 (26), then it is desirable to have urban commodity taxation.<sup>51</sup>

The above model is easily generalized to incorporate heterogeneity of

individuals in the industrial sector.<sup>52</sup> The main implication of this extension is that, in general, various goods will differ not only in their productivity effects ( $b_i$ 's), but also in their distributional effects. Goods such as food may have larger distributional effects (since the welfare of the poor is more sensitive to the food prices) as well as larger productivity effects (due to the effect of food consumption on workers' health, for example) and, if this is the case, then the (tax-induced) proportional reduction in food consumption should be smaller than in other goods. This extension, however, does not alter our earlier results concerning the desirability or the undesirability of urban commodity taxes-subsidies.

## 6. MIGRATION AND UNEMPLOYMENT

Recent research has drawn attention to the importance of labor mobility across sectors. In particular, it has been pointed out 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 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 to 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 agricultural surplus to account for the fact that 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, since workers move from one group to another which, in general, have different levels of utility.

In a general model of migration which we have proposed elsewhere, the rural population is represented as:  $N^1 = N^1(p, q, w, N^2)$ , 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 (7) is replaced by  $H = N^a W(V^a) + N^m W(V^m) + N^u W(V^u) + \delta I$ . The optimal rural food price is characterized by<sup>53</sup>

$$(31) \quad p = \frac{P + \phi}{1 + \left(1 - \frac{\beta^a}{\delta}\right) \frac{1}{\bar{\eta}_{Qp}}},$$

where  $\bar{\eta}_{Qp} = \partial \ln(N^a Q) / \partial \ln p$  is the redefined price elasticity of agricultural surplus (taking into account the effect of price on rural population), and  $\phi$  represents the welfare effects of price-induced migration.<sup>54</sup> If there is no migration, then  $\bar{\eta}_{Qp} = \eta_{Qp}$ , and  $\phi = 0$ . Not surprisingly, (31) is the same as (12), in this special case. When there

is migration,  $\bar{\eta}_{Qp}$  exceeds  $\eta_{Qp}$ , and  $\delta$  is positive, under plausible circumstances.<sup>55</sup>

Now compare the above expression for the optimal price, (31), to the special case (12) when there is no migration. The effect of migration then is to increase the numerator and decrease the denominator in (31), if investment is more valuable than consumption. Heuristically, this implies that migration increases the price which should be paid to peasants for their surplus. This makes sense since by paying a higher price to peasants, the government can reduce the pressure of migration to cities and hence reduce the resulting urban unemployment which 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 in-migration from the rural sector has led to serious social degradation.

Another special case of the above formulation, 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,<sup>56</sup> and where the marginal productivity of a worker in the rural sector is fixed. Then our pricing formula becomes

$$(32) \quad p = \frac{P}{1 + \left(1 - \frac{N\lambda^a}{N^a\delta}\right) \frac{1}{\eta_{Qp}}},$$

where recall that  $\lambda^a$  is the marginal utility of income to a rural worker.

This expression has an interesting implication. In the early stages of development, when the relative social weight on investment,  $\delta/\lambda^a$ , 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. But as the economy develops, the price paid to peasants should increase, and it is quite possible that it should even exceed the international price.<sup>57</sup>

## 7. FURTHER EXTENSIONS

The major components of our models of developing economies involve (i) the organization of the agricultural sector, (ii) the organization of the industrial sector, (iii) the migration and unemployment, and (iv) the international trade environment. In our basic model, the agricultural sector consisted of homogenous owner-peasants, the industrial sector had homogenous workers receiving a rigid wage, and there was no induced migration. We have then shown how we can incorporate aspects such as the heterogeneity of individuals within the two sectors, migration and unemployment, and endogenous determination of industrial and agricultural wages. These features are clearly important in many LDCs. In this section, we illustrate how the model may be further extended to incorporate additional features which might be important in certain economies.

(a) Sharecropping in Agriculture: In some economies, sharecropping is important. In such cases, all we need to do is to interpret  $Q^h$  as the net surplus of an individual after paying the landlord's share, or after receiving the share from the tenant. Further, if the share contract is endogenously determined, then the individuals' surplus elasticity will be based in part on the elasticities of equilibrium shares with respect to price. Clearly, the values of price elasticities may differ between economies with sharecropping and with peasant holdings, even if the underlying utility functions and

production functions were identical.

