Pakistan Journal of Applied Economics, (1990), Vol. IX No. 1, (27 - 69)

PRICING POLICY IN DEVELOPING COUNTRIES:
The Case of Pakistan.

David COADY*

This paper presents an analysis of price (tax) reform in developing countries, with particular reference to Pakistan for 1976. The purpose of the paper is to highlight aspects which need to be taken account of when formulating price policies. The results and conclusions presented should therefore be accepted in this spirit and also seen as preliminary.

I. Introduction

All governments find it necessary to raise some revenue to finance various public expenditures. The theory of public finance suggests ways in which such revenues should be raised. The 'first best' method of raising the necessary revenue is through lump-sum taxes. However, particularly in developing countries, such taxes are not always feasible, or in some cases, acceptable. One is therefore forced to rely on 'distortionary' taxes. Distortionary taxes are often divided into 'direct' and 'indirect' taxes. Direct taxes usually take income and wealth as their base whereas indirect taxation refers to the taxation of commodities. The amount of revenue raised through direct taxes in developing countries is rarely sufficient to meet government requirements. As a result it is often left to the indirect tax system to raise the bulk of the funds required. In Pakistan indirect taxes have accounted for over 80 percent of total tax revenues throughout the 1970s and the 1980s, equivalent to roughly 10 percent of the GDP.

* This paper is a reduced version of an earlier paper written while the author was visiting the Applied Economics Research Centre, University of Karachi, Pakistan, from February to June 1988. I am very grateful to the staff of this institution for helpful discussion and access to their facilities and to all with whom I came in contact for making my stay both enjoyable and productive. I would also like to thank Nick Stern for helpful discussion and comments, and also reviewers of the journal for comments. However, all errors remain my own.

In this paper we take a broad view of indirect taxes which incorporate both *explicit* taxes (e.g., export taxes, import duties and sales taxes) and *implicit* taxes (e.g., procurement prices fixed below world prices, low consumer ration prices and low agricultural input price to farmers). Subsidies can be viewed simply as negative taxes. The now standard model presented by Diamond and Mirrlees (1971) to analyse optimal commodity taxation assumes that all goods can be taxed and that the production technology exhibits constant returns to scale or alternatively, a 100 per cent profits tax. The implications of these assumptions are that production efficiency is desirable and the model can be formulated as if producer prices are constant, so that taxes are totally shifted forward onto the consumer. At the optimum, final commodity taxes reflect both efficiency and equity considerations. However, this model is not as helpful when we consider developing countries, where a large proportion of the population usually relies, directly on agriculture as their main source of income.

The assumptions above cannot be realistically applied to agriculture. For example, it is widely accepted that taxation of profits from agricultural production is very difficult so that the assumption of 100 percent profits taxation is no longer valid. Also, since most farm households consume from their own production before marketing their surplus, it is not possible to tax all goods (total household consumption), i.e., we cannot confront producers and consumers with different prices. However, if there are no agricultural profit (rent) taxes, one can include the agricultural sector along with the consumer sector. In this case production efficiency is desirable in the remaining 'limited' production sector, and the relevant derivatives in the tax rules relate to marketed surplus rather than consumption. Notice that because the agricultural sector is now taken as part of the consumer sector, we will in general require inputs to be taxed or subsidized at the optimum – production efficiency is desirable only for the limited production sector.

A further drawback is that the theory specifies what an indirect tax system should look like at the optimum, but says nothing about how one should go about 'reforming' the system away from the optimum, in particular where existing distortions drive a wedge between market and shadow prices. Since most governments would wish to find answers precisely to this question, it is necessary to develop a theory of tax (or price) reform. The theory of tax reform has been analysed in detail by Dreze and Stern (1987) so we do not present it here. Ahmad and Stern (1986) have applied it to Pakistan. However, they assumed that all final consumption could be taxed and did not analyse the agricultural sector in detail. These omissions are rectified here but, given the nature of the data available when this analysis was undertaken, the results should be viewed as preliminary and suggestive of issues that need to be considered when formulating indirect tax and pricing policies.

II. Theory

Ahmad and Stern [(1984) and (1990)] introduced the concept of the marginal social cost of raising an extra unit of government revenue by increasing the tax (or changing the price) on a particular commodity. This was derived as follows. The effect on welfare of the change dt_i, in the tax on commodity i is:

$$dV = \left\{ \frac{\partial V}{\partial t_i} + \frac{\partial R}{\partial t_i} \right\} dt_i \tag{2.1}$$

where R is government revenue (its derivative taken at constant producer prices). The effect of the reform on welfare plus the change in government revenue representing the general equilibrium adjustments to the reform. We can then define the marginal cost in terms of social welfare of raising one extra unit of revenue by taxing good i as:

$$\lambda_i = \frac{\partial V}{\partial t_i} / \frac{\partial R}{\partial t_i} \tag{2.2}$$

Away from the optimum there will be as many marginal cost of funds raised as there are tax instruments. If we think of another commodity, j, where $\lambda_i > \lambda_j$, i.e., the marginal social cost of raising one unit of revenue by taxing i is greater than that from taxing j, then we can increase social welfare, at constant government revenue, by switching a unit of revenue on the margin from good i to good j.

So far have focused on a one consumer economy so that the individual indirect utility function, V, is also the social welfare function for the economy as a whole, W. Let social welfare W be represented by a Bergson-Samuelson welfare function such that:

$$W = W(V^1, V^2, \ldots V^h, \ldots V^H)$$

where V^h, the indirect utility of household h, is a function of consumer prices (lump-sum income is assumed constant). We assume H households so that i = 1,…,H. Then the 'direct effect' on household welfare of the tax change is:

$$\frac{\partial W}{\partial t_i} = \Sigma_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial t_i}$$

$$= -\Sigma_h \beta^h x_i^h$$

where $\beta^h = (\partial W/\partial V^h)\ \alpha^h$ is the social marginal utility of income to household h, α^h is its private marginal utility of income, x_i^h is the consumption of commodity i by household h and $q_i = p_i + t_i$ with p_i constant so that $dq_i = dt_i$. q_i and p_i are, respectively, the consumer and producer prices of the i'th commodity. The indirect effect is given by the effect on government revenue, R, so that:

$$\frac{\partial R}{\partial t_i} = x_i + \Sigma_j (q_j - p_j)\ \frac{\partial x_j}{\partial t_i}$$

The marginal social cost of raising an extra unit of shadow revenue by taxing good i is simply the direct effect on welfare of the change divided by the indirect effect (here multiplied above and below by q_i to facilitate empirical investigation):

$$\lambda_i = \frac{-\Sigma^h \beta^h q_i x_i^h}{q_i x_i + \Sigma_j t_j q_j x_j \varepsilon_{ji}} \tag{2.3}$$

where $q_i x_i$ is the expenditure on good i (summed over all households), t_j is the tax on good j as a proportion of its consumer price and ε_{ji} is the uncompensated elasticity of demand for good j with respect to the price of good i. This formula is more useful because household expenditure surveys usually contain expenditures by each household on each commodity and demand responses often come in the form of elasticities.