(b) Composition of Households: This aspect, though ignored in much of the standard tax literature, is important since we know that households have heterogeneous demographic characteristics, particularly when we contrast rural versus urban households, or rich versus poor households in the agricultural as well as the industrial sectors. This affects the social weights,  $\beta^{ih}$ , which depends 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.<sup>58</sup>

(c) International Trade Environment: So far we have assumed that all goods can be exported or imported. But some goods have such high transportation costs that neither alternative is attractive, while 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 import of certain goods due to self-sufficiency considerations. These and other similar situations entail additional constraints within which pricing policies need to be determined.

Self-sufficiency Objective: 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 can not exceed a certain pre-specified fraction of the domestic production. Obviously, such a constraint influences pricing decisions only when it is binding. But once it is binding, the government's flexibility in setting prices decreases. For instance, in the simple model of Section 2, 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 to a situation in which there were no self-sufficiency objectives.

Non-Traded Goods: Goods such as infrastructure and inputs into human capital formation are non-traded. Also, a large number of ordinary consumption and industrial goods produced in LDCs 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 non-traded goods. If, in addition, it happens that an LDC faces export constraints on goods which 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 non-traded good is simple. The shadow price for a traded good is its international price, whereas the shadow price of a non-traded good is determined, in our model, endogenously (and simultaneously with the determination of optimal prices) based on its social marginal value.<sup>59</sup> 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 non-traded goods can be defined correspondingly with respect to their shadow prices. This redefinition,

however, does not change the expressions for the optimal tax rates which we have derived earlier. Our discussion of the qualitative properties of optimal taxation thus applies to the traded as well as the non-traded goods.

(d) 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 which 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.<sup>60</sup>

Two other implications of rigidities are as follows. First, other rigidities might exist in the economy, such as those in the credit and land markets, and in the international trade and borrowing environment. It would then be necessary to consider all of these rigidities simultaneously. Second, our analysis has 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, 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.

(e) Taxation and Alternative Markets: A key characteristic of most tax instruments is that the tax is actually imposed on the (formal) market transactions (for example, on a consumer's purchase of a good from a trader, or an employer's payment of wage to his employee). What is often ignored in the

conventional tax analysis is that transactions also take place, to varying degree, outside the formal market (in which middlemen's services are employed to a substantially lesser extent, but which may not be as economical for large transactions as the formal market) and that the choice of markets would be affected by the tax policy. Moreover, this shift would be different for different individuals. This, in turn, has efficiency and equity effects which have not yet been studied.

This issue is important in LDCs for at least two reasons. First, a large proportion of transactions takes place informally because formal markets are often nonexistent in many areas (due perhaps to the small size of transactions). Second, the widespread prevalence of corruption and tax avoidance can be viewed as an additional division of the formal market into a regular and an irregular (underground) market. The latter market, while economizing on transactions and entailing middlemen's costs, avoids taxation, often with the connivance of the tax bureaucracy. Presumably, however, it has some disadvantages over the formal regular market, otherwise everyone would switch to the irregular market and no tax revenue would be collected. A full analysis of taxation in LDCs needs to take into account the shifts among these various markets.

## 8. TAX ANALYSIS FOR DEVELOPING VERSUS DEVELOPED ECONOMIES

Often there is a temptation among policy analysts to borrow results from the standard tax literature and prescribe them in LDC situations without examining the premises on which these results are based. Such an approach overlooks what we consider to be two fundamental differences between LDCs and

developed economies: concerning the tax instruments which the government can or cannot use, and concerning the salient features of the economy.

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.<sup>61</sup> In LDC 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 which are quantitatively ascertainable (at a reasonable cost) by an outside party. We therefore believe that our assumption that the labor transactions cannot be taxed in an LDC agriculture with heterogenous individuals 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.<sup>62,63</sup>

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 highly recommended by conventional economic theory since David Ricardo,<sup>64</sup> 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, basing a land tax on land quality is inherently difficult: 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.<sup>65</sup>

These differences have important consequences on tax policy. For instance, oft quoted results [Diamond and Mirrlees (1971)] that the producer prices should be same as the shadow prices and that there should be no tax on international trade 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 it is also based on the standard definition of firms which purchase all of their inputs and sell all of their output. Firms, by definition do not consume. Under this definition, the farms of our model are not firms, since farmers are both producers as well as consumers (at least for certain goods like foodgrains).<sup>66</sup> Moreover, within an LDC agricultural sector, it is virtually impossible to implement different producers' and consumers' prices, since the transactions (of food, for example) within a household and across households can not be easily monitored.