By focusing on the reciprocal of λ_i we can arrive at an informative decomposition involving a distributional characteristic of the commodity and a tax elasticity [see Stern, (1987)]. From (2.3):

$$\frac{1}{\lambda_i} = \frac{1}{D_i} \left\{ 1 + \frac{1}{x_i} \Sigma_j (q_j - p_j) \frac{\partial x_j}{\partial t_i} \right\} \tag{2.4}$$

where $D_i = (\Sigma_h \beta^h x_i^h / x_i)$ and other variables are as earlier. The term D_i involves only household demands and welfare weights but not demand derivatives and it is often termed the distributional characteristic of a good. It often plays a dominant role in determining the ranking of λs over commodities, especially when one has a high aversion to inequality (reflected in β^h).

The above model assumes that producer prices are proportional to shadow prices. However, the prevalence of distortions in developing countries (e.g., trade taxes and fixed prices) means that relative producer prices often do not reflect the relative social costs of changes in net demands. In this situation one must replace actual government revenue with shadow revenue. Changes in shadow revenue are composed of two elements, i.e., the change in actual revenue and an adjustment to take into account the divergence between shadow and market prices, and reflect the true costs of the general equilibrium adjustments to any reform. So we replace producer prices, p, above with shadow prices, v, and taxes, t, with shadow taxes, τ. Another attractive feature of (2.3) is that τ_j can be rewritten as :

$$\tau_j = (q_j - v_j) / q_j$$
$$= 1 - (v_j / q_j)$$

i.e., one minus the accounting ratio for commodity j. Commodity accounting ratios can be easily calculated using input-output data and information on revenue collections or government-controlled prices. [see Ahmad, Coady and Stern, (1988), for calculations for Pakistan].

Newbery (1987) gives a simple example which shows how marketed surplus enters the tax formulas. Consider the agricultural sector in isolation, The indirect utility for the farmer is given by:

$$V = V(p, m)$$

where m = Π(p)+I, Π is profits from farming, I is exogenous or lump-sum income and all other prices are held constant. Differentiating with respect to p we have:

$$\frac{\partial V}{\partial p} = \frac{\partial V}{\partial p} + \frac{\partial V}{\partial m}\frac{\partial \Pi}{\partial p}$$

which, using Roy's Identity and Hotelling's Lemma, reduces to:

$$\frac{\partial V}{\partial p} = \frac{\partial V}{\partial m}(y - x)$$
$$= \frac{\partial V}{\partial m} s \qquad (2.5)$$

where x is consumption and y production, (∂V/∂m) is the marginal utility of income and s is the marketed surplus . So when measuring the direct effect on households of a change in price we focus on net trade. Non-producing households can be introduced by setting s = –x. Since the government can only tax commodities through market trade the revenue impact also depends on net trade. We will expand on these issues below.

As defined above λ is the marginal cost, in terms of social welfare, of raising one extra unit of shadow revenue through taxing the i'th commodity. This was seen to incorporate both equity and efficiency considerations. With households who are both consumers and producers, the efficiency considerations also relate to the elasticity of marketed surplus (consumption for non-producers). Concern for equity will be captured through the distributional characteristic, also focusing on marketed surplus. Some reforms may have a substantial impact on factor markets. For example, if a price reform reduces demand for a labour-intensive commodity then it is possible that the wage rate may fall. Since the poorest members (with high welfare weights) of the rural community are often landless labourers, reforms which lead to a fall in their wage rate are often undesirable. Indeed, this is a common argument against reducing crop prices. In the results presented below we assume that the direct effect on net labour supplies of the price reforms considered are minimal and can be ignored. The effect of changes in the wage rate resulting from these price reforms would be captured by the shadow wage rate which would enter through the vector τ as one minus the ratio of the shadow wage rate to the actual wage rate. The shadow wage rate captures the net effect on welfare of a increase in the demand for labour.

The set of λ's which emerge from our analysis will provide a menu of possible tax reforms. By comparing the marginal social cost of varying each tax rate (price) we can focus on equal- revenue welfare improving reforms. If $\lambda_i > \lambda_j$, i.e., the marginal social cost of raising an extra unit of revenue by taxing good i exceeds that from taxing good j, then we can increase welfare by switching revenue from i to j in such a manner that shadow revenue is constant. Alternatively, we can use the results to decide on the least damaging way of raising extra revenue. There are many arguments as to whether there should be a net transfer of resources to or from the agricultural sector. Some argue that because the elasticity of supply of agricultural output is relatively low it is a natural candidate for taxation, while others counter that, although aggregate agricultural supply may be inelastic, individual crop elasticities can be quite high in the medium to long run, especially where investments in complementary activities take place, e.g., improved irrigation systems, extensions programs and infrastructural investment. Another argument is that investment in such complementary activities exhibits a high social profitability, often much higher than many industrial projects, so investment in these activities is desirable. It is also argued that although the direct effect of the taxation of agricultural output (more precisely, marketed surplus) is to decrease the income of relatively wealthy farmers the indirect effects on labour markets may imply a fall in the incomes of rural labourers whose standard of living may already be quite low. This in turn may decrease wages and prices in the modern industrial sector thus increasing the welfare of urban consumers who often enjoy a much higher standard of living than their rural counterparts. Obviously the conclusions we come to in relation to all of these arguments will ultimately depend on empirical analysis.

Finally, a common debate in Pakistan centres around the necessity of raising extra resources to finance the investments in socially desirable infrastructure and services if these are to cope with and provide a foundation for economic growth. It is also possible that one should undertake agricultural investments and that the necessary funding should be raised through extra agricultural taxation. The analysis which follows will contribute to such a discussion and guide policy makers in their decision making.

III. A Model for Pakistan

We now examine the revenue equations for each commodity, the nature of government involvement in each sector and the elasticity of government revenue with respect to various prices set by the government. The analysis is presented in terms of actual revenue but one needs only to replace producer prices and marginal costs with shadow prices and shadow costs to get to (2.3) above.

1. Wheat and Atta

Government involvement in the wheat and atta (flour) markets is modelled as follows. The government sets the procurement price of wheat, p_1, which also determines the market price. At this price producers decide how much to produce and to consume on farm, the difference being their market surplus. Non-producers also decide on their level of consumption. The government procures the residual after these decisions, i.e.,

$$G_1 = S_1 - X_1 \tag{3.1}$$

Where G_1 is government procurement of wheat, S_1 is producers marketed surplus and X_1 is demand by non-producers (mainly landless rural households). We assume that the wheat milling industry is in the public sector. Notice that it is now uninteresting to focus on the 'issue price' of wheat to millers since changes in this price act only as a transfer between the government 'wheat revenue account' and its 'atta revenue account'. The prices of interest are the procurement price and the consumer prices set by the government. The government sets both the price of atta in the ration shops, q_2, and the open-market price of atta, q_2. At these prices it forecasts total atta demand, X_2, where:

$$X_2 = X_2^0 + \overline{X}_2 \tag{3.2}$$

X_2^0 is demanded in the open-market and $\overline{X}_2$ is demanded for rationed wheat. We further assume that the government sets ration levels which are inflexible, i.e., households take up the whole ration quota or consume zero rationed atta. This may not be representative of the actual operation of the rationing system, where it is often possible that households can consume less than the ration-quota. In such cases we can further assume that the reasons for not taking up the full ration quota are fixed exogenously so that households consume the same level of rationed wheat before and after any price change.

Given total demand for atta this in turn implies a demand for wheat through the relationship:

$$Y_1 = \alpha X_2 \tag{3.3}$$

where Y_1 is demand for wheat by the milling industry and α is the fixed amount of wheat required to produced one unit of atta, i.e., the physical input-output coefficient Y_1 / X_2. The difference between this demand and the amount procured by the government is imported so that:

$$M_1 = Y_1 - G_1 = \alpha X_1 - G_1 \tag{3.4}$$

where M_1 is wheat imports.

Using (3.1) – (3.4) government revenue from its operations in the wheat-atta market can be written as:

$$R = -p_1 G_1 + \bar{q}_2 X_2^0 + q_2 X_2 - \bar{c} - \tilde{c} X_2 - p_1^* M_1 \tag{3.5}$$

where R is government revenue, $\bar{c}$ the total fixed costs of millers, $\tilde{c}$ the variable cost of production (per unit of X_2) and p_1^* the price paid by the government for imports (the border price plus trade and transport margins). So:

$$p_1 \frac{\partial R}{\partial p_1} = \frac{-(p_1 - p_1^*)}{p_1} \varepsilon^{\alpha}_{11} p_1 G_1 - p_1 G_1 \tag{3.6}$$

where $\varepsilon^{\alpha}_{11}$ is the elasticity of government procurement of wheat with respect to the procurement price of wheat and $p_1 G_1$ is the cost of wheat procured by the government. It is this equation which enters into the calculation of λ_1, the effect on social welfare of raising one extra unit of revenue by changing the procurement price of wheat. When revenue is valued at shadow prices we interpret p_1^* as the shadow price of wheat. Note that the relevant elasticity is that of government procurement.

The effect on revenue of a change in the market price of atta is:

$$q_2 \frac{\partial R}{\partial q_2} = \frac{(q_2 - c - p_1^* \alpha)}{\partial q_2} \varepsilon^{0}_{22} q_2 X_2^0 + q_2 X_2^0 \tag{3.7}$$

where ε_{22} is the elasticity of open-market atta demand with respect to the open-market price and q_2X_2 is the value of open-market purchases. The term $(\tilde{c} + P_1^* \ \alpha)$ is the marginal cost production.

The effect on R of a change in the ration price is:

$$\bar{q}_2 \frac{\partial R}{\partial \bar{q}_2} = \frac{(q_2 - c - \alpha p_1^*)}{q_2} \bar{\varepsilon}_{22} q_2 X_2^0 + \bar{q}_2 \bar{X}_2 \qquad (3.8)$$

since ration levels are fixed so that a change in the ration price acts as an income transfer which in turn leads to a change in demand for open market atta. $\bar{\varepsilon}_{22}$ is the elasticity of demand for open-market atta with respect to the ration price of atta. In a similar manner to the above one can derive the effect on R of a change in any other price, p_i, so that:

$$p_i \frac{\partial R}{\partial p_i} = \frac{(q_2 - \tilde{c} - \alpha p_1^*)}{q_2} \varepsilon_{2i}^0 q_2 X_2^0 - \frac{(p_1 - p_1^*)}{p_1} \varepsilon_{1i}^G p_1 G_1 \qquad (3.9)$$

where ε_{2i}^0 and ε_{1i}^G are the elasticities, with respect to P_i of open-market atta demand and government procurement of wheat, respectively.

The direct effect on welfare of all these price changes is given by the welfare weighted sum of the relevant household surplus. From (3.6) – (3.9) we can see that the relevant elasticities for our tax reform analysis in the wheat-atta sector are the own and cross -price elasticities of government procurement of wheat and market atta demand. A detailed analysis of household production-sales-purchase profiles (using Government of Pakistan, 1979) indicates that no farmer who purchased wheat from the market also purchased market atta and less than one percent purchased ration atta. Atta was mainly consumed in urban areas with wheat consumption predominant in rural areas. The data therefore suggest that whether or not a household purchases wheat or atta is determined exogenously by location and is not dependent on the relative prices of wheat and atta. This indicates that the government is not constrained by substitution between both in consumption when setting the procurement price of wheat (which in turn determines the market price) and the market price of atta. It is also clear from the data that both Baluchistan and NWFP are deficit areas or net consumers of wheat-atta. In fact, consumption of market wheat is zero in Baluchistan which relies mainly on ration and market atta. While there are some market wheat purchases in NWFP a large majority of households rely on atta consumption. The take-up of ration atta (almost solely in urban areas) is highest in these two provinces [see Rogers, (1988), for a discussion of the rationing system in Pakistan]. Information on overall production, marketed surplus and government procurement is presented in Appendix (Table 1) for major crops.

2. *Rice*

In the rice industry the government sets the procurement price of rice (unhusked grain), P_4. Given P_4, rice farmers decide how much to produce. The farmer sells all this grain to the public sector rice husking plant and buys back his consumption requirements at a price of q_5 which is fixed by the government. We also assume that q_5 is the price faced by other consumers so the government can confront all consumers with q_5, even rice producers. The government has a price fixing rule given by:

$$q_5 = \gamma p_4 \qquad (3.10)$$

so that $q_5 / p_4 = \partial q_5 / \partial p_4 = \gamma$.