## 9. POLITICAL ECONOMY OF PRICING AND TAXATION:

### SOME MISGIVINGS ON THE STANDARD TAX THEORY

Often the most important rationale for taxation and pricing policies in LDCs is that they redistribute from the rich to the poor. On the other hand, actual policies often seem to do just the opposite. This apparent contradiction raises some issues which need to be studied.

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 feasible taxation and

pricing 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), 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 since, given the set of available 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 work towards enlarging the set of instruments.

Sah (1983a) has examined the maximum extent to which the welfare of the poorest can be improved (when the only instruments available to the government are taxation and pricing of goods), and has shown that the achievable redistribution can indeed be quite small. There are at least three 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. This analysis clearly suggests that there might be hitherto



unrecognized limitations on the redistributive capabilities of commodity taxation and pricing.<sup>67</sup>

Now, assume that redistribution from 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. For example, if the city dwellers control the political system and they maximize their own welfare, then the prices they will set will correspond to the rules we developed earlier, where the social weights on the income of peasants is 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 versus those of industrial workers in the pre-collectivization USSR.

It is quite plausible, then, that the domination of one group by another is an important factor determining pricing policies in present-day LDCs. 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 discriminate against others, is a question of concern to us.

## 10. CONCLUDING REMARKS

LDCs display an enormous variety of institutional arrangements, and these arrangements have a critical influence in determining the impact of taxation and pricing policies and, hence, on the design of these policies. Clearly, then, there is no single model, no single prescription, which is applicable to all countries. We have therefore constructed a general framework which 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 out labor), landless workers and sharecropping. Plantations are important in some countries, and our framework can be easily adapted to take that 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 LDCs. 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 LDCs), 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 lead many of our results to be different from those in the standard tax literature.

Concerning the salient features of the LDCs, 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, due to 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 is markedly different from the central concern of standard tax theory which assumes full employment, and focuses on the deleterious effects of reductions in labor supply.

Finally, in most LDCs 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 which can be applied based on 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 which lead to Pareto improvements; reforms that increase not only the welfare of each individual in the economy, but also public investment.

## FOOTNOTES

1. For some empirical details on the interventions in LDCs agriculture, see Bale and Lutz (1979).
2. There is a long tradition, cutting across ideological boundaries, which 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'. Our 1984a and 1985a papers analyze this problem, both in the context of the Soviet debate as well as in the context of present day LDCs. In the classical laissez faire tradition, on the other hand, 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 later discuss the issue of land taxes.
3. Economists are typically reluctant to deal with so-called 'non-economic' objectives such as self-sufficiency. The fact of the matter is that in many countries (for example, India and South Korea), self-sufficiency is an unambiguously stated national policy. We show how these objectives may be incorporated into a policy analysis, while pointing out the associated economic costs.
4. Among other objectives are to stabilize prices faced by consumers and producers [see Newbery and Stiglitz (1981)], to redistribute income away from middlemen towards consumers and producers, or from one region to another.

5. These remarks apply outside of LDCs as well. Not only are farm price interventions widespread in industrial economies, but so is the confusion associated with it. Some of the most bitter controversies among the EEC members have arisen in the past, for example, due to their disagreements on farm price policies.
6. In economies where different commodities are produced or consumed in different regions, or by different ethnic groups, different agricultural policies have different effects on the welfare of these different regions and groups.
7. These issues have not received much attention in the literature. See, however, Dixit (1969, 1971), and Dixit and Stern (1974). Also, some researchers have analyzed agricultural pricing using approaches based on consumer and producer surplus; for example, Tolley, Thomas and Wong (1982). Sah (1982b) points out the limitations of such approaches, and provides an empirical framework to implement an approach such as the one developed in this chapter.
8. See Sah (1978, 1982b, 1983a), Stiglitz (1982b) and Sah and Stiglitz (1984a, 1984b, 1985a, 1985b).
9. Harberger (1971) and Stiglitz (1974a) have pointed out the dramatic implications that migration may have on shadow prices in social cost-benefit analysis; the implications for pricing and taxation would appear to be potentially no less significant.
10. In simple models, it can be shown that the complements of leisure should be taxed, and the substitutes subsidized. See Corlett and Hague (1953). For an extension of this interpretation to many commodities, see Atkinson and Stiglitz (1972).

11. In our 1985b paper, for instance, we have followed this approach in analyzing shadow wages. Our formulae not only provide new insights, but they also yield most of the existing results on shadow wages as special cases.
12. For instance, under certain circumstances, sharecropping can be explained as a risk-sharing incentive scheme (Stiglitz, 1974b). In this case, changes in taxation and pricing policies may result in the long run in changes in the terms of the sharecropping. Unfortunately, space limitation does not allow us to pursue here some of these issues as much as we would like.
13. See Stiglitz (1974a, 1976a, 1982a, 1982c, 1982d), and Mirrlees (1975b), among others, on wage-productivity effects in LDCs. For a discussion of these effects in the context of developed countries, see Akerlof (1984), Calvo (1979), Shapiro and Stiglitz (1984), Stiglitz (1976b, 1985a), and Yellen (1984).
14. The two classic papers are by Ramsey (1927) who posed the problem as one of taxation, and Boiteaux (1956) who posed it as one of pricing. For a survey of what has grown to be a vast literature, see Atkinson and Stiglitz (1980).
15. The fact that limitations on the instruments available to the government may have significant effects on tax policy has long been recognized. For instance, Stiglitz and Dasgupta (1971) 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 which

are even less persuasive in the context of LDCs than in the context of developed countries. Similarly, Atkinson and Stiglitz (1980) show that the the structure of optimal commodity taxes depends critically on whether income tax is feasible or not.

16. 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 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.
17. Though it is important to note here that different social welfare functions, while giving rise to different sets of optimal taxes, may not always lead to significant differences in the total amount of taxes which an individual pays, or in the resulting levels of welfare of different individuals. For example, a simulation of optimal commodity taxes for India, 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.
18. Elsewhere, such an approach has been called the New New Welfare Economics [Stiglitz (1985b)].
19. 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 turn up to be of importance in subsequent research. However, it should be noted that we

- have analyzed a much wider variety of considerations than those reported here. For instance, we do not discuss here the consequences of capital allocation and mobility between the two sectors, and of private savings which, in the long run, may indeed be important. These aspects can be easily incorporated within our general framework. See the earlier (1984b) version of this paper for a discussion of some of these aspects.
20. In our 1985b paper, we have developed a similarly general model for the determination of wages and earnings in the industrial sector. Due to space constraints, we present later only some special cases of this model.
  21. Nor do we assume any functional forms to represent individuals' responses. It should be obvious, however, that simulation exercises at this level of generality can become quite difficult and, not surprisingly, strong special assumptions are typically employed in such exercises. For instance, the simulation analysis in the Heady-Mitra chapter in this volume is based on the special case in which individuals within each sector are homogeneous, demand functions are based on the linear expenditure system (LES), and the production technology has constant elasticity of substitution. The results of such simulations must be interpreted with care because, as is well known, the parameterization one employs in simulation may seriously bias the optimal tax rates one obtains. For a dramatic example of the consequences of the LES assumption on optimal commodity taxes, see Atkinson and Stiglitz (1980).
  22. 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.

23. In any event, our present analysis does not deal with a collectivist agriculture or with an agriculture based on government managed parastatals.
24. It should be obvious that non-linear tax-subsidy-pricing schemes, if administratively feasible and not too expensive, are better (in a Pareto sense) than the standard (linear) pricing. This is simply because a non-linear scheme provides 'more' instruments to the government than the standard pricing, and the government cannot do worse by having more instruments. Also, restricted non-linear schemes, such as those entailed by quotas and rations, are desirable additions to standard pricing because, once again, one cannot do worse by having more instruments. But schemes such as quotas and rations are not necessarily desirable alternatives to standard pricing. See Sah (1982a) for an analysis of these schemes.
25. Yet the 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 LDCs have in controlling multi-nationals. 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 discuss later, the analysis can be modified for those cases in which the government's control on the industrial sector is limited and indirect.
26. If  $\eta_{xq} < 1$ , then a decrease in the urban food prices decreases

investment and, hence, a Pareto improving reform in the urban price is not possible within the simple model presented here.