Let Y_4 be the total production of rice, all of which is procured by the government. This level of production is a function of p_4. Given p_4, the government sets q_5 to satisfy equation (3.10) and this determines the level of demand for (husked) rice, X_5. The demand for unhusked rice by the domestic rice husking industry, X_4, is then determined by the following relationship:

$$X_4 = \alpha X_5 \qquad (3.11)$$

where α is the physical input-output coefficient, i.e., the amount of unhusked rice required to produce one unit of husked rice. The difference between domestic demand for and supply of unhusked rice is exported with:

$$E_4 = Y_4 - X_4 \qquad (3.12)$$

where E_4 is net exports of rice.

Using (3.10) – (3.12) the revenue equation for the rice sector can be written as:

$$R = -p_4 Y_4 + q_5 X_5 - \bar{c} - \tilde{c} X_5 + p_4^* E_4 \qquad (3.13)$$

where $\bar{c}$ represents the fixed costs of the rice husking plants, $\tilde{c}$ their per unit variable costs of production and p_4^* is the rice export price. The effect of a change in the procurement price of rice on R is then:

$$p_4 \frac{\partial R}{\partial p_4} = -\frac{(p_4 - p_4^*)}{p_4} \eta_{44}{}^{y} p_4 Y_4 - p_4 Y_4 + \frac{(q_5 - \tilde{c}_1 - \alpha p_4^*)}{q_5} \varepsilon_{55} q_5 X_5 + q_5 X_5 \qquad (3.14)$$

where $(\tilde{c} + \alpha p_4^*)$ is the marginal cost of producing husked rice and p_4^* is the world price of unhusked rice.

The effect on R of a change in any other price p_i can similarly be written as:

$$p_i \frac{\partial R}{\partial p_i} = -\frac{(p_4 - p_4^*)}{p_4} \eta_{4i}^y p_4 Y_4 + \frac{(q_5 - c - \alpha p_4^*)}{q_5} \varepsilon_{5i} q_5 X_5 \tag{3.15}$$

So the relevant elasticities for the tax analysis are the supply elasticities (own and cross) for rice and rice demand elasticities.

The direct affect on welfare of a change in p_4 is:

$$s_i^h = p_4 y_4^h - q_5 X_5^h$$

where we interpret the surplus as the difference between the value of rice production (zero for non-producers) minus the value of rice consumption. Notice that we have not distinguished between basmati and coarse varieties of rice due to lack of data.

3. *Sugarcane and Refined Sugar*

In the sugar industry we assume that the government sets the procurement price of cane, p_6. Given this price farmers decide on the level of their marketed surplus, G_6, all of which is sold to the government. The government then sets both the market and ration prices for sugar as well as the sugar ration quota for various households. We assume that this quota is inflexible and households either take up the complete quota or none at all. The decision to take up the ration is assumed unaffected by price changes. The market price of sugar is set at q_9 and the ration price at q_9. At these prices consumers decide on their consumption of refined sugar so that:

$$X_9 = X_9^o + \bar{X}_9 \tag{3.16}$$

where X_9 is total demand for sugar, X_9^o demand for open-market sugar and $\bar{X}_9$ demand for ration sugar. Domestic production of sugar is a function of the amount of cane procured by the government and is given by the relationship:

$$Y_9 = \alpha G_6 \tag{3.17}$$

where Y_9 is domestic production of sugar and α is the amount of sugar produced from one unit of cane or the 'recovery percentage' (the inverse of the physical input-output coefficient). The excess of demand over domestic production is met through imports of sugar:

$$M_9 = X_9 - Y_9 = X_9 - \alpha G_6 \tag{3.18}$$

where M_9 represents imports of refined sugar.

The revenue from the sugar industry is given by:

$$R = -p_6 G_6 + q_9 X_9^{o} + \bar{q}_9 \bar{X}_9 - \bar{c} - \tilde{c} X_9 - p_9^{*} M_9 \qquad (3.19)$$

where $\bar{c}$ is the fixed cost of the sugar refining industry, $\tilde{c}$ unit variable costs and p_9 the cost of importing sugar. The effect on R changing the procurement price of cane is:

$$p_6 \frac{\partial R}{\partial p_6} = \frac{\alpha \Phi (p_9^{*} - \tilde{c} - \bar{\alpha} p_6)}{q_9} \varepsilon_{66}^{G} p_6 G_6 - p_6 G_6 \qquad (3.20)$$

where $\bar{\alpha}$ is the inverse of α (or physical input-output coefficient) amount of cane required to produce one unit of sugar), Φ is the ratio of the market price of sugar to the procurement price of cane, q_9 / p_6, and ε^{G} is the elasticity of government procurement of cane with respect to the procurement price. The term in brackets is positive if the marginal cost of producing sugar domestically is less than the cost of importing sugar, i.e., if domestic production is privately (socially if valued at shadow prices) profitable.

The effect on R of a change in the market price of sugar is:

$$q_9 \frac{\partial R}{\partial q_9} = \frac{(q_9 - p_9^{*})}{q_9} \varepsilon_{99}^{o} q_9 X_9^{o} + q_9 X_9^{o} \qquad (3.21)$$

and the revenue effect of a change in the ration price is:

$$\bar{q}_9 \frac{\partial R}{\partial \bar{q}_9} = \frac{(q_9 - p_9)}{q_9} \varepsilon_{99}^{o} q_9 X_9^{o} + \bar{q}_9 \bar{X}_9 \qquad (3.22)$$

The effect on R of a change in any other price, p_i, is:

$$p_i \frac{\partial R}{\partial p_i} = \frac{(q_9 - p_9^{*})}{q_9} \varepsilon_9^{o} i\, q_9 X_9^{o} + \frac{\alpha \Phi (p_9^{*} - c - \bar{\alpha} p_6)}{q_9} \varepsilon_{6i}^{G} i\, p_6 G_6 \qquad (3.23)$$

with all variables as defined earlier. From (3.20) – (3.22) we see that the elasticities of government procurement and of open-market demand for sugar are the relevant elasticities when analysing price reforms.

Data from the Agricultural Statistics of Pakistan [Government of Pakistan (1977) and (1985)] indicate that around 30 per cent of total sugarcane output was purchased by the sugar-refining industry. On the other hand, Government of Pakistan (1979) suggests that on an average farmers sold 80 per cent of cane production. It is most likely that the 50 per cent difference was sales to the gur industry. In this paper we treat this element of supply as on-farm consumption so that the elasticity of demand for cane (taken as that for sugar) is assumed to reflect the decision as to how much cane to withhold for the gur industry. Although this is not satisfactory, a more detailed analysis would need to undertake a more detailed study of the existence of a gur industry side with the sugar refining industry. This is not attempted here.