27. 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 as well as the urban price, since corresponding to a  $p$  there is a value of  $q$  which clears the market for the agricultural good. See Sah and Stiglitz (1985b).
28. In an agricultural sector in which individuals buy and sell labor services, an additional requirement for the above rule of price reform to hold is that the rural wage should not be significantly sensitive to the rural food price. A disaggregated analysis of the agricultural sector with heterogenous individuals is presented later in this chapter.
29.  $W$  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 be further employed to trace the path of optimal prices and other variables over time; this however is beyond the scope of the present chapter.) Further, the simplest assumption to make concerning how the investment is used is that it is employed to increase the capital stock in the industrial sector. For a more detailed discussion of the alternative uses of investment, see the earlier version (1984b) of this chapter.
30. To obtain these expressions we have used the Roy's formula:  $\partial V^a / \partial p = \lambda^a Q$ , and  $\partial V^m / \partial q = -\lambda^m x^m$ . Also, we assume that  $\mu^a$  and  $\mu^m$  are positive. From (10),  $\mu^a$  is positive if  $\eta_{qp} > \beta^a / \delta - 1$ . We expect this condition to be met in LDCs at early stages of development, since the social weight on investment is likely

to be higher than that on the rural income. From (11),  $\mu^m > 0$  if  $\eta_{xq} > 1 - \beta^m/\delta$ . 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.

31. The observed pattern in many LDCs 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 intra-sectoral inequality, which we do below.
32. Since the choice of peasants' labor hours is endogenous, and the value of their output is influenced by a change in  $p$ , these elasticities,  $\eta_{xp}$  and  $\eta_{xp}$ , are not the standard partial elasticities in which income is held constant.
33. In Pigou's formula, the magnitude of the tax rate is proportional to  $1/\eta_{xp} + 1/\eta_{xp}$ . See, Atkinson and Stiglitz (1980, p. 467).
34. This should not be surprising. In the formulations of standard general equilibrium models, what matters is the net trade; for farmers, this is just their marketed surplus.
35. The sum of weights in the numerator adds up to the denominator since, from the rural labor market clearing condition,  $\sum_h L^h = 0$ . Obviously,  $L^h = 0$  in the special case in which everyone is

identical. Also, (7) is now modified to be:  $H = \sum_h W(V^{ah}) + \sum_h W(V^{mh}) + \delta I.$

36. 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.
37. The wage elasticity term does not appear in (17), while it does in (16). This is simply because at present we are assuming that industrial wages are fixed. In more general models, such as those discussed later in Section 5, wage elasticity terms would appear in the expressions analogous to (17). Also, though we are considering here a single type of labor, its generalization to a multitude of skill types is straightforward.
38. We have attempted to compare the resulting optimal prices with those which would be optimal when the intrasectoral heterogeneity is suppressed [that is, when the social weight in the rural (urban) sector is calculated for a 'representative' peasant (industrial worker) who has average land area (income)]. The comparison depends, in a complicated way, on the precise functional forms of the social welfare function and the utility functions, and it does not yield any general conclusion.
39. The same good sometimes belongs to more than one category; for example, tractors are primarily employed in agricultural production but are occasionally used for personal transportation.
40. In practice, there are some ambiguities in the precise geographical definition of such a border, since agricultural activities are sometimes

undertaken on the fringe areas of cities which fall under cities' tax jurisdiction. Also, our 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 that a tax can be imposed. If a farmer can sell directly to another farmer, then it is unlikely that a tax can be collected. The LDC governments can (and frequently do) attempt to 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.

41. Further, in (3),  $Y$  now denotes the value of the entire vector of industrial outputs, measured at the international prices. The numeraire good is any one of the pure consumption goods produced in the industrial sector, of which the quantity consumed by a peasant is  $y^{ah}$ . Both  $x^{mh}$  and  $q$  are also vectors.
42. This equality yields a multiperson Ramsey-like 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 consumption of a good should be related to its distributional characteristics [see Atkinson and Stiglitz (1980, p. 386-390)].
43. This assumption, however, is not required in the rest of this chapter. We should point out here that the same assumption is made in most of the empirical work on farmers' responses (on which an implementation of price policy must ultimately be based). Moreover, the same assumption

underlies typical simulation exercises on tax policy (see, for example, the chapter by Heady and Mitra in this volume).

44. For dimensional consistency, the vector  $z$  contains zeros for those goods which are not produced but are consumed by the households. Similarly, the vector  $x^{ah}$  contains zeros for those goods which are produced but are not consumed by the households. This convention is adopted solely for expositional simplicity; it has no economic significance.

45. 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  $G = (G^1(p^1, w^a), G^2(p^2)) = pz - w^a L_d$ , where

$p^2$  is the vector of production goods' prices and  $L_d$  is the labor applied on unit land. Then, for the production good  $i$ ,

$$\partial z_i / \partial w^a = -\partial L_d / \partial p_i = g_1 z_i, \text{ where } g_1 = \frac{\partial^2 G}{\partial G^1 \partial G^2} \frac{\partial G^1}{\partial w^a} / \frac{\partial G}{\partial G^2}.$$

Therefore, the elasticity  $\partial \ln z_i / \partial \ln w^a = g_1 w^a$  is the same for all  $i$ . For details on the underlying production technologies, see Lau (1978).

46. The labor market clearing condition is  $\sum_h L^h(p, w^a) = 0$ , which, upon differentiation, gives  $dw^a / dp_i = - (\sum_h \partial L^h / \partial p_i) / \sum_h \partial L^h / \partial w^a$ . Next,  $L^h = L_s^h - A^h L_d$  where  $L_s^h$  is the labor supply of the household  $h$ .

Since the prices of production good affect the labor supply only through full income,  $\partial L^h / \partial p_i = A^h z_i \partial L_s^h / \partial M^h - A^h \partial L_d / \partial p_i$ . Now, recall from footnote 45 that  $-\partial L_d / \partial p_i = g_1 z_i$ . It follows that:  $dw^a / dp_i = g z_i$ , where  $g = - \sum_h A^h (g_1 + \partial L_s^h / \partial M^h) / \sum_h \partial L^h / \partial w^a$ . Using these, the earlier reform analysis can be reproduced, with a difference that

now 
$$B = (P - p) \left\{ \sum_h (A^h \frac{\partial x^{ah}}{\partial M^h} - g \frac{\partial Q^h}{\partial w^a}) \right\} / N^a A.$$
 A special case of

this is, of course, when there are no induced wage effects. For this, simply substitute  $g = 0$ .

47. Obviously, one needs to take account of the functioning of credit markets.
48. In Sah and Stiglitz (1985b), we develop general approaches to migration as well as to the determination of industrial earnings. These can be specialized, for example, to situations in which wages are set (by private or public firms) taking into account the induced effects on labor efficiency, labor quality and labor turnover. Also, the model can be extended to multiple agricultural regions providing different types of employment opportunities, and to heterogenous urban population (for example, workers in the formal subsector versus workers in the 'grey' informal subsector).
49. 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.
50. For instance, consider the case in which productivity depends on the quantities of consumption goods, that is  $Y = Y(x^m(q, w))$ . The effect of a price change on productivity is then determined, in part, by how the consumption quantities are affected by prices. Now, an increase in the price of a good increases the consumption of some goods (gross substitutes) while it decreases the consumption of others (gross complements). Clearly, therefore, the

sign of  $\partial Y / \partial q_i$  cannot be predicted in general. In the special case,  $Y = Y(V^m(q, w))$ , however,  $\partial Y / \partial q_i = -\lambda^m x_i^m \partial Y / \partial V^m < 0$ .

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

52. This extension is similar to the one in Section 4. Expression (27) now becomes:

$$- \sum_j (q_j - P_j) \sum_h \frac{\partial x_i^{mhu}}{\partial q_j} = \sum_h \left[ 1 - \frac{\beta^{mh}}{\delta} - (q - P) \frac{\partial x_i^{mh}}{\partial w} \right] x_i^{mh} + N^2 \frac{\partial Y}{\partial q_i}$$

Productivity is now represented, in general, as:

$Y = Y(q, w^1, \dots, w^h, \dots)$ . A special case of this is:  $Y = Y(V^{m1}(q, w^1), \dots, V^{mh}(q, w^h), \dots)$ .