4. *Cotton*

We assume that all raw cotton is sold to the government, so that the procurement elasticity is simply the supply elasticity for cotton. Since other prices are held constant, the domestic demand for cotton does not change and the change in the domestic supply of cotton is matched by a corresponding change in cotton exports. Since all cross-supply elasticities are assumed equal to zero and since cotton is not a consumption good, the only prices which affect the procurement of cotton are the procurement price of cotton and the price of fertilizer.

5. *Fertilizer*

In Pakistan the government fixes the consumer price of fertilizer. Some fertilizer producers are in the private sector while others are in the public sector. However, since the government guarantees producers a fixed return and subsidizes or taxes (surcharge) any deviations from this return, we can proceed as if the fertilizer sector is totally within the public sector. We assume that domestic producers are producing at full capacity, and that domestic demand for fertilizer exceeds domestic supply with the difference being imported. Any changes in demand brought about by a price reforms will therefore lead to an adjustment in imports. The relevant elasticity is then the elasticity of demand for fertilizer. The demand for fertilizer is a function of crop prices and its own price. The elasticity of demand for fertilizer is taken as 0.5 over all crops. However, for each crop, this elasticity is multiplied by the crop demand for fertilizer as a proportion of total demand.

6. *Other Final Commodities*

The effect on government revenue from other final commodities due to price changes depends on the elasticity of demand for these commodities with respect to the relevant price. The elasticities are presented in Appendix (Table 2). These needs to be adjusted for the limited incidence of certain prices and also for the existence of both producers and consumers for various commodities.

Some price changes do not always affect all consumers. For example, changes in procurement prices only affect farmers, while changes in ration prices only affect those entitled to rations. Therefore, the elasticities used in our analysis take account of the limited incidence of price changes. In calculating the relevant elasticities, because of lack of data at the time of the analysis, we assumed that both compensated cross-price demand elasticities and crop cross-supply elasticities are zero. Compensated demand elasticities are taken from Ahmad and Ludlow (1987) as are marginal budget shares, expenditure elasticities and own-price compensated elasticities. Consumption, output and surplus shares (i.e., as a proportion of total household expenditure) are calculated from the Government of Pakistan (1979). These elasticities are used to calculate the elasticities relevant for our tax analysis and which have been discussed in this section. A detailed breakdown of all elasticities is not presented here for reasons of space, but we presented in Coady (1990). The marginal budget shares, expenditure elasticities and own-price compensated elasticities are presented in Appendix (Table 2). The elasticities analysed in this section which are direct data for our tax analysis are presented in Appendix (Table 3).

IV. Data

In the previous section we examined commodity revenue equations and these highlighted the data requirements for calculating the social cost (indirect effect) of price (tax) reforms, i.e., the effect on shadow revenue. The relevant elasticities were also discussed. In this section we focus on other data requirements for tax reform analysis.

The effect on social welfare of raising one extra unit of shadow revenue by varying R was presented earlier as:

$$\lambda_i = \frac{\Sigma^h \beta^h p_i s_i^h}{p_i G_i + \Sigma_j \tau_j \varepsilon_{ji} p_j G_j} \qquad (4.1)$$

where $G_j = \sum_j s_j^h$ captures the extent of government involvement in the total trade in commodity j, β^h is the social marginal utility of income to households h (the welfare weights), s_i^h is the surplus trade in commodity i by household h, ε_{ji} is the elasticity of G_j with respect to p_i and τ_j is the shadow tax rate. We now discuss each of these in more detail.

1. *Surplus Trade* (s_i^h)

This value is taken as the value of output minus the value of consumption for household h. For commodities such as wheat, rice and sugarcane there is both output and consumption for most households. For cotton consumption is zero. For all other commodities the surplus is simply minus the value of consumption. These values are taken directly from the government of Pakistan (1979).

2. *Government Trade* (G_i)

For most final commodities this is given by the level of total consumption of the commodity, since we assume that all consumption can be taxed. For other commodities allowance must be made for the degree of government intervention in total trade. In the case of wheat, sugarcane and cotton the relevant values are those for government procurement. To calculate these values we multiply the total value of output for each commodity [as given in Government of Pakistan, (1979)] by the percentage procured by the government [see Appendix (Table 1)]. Note also that these values are preceded by a negative sign reflecting the fact that an increase in the procurement price leads to a fall in revenue from that commodity. For rice some extra calculations need to be made. The relevant entry is the value of total consumptions of rice less the value of total output, i.e.,

$$q_5 X_5 - p_4 Y_4$$

Using (3.10) – (3.12) this becomes:

$$p_4 Y_4 [\Phi \alpha^{-1} (1 - r_e) - 1] \tag{4.2}$$

where Φ is the ratio of the consumer price of rice to the procurement price, α the amount of unhusked rice required to produce one unit of husked rice, and r_e is the ratio of government procurement of rice for export to the total production of rice. The value of output is taken from the government of Pakistan (1979) as is Φ, the ratio of q_5 to p_4 (calculated as 1.16). The value of r_e is taken from the Agricultural Statistics of Pakistan [Government of Pakistan, (1977), p.122] and approximately equals 0.35. Notice that if we take $\alpha = 1.67$ (or $\alpha^{-1} = 0.6$) then (4.2) is greater (less) than zero if Φ is greater (less) than 2.57. The first term inside the brackets of (4.2) is used to calculate the value of domestic consumption of rice implied by the value of output.

Notice that when calculating the denominator of (4.1) we derive values for the level of government involvement, using our assumptions rather than the values implied by the Government of Pakistan (1979). The purpose of the denominator is to calculate the change in price is necessary to raise an extra unit of revenue and this will depend on the present extent of government involvement in the market as well as on the elasticities. The numerator then calculates the direct effect of the price change. It is therefore important that the values used in the denominator reflect the actual extent of government involvement in each market. The data provided in household surveys may not be altogether consistent with the actual level of government involvement, or may be given in a form unsuitable for calculating the relevant values directly and comparing these with the actual situation. It is for these reasons that we impose certain of our assumptions about the workings of markets on the survey data. When calculating the λs we use the multiplicative decomposition given earlier, and use the survey data when deriving distributional characteristics but the assumed extent of government involvement when deriving tax elasticities.