53. Here, we are ignoring the consumption of unemployed workers, and assuming that the industrial wage is fixed in terms of industrial goods. Also, the level of industrial employment is fixed, since it is derived from an equalization of the industrial wage and the marginal product of labor. These assumptions are being made solely for brevity, as should be obvious from the footnote 48.
54.  $\phi = [W(V^a) - W(V^u) - \beta^a p X_A] m_p / \delta Q \bar{n}_{Qp}$ , where  $A$  is the agricultural land per peasant,  $X_A = \frac{\partial X}{\partial A}$  is the marginal output (per peasant) of land, and  $m_p = \frac{\partial \ln N^a}{\partial \ln p}$  is the elasticity of rural



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 agricultural land is not too scarce, that is  $AX_A$  is small, and that  $\eta_{QA} = \frac{\partial \ln Q}{\partial \ln A}$  (which is the elasticity of agricultural surplus per peasant with respect to the land per peasant) is smaller than one. Now, note in the expression for  $\phi$  that the square bracket 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  $\beta^a p \bar{X}_A A$  is the welfare loss due to the congestion effect of migration on others in the agricultural sector. This net gain is positive, from the above assumptions.

55. This follows from the previous footnote, and from  $\bar{\eta}_{Qp} = \eta_{Qp} + (1 - \eta_{QA})m_p$ . 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.
56. This is the well known Harris-Todaro migration hypothesis. For simplicity, we assume here that the social welfare function is utilitarian, that is,  $\beta^a = \lambda^a$ . The main implication of the Harris-Todaro hypothesis then is that:  $H = NV^a + \delta I$ , instead of (7). 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. For instance, if it is posited that there is free migration and no

unemployment, but the utility of a worker in one sector is a fraction of the utility in another sector (see the chapter by Heady and Mitra in this volume), then this is a special case of our formulation in which  $N^u$  is set at zero, and the expression  $N^1 = N^1(p, q, w, N^2)$  is implicitly defined by  $V^1(p, N^1) = eV^2(p, w, N^2)$ , where  $e$  is a parameter. A further special case is:  $e = 1$ , which implies the standard neoclassical assumption that free migration equalizes workers' utilities across sectors.

57. 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 in Section 3 apply with some modifications in the present case as well. For example, the rule for reform in the rural food price, (4), applies in the present case if  $\eta_{Qp}$  is replaced by  $\bar{\eta}_{Qp}$ .
58. See Sah (1983b) for a methodology for analyzing intra-household allocations.
59. Specifically, those elements of the vector  $P$  which correspond to non-traded goods are replaced by the vector  $\xi/\delta$ , where elements of the vector  $\xi$  are the Lagrange multipliers to the market clearing conditions of various non-traded goods.
60. This point has been missed in some of the earlier literature which has presumed that there always exist government policies which can eliminate unemployment. This supposition, in turn, has sometimes led to a belief that since the government can eliminate unemployment, it would do so. Consequently, unemployment must necessarily be a short run phenomenon which can be ignored in a long run policy analysis. These views are clearly misleading if the endogeneity of wages is taken into account.

61. See Stiglitz (forthcoming), for a discussion of such constraints.
62. This difference, however, is not important in our simpler model (Section 2 and 3) in which there are homogenous peasants, since there are no labor transactions in this case.
63. There are other restrictions on the set of taxes, which the standard models impose as we do; in particular, that there is no income tax. This assumption makes no sense for a developed economy, but is relevant for many LDCs. See Atkinson and Stiglitz (1980) for a discussion of the effects of income taxation on the optimal structure of commodity taxes.
64. For a recent analysis of some of the classical views on land taxation, see Feldstein (1977).
65. It is perhaps not surprising that negligible use is made of the land tax in most LDCs, and that its use has steadily declined over time. This is possibly because the use of coercion required to administer such a tax is less feasible today than it was earlier.
66. Also, by this definition, those establishments are not firms where an owner-manager's effort has an effect on the outcomes, and his effort cannot be monitored. Such establishments are in this formal sense just like the farms in our model [See Stiglitz (1974b)], in which a direct tax on labor (effort) can not 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 which represents pure profits. Thus, the production efficiency result may be almost as inapplicable to developed economies as it is to LDCs.
67. 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.

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