3. *Accounting Ratios (ARs) and Prices*

Accounting ratios are defined as the ratio of the shadow price of a commodity to its market price. These ARs are taken from two sources – Ahmad, Coady and Stern (1988) and Cheong and D'Silva (1984) – and are presented in Table 1. For our purposes we can think of the world price (appropriately adjusted to reflect the domestic equivalent) as the shadow price. From Table 1 we see that from 1974 to 1983 domestic prices of wheat and rice were kept below world prices so that farmers were taxed throughout the period. However, the level of taxes has fallen over the period as domestic procurement prices were raised by the government, especially in the case of wheat. With cotton that ratio has been more erratic due more to a fluctuating world price rather than changes in government pricing policy. The tax (subsidy) rate has been much lower than those on wheat and rice.

The AR for wheat is taken from Cheong and D'Silva (CDS) as the average over the three year period 1975-77. The AR for atta is taken from Ahmad, Coady and Stern (ACS). The ratio of the AR for atta (its marginal social cost of production) to the AR for wheat in ACS is applied to the AR for wheat from CDS to derive the AR for atta. The average regional prices were applied to quantities consumed to get the value of consumption.

The AR for rice (unhusked) is taken from CDS (average over 1975-77) and that for rice (husked) taken from ACS applying the same procedure as that for wheat. Although we have not distinguished between basmati and coarse grain, a crude division of rice using the MNS with Rs. 70 per maund as a cut-off point (if price was below Rs. 70 price was taken as coarse, if above, it was taken as basmati) suggests that the ratio of consumer to producer price is about 1.16 for both varieties. These values are derived using quantities sold and purchased and the value of these sales/ purchases over households. A comparison of the average district price of rice (given separately in the sample for basmati and coarse rice) with the above (derived) sales price suggests a much higher ratio for both, of roughly 1.3 for basmati and 1.98 for coarse. In this paper we work with the ratio 1.16.

For sugarcane the relevant entry for the shadow tax is the difference between the shadow price of refined sugar minus the marginal social cost of the domestic production of sugar, adjusted to allow for the 'recovery' of refined sugar from cane – see (3.20). The recovery percentage is taken as 10 percent and the ratio of the market price of sugar to the procurement price of cane as 54.1. The prices for cane derived from the Government of Pakistan (1979) using amounts sold and the value of sales are very unreliable. However, data from the Agricultural Statistics of

TABLE 1

Ratios of Domestic to International Prices, FY74-FY82[a]

(per cent)

Fiscal year	Cotton[b]	RICE[e] Basmati	Irri-6	Wheat[c]	Sugar[d]
1974	62	46	35	34	-
1975	90	41	46	58	-
1976	102	61	77	56	-
1977	82	99	97	72	-
1978	117	93	75	85	-
1979	130	52	75	73	-
1980	97	56	74	61	-
1981	87	65	70	64	-
1982	113	66	94	75 (102)	163
1983	95	68	97	74 (98)	206

[a]For rice and cotton, domestic prices are compared with equivalent export parity prices. For wheat and sugar, comparisons are with import parity prices; export parity comparisons for FY 82 and FY 83 are shown in parentheses. International prices for rice, cotton and sugar are the averages of third and fourth quarter prices in the fiscal year. Those for wheat are the averages of the fourth quarter price in the fiscal year and the first quarter price in the following fiscal year.

[b]Based on wholesale price of lint, Karachi market.

[c]Based on procurement prices.

[d]Based on rationshop sales price.

[e]International prices based on World Bank commodities price projections.

Source: Reproduced from Cheong and D'Silva (1984), Prices, Terms of Trade and the Role of Government in Pakistan's Agriculture, WBSWP No.643, pg.30.

Pakistan [Government of Pakistan, (1985), p.183] indicate a support price just above Rs.5.6 per maund in the Punjab and Sindh and just below this for the NWFP. We apply this price to cane output to get the value of output. Consumption of sugar is divided into total purchases from the market, the difference being ration consumption. The average sample market price is Rs.303 per maund. However, this varies widely over provinces with prices much higher in NWFP than elsewhere (over one and a half times as high). The average sample ration price was about Rs.170 per maund with little difference over provinces. The average regional prices are used to calculate the relevant consumption values.

The AR for cotton is taken from CDS. The cotton output is valued at Rs. 100 per maund, the approximate average sample price (derived using value of sales and amount sold). The AR for fertilizer is taken from Chemonics (1985). The Government of Pakistan (1979) does not provide data on the use of fertilizer, so we impose certain values on the sample. We assume that the per acre level of fertilizer applied is as in Table 2 but this is obviously a crude method. The consumer price fixed by the Government is taken as Rs. 3 per Kg.

The ARs for other final commodities are taken from the ACS. Table 3 presents the ARs and shadow tax rates for all commodities. The elasticities are shown in Appendix (Table 4).

4. *Welfare Weights (β^h)*

To evaluate tax reforms we need to select welfare weights. These weights are attached to households and reflect our views as to how the relative social value of income varies over households. It is usual to make this rate a decreasing function of income (income taken as an indicator of the present level of well-being so that we

TABLE 2

Fertilizer Use Over Farm Size and Irrigation

Farm Size (acres)	Irrigated (kg/acre)	Non-Irrigated (kg/acre)
0 - 25	35	20
Over 25	45	35

view a unit increase in income as more valuable, if it accrues to lower-income families rather than higher-income households). The relative weights chosen therefore reflect our attitude towards the present distribution of income and our aversion to inequality. A useful way of representing our views of the prevailing distribution of income is:

$$\beta^h = (I^k/I^h)^e \tag{4.3}$$

where β^h is the welfare weight for household h (the marginal social value of income to h), I^h the income level of household h and I^k that for the k'th household. The term e reflects the extent of our aversion to inequality. The higher e the greater our dislike of an unequal distribution of income and, consequently, the greater the weight (in relative terms) attached to income accruing to lower-income households. For

TABLE 3

Accounting Ratios and Shadow Taxes

	Sector	Accounting Ratios	Shadow Taxes
1.	Wheat	1.61	0.61
2.	Atta (M)	1.53	-0.53
3.	Rice (U)	1.42	0.42
4.	Rice (H)	1.35	-0.35
5.	Sugarcane	0.75	0.00
6.	Cotton	1.10	0.10
7.	Fertilizer	1.33	-0.33
8.	Sugar (M)	0.64	0.36
10.	Pulses	0.89	0.11
11.	Maize	0.74	0.26
12.	Meat	0.76	0.24
13.	Milk	0.76	0.24
14.	Vegetables, etc	0.75	0.25
15.	Edible Oils	0.96	0.04
16.	Tea	0.95	0.05
17.	Housing	0.83	0.17
18.	Clothing	1.01	-0.01
19.	Other Food	0.74	0.26
20.	Non-Food	0.76	0.24

example, if household k has income half that of h then with e = 0 a unit of income accruing to k is seen to be just as valuable as a unit to h, with e = 1 it is seen to be twice as valuable, with e = 2 four times as valuable and with e = 5 it is 32 times as valuable. This approach has been used elsewhere [see, for example, Ahmad and Stern, (1984) and (1990)].

In this paper we normalize the welfare weights by setting the weight for the lowest-income (per capita) household equal to unity. Households are classified into income groups according to their per capita income level (see Table 4a). Using average group expenditures we calculate group welfare weights applying (4.3). The welfare weight of any household is the welfare weight of the income group to which it belongs. We check the sensitivity of our results to different values of e, choosing e = 0, 0.5, 1.0, 2.0 and 5.0.

An analysis of the Government of Pakistan (1979) makes it quite clear that prices vary widely over regions for many commodities. Therefore, we cannot be very confident that the relative levels of household expenditures reflect relative levels of welfare. It is more realistic to think of household welfare as a function of quantities consumed, so that two households with the same levels of consumption of each commodity but facing different prices should be seen as having the same level of welfare, even though their total expenditures may differ. To correct for this discrepancy we apply single prices to certain commodities rather than regional prices as above and calculate a new set of welfare weights using the implied total expenditures. This procedure can only be carried out on certain commodities such as wheat and atta which are relatively homogenous. Other more aggregate commodity groups prevent the application of such procedures since commodities within these groups are not homogenous and the composition of within group consumption may vary widely over households.

5. *Distributional Characteristic (D_i)*

A multiplicative decomposition of λ_i as the product of the distributional characteristic of the commodity, D_i, and a shadow tax elasticity term:

$$\frac{1}{\lambda_i} = \frac{1}{D_i}\left\{1 + \frac{1}{x_i}\Sigma_j\,(q_j - v_j)\,\frac{\partial x_j}{\partial p_i}\right\}$$

where $D_i = [\Sigma^h \beta^h x_i^h / x^i]$. If welfare weights are a decreasing function of income then commodities which account for a relatively large proportion of the budgets of higher income groups will have a relatively lower distributional characteristic implying a lower social cost of raising revenue by taxing these commodities, making them more attractive candidates for taxation. Also, as our aversion to inequality (e) increases there is a greater proportionate decrease in the distributional characteristic of such

TABLE 4a

Per Capita Income Groups

Income Group	No. of Households	% of Total	Cuml. %	Average Expenditure	B
1. Less than 700	54	5.5	5.5	572.98	1.00
2. 700 to 900	76	7.7	13.2	816.50	0.70
3. 900 to 1100	88	8.9	22.1	1004.48	0.57
4. 1100 to 1400	156	15.8	37.9	1243.99	0.46
5. 1400 to 2000	250	25.3	63.2	1688.18	0.34
6. 2000 to 2600	146	14.8	78.0	2273.76	0.25
7. 2600 to 3200	87	8.8	86.8	2865.61	0.20
8. 3200 to 4000	60	6.1	92.9	3603.73	0.16
9. 4000 to 5200	40	4.1	97.0	4529.49	0.13
10. Over 5200	30	3.0	100.0	8201.34	0.07

TABLE 4b

Per Capita Income Groups
(Corrected Prices)

Income Group	No. of Households	% of Total	Cuml. %	Average Expenditure	B
1. Less than 700	51	5.2	5.2	572.33	1.00
2. 700 to 900	65	6.6	11.8	807.21	0.71
3. 900 to 1100	94	9.5	21.3	1000.98	0.57
4. 1100 to 1400	152	15.4	36.7	1242.72	0.46
5. 1400 to 2000	256	25.9	62.6	1685.83	0.34
6. 2000 to 2600	148	15.0	77.6	2273.07	0.25
7. 2600 to 3200	86	8.7	86.3	2861.68	0.20
8. 3200 to 4000	66	6.7	93.0	3605.26	0.16
9. 4000 to 5200	39	4.0	97.0	4558.09	0.12
10. Over 5200	30	3.0	100.0	8277.55	0.07

commodities, making them still more attractive as sources of additional revenue. Such guidelines, however, are less straight forward when producer and shadow prices are not proportional. In this case the tax elasticity involves shadow prices which may be dependent on welfare weights.

Let us divide commodities into those traded and non-traded at the margin. The shadow price of a non-traded commodity is taken as the marginal social cost of production. As e increases the welfare weight of lower income households increases in relative terms, so that the shadow cost of employing such household labour decreases. Therefore, the shadow price of low-income labour-intensive commodities falls relative to other shadow prices. The social profitability of industries which use this commodity increases, thus suggesting investments in industries which use this input intensively. In our tax reform analysis this is reflected in a higher (lower) shadow tax (subsidy) on this commodity so that reforms which switch demand towards this commodity become more desirable as e increases. Therefore, commodities which have a relatively high distributional characteristic and whose production involves use of a large amount of low-income labour will exhibit a relatively greater increase in λ, the marginal social cost of raising revenue through taxing this commodity. This suggests reforms which increases demand for those commodities and investment in industries which use these commodities intensively.

The shadow price of traded commodities does not vary with e (ignoring the social cost of domestic trade and transport margins which, in any case, usually have little effect – see ACS), reflecting our definition of traded commodities as those for which a change in net demands leads to a change in net foreign trade with no adjustment in domestic production. However, as e increases the social profitability of domestic production of traded commodities increases, the extent of the increase depending on the extent to which traded industries use low-income labour. This suggests investments in such industries leading to a fall in imports or an expansion of exports. So a change in e affects the optimal level of domestic production of traded commodities. From the point of view of tax reform, however, an increases in e suggests a switch in taxation from non-traded to traded commodities, the desirability of such a switch being reduced if traded commodities figure prominently in the budgets of low-income households. In this paper we work with a fixed shadow tax vector so that the effect of a change in e on shadow prices is not captured.

V. Results

We rewrite the equation for λ_i, the marginal social cost of raising one extra unit of (shadow) revenue by taxing good i, as:

$$\lambda_i = D_i / E_i$$

where D_i is the distributional characteristic for i and E_i the elasticity of revenue with respect to the price (tax) of i. This decomposition enables us to set out some general rules of thumb when selecting commodities as candidates for taxation. The higher the distributional characteristic of a commodity the higher the cost of using it as a source of revenue. The distributional characteristic of a commodity is higher the more it is consumed by poorer households. In the case of agricultural output, the distributional characteristic will be lower, the more it is produced by richer households. Therefore, as e (our inequality aversion parameter) increases commodities for which poorer households are net consumers and richer households net producers become major candidates for sources of revenue. Anticipating our results, the case of wheat is the best example of such a commodity for Pakistan.

The more elastic is revenue to a commodity tax, the lower the social cost of using it as a source of revenue. The revenue elasticity reflects the elasticities of demand and supply and the prevailing tax rates. The lower the own-price elasticity of a commodity, the higher the revenue elasticity thus making it an attractive source of revenue. Also, taxation of a commodity becomes more attractive, the more an increase in its tax switches demand towards commodities with relative high tax rates. Again anticipating our results the cases of wheat and fertilizer are the best examples of such commodities.

We focus first on the distributional characteristic, D, over commodities. Table 5 presents the distributional characteristics and their rankings for various values of e. From the results we see that the D for wheat becomes negative at very low values for e. This reflects the fact that poorer households are net consumers of wheat and richer households net producers. An increase in the tax on wheat corresponds to a decrease units procurement price and also in the market price. This makes wheat the most attractive source of revenue from a distributional point of view. Notice that a tax on wheat is simultaneously a subsidy to consumers. Other commodities with low distributional characteristics are rice (where D becomes negative for e = 5), meat, other foods and other non-foods. Commodities exhibiting high D's are atta (market and rationed), sugar (rationed), maize and pulses. The high D's for rationed commodities are, of course, expected since rationing systems are designed to channel commodities to lower income households. Sugarcane and fertilizer become more attractive sources of revenue as e increases with cotton becoming a less attractive candidate.

We now turn to the revenue elasticities. Note that when e = 0 (i.e., D = 1) the λs are simply the inverse of the revenue elasticities. Table 6 presents the λs over various values of e. Focusing on values for e = 0 we see that the commodities which appear least attractive as sources of taxation from the efficiency (as reflected in the tax elasticities) point of view are wheat, edible oils, fertilizer, rice and sugar (market). This in stark contrast to the above where taxation of wheat and rice is desirable using distributional considerations. Commodities such as atta (market and ration), ration

TABLE 5a

Sensitivity of Distributional Characteristics over e

e =	0	0.5	1.0	2.0	5.0
1. Wheat	1	-0.1263	-0.4104	-0.3969	-0.1743
2. Atta M)	1	0.5805	0.3589	0.1661	0.0559
3. Atta (R	1	0.5982	0.3886	0.2010	0.0822
4. Rice	1	0.4996	0.2581	0.0703	-0.0056
5. Sugarcane	1	0.5239	0.2933	0.1087	0.0131
6. Cotton.	1	0.5331	0.3176	0.1504	0.0643
7. Fertilizer	1	0.5205	0.2915	0.1113	0.0229
8. Sugar (M)	1	0.5286	0.3047	0.1262	0.0292
9. Sugar (R)	1	0.5822	0.3689	0.1859	0.0780
10. Pulses	1	0.5528	0.3317	0.1483	0.0462
11. Maize	1	0.5579	0.3388	0.1640	0.0821
12. Meat	1	0.5003	0.2731	0.1024	0.0209
13. Milk	1	0.5166	0.2884	0.1109	0.0243
14. Vegetables, etc	1	0.5177	0.2913	0.1161	0.0300
15. Edible Oils	1	0.5168	0.2898	0.1134	0.0258
16. Tea	1	0.5338	0.3100	0.1303	0.0340
17. Housing	1	0.5135	0.2888	0.1176	0.0337
18. Clothing	1	0.5240	0.2964	0.1178	0.0301
19. Other Food	1	0.4960	0.2646	0.0926	0.0154
20. Non-Food	1	0.4919	0.2631	0.0952	0.0205

TABLE 5b

Sensitivity of Ranks of D's over e

e =	0	0.5	1.0	2.0	5.0
1. Wheat	1	1	1	1	1
2. Atta M)	1	18	18	18	16
3. Atta (R)	1	20	20	20	20
4. Rice	1	4	2	2	2
5. Sugarcane	1	11	11	6	3
6. Cotton	1	14	15	16	17
7. Fertilizer	1	10	10	8	7
8. Sugar (M)	1	13	13	13	10
9. Sugar (R)	1	19	19	19	18
10. Pulses	1	16	16	15	15
11. Maize	1	17	17	17	19
12. Meat	1	5	5	5	6
13. Milk	1	7	6	7	8
14. Vegetables, etc	1	9	9	10	11
15. Edible Oils	1	8	8	9	9
16. Tea	1	15	14	14	14
17. Housing	1	6	7	11	13
18. Clothing	1	12	12	12	12
19. Other Food	1	3	4	3	4
20. Non-Food	1	2	3	4	5

TABLE 6a

Sensitivity of Lambdas over e

e =	0	0.5	1.0	2.0	5.0
1. Wheat	3.5286	-0.4456	-1.4481	-1.4004	-0.6149
2. Atta M)	1.0075	0.5848	0.3616	0.1673	0.0563
3. Atta (R)	1.0503	0.6283	0.4081	0.2111	0.0862
4. Rice	1.5829	0.7908	0.4085	0.1113	-0.0089
5. Sugarcane	1.3350	0.6994	0.3915	0.1452	0.0175
6. Cotton	1.3445	0.7167	0.4271	0.2022	0.0865
7. Fertilizer	1.8609	0.9686	0.5424	0.2071	0.0427
8. Sugar (M)	1.3543	0.7159	0.4126	0.1709	0.0396
9. Sugar (R)	1.1448	0.665	0.4223	0.2128	0.0893
10. Pulses	1.3582	0.7508	0.4505	0.2014	0.0628
11. Maize	1.2645	0.7055	0.4285	0.2074	0.1038
12. Meat	1.3210	0.6608	0.3607	0.1353	0.0276
13. Milk	1.3461	0.6954	0.3882	0.1493	0.0327
14. Vegetables, etc	1.3183	0.6824	0.3841	0.1530	0.0395
15. Edible Oils	2.8237	1.4592	0.8182	0.3203	0.0728
16. Tea	1.1494	0.6136	0.3563	0.1498	0.0391
17. Housing	1.2158	0.6243	0.3511	0.1430	0.0410
18. Clothing	1.0438	0.5470	0.3094	0.1230	0.0314
19. Other Food	1.2372	0.6137	0.3274	0.1146	0.0191
20. Non-Food	1.3058	0.6423	0.3435	0.1243	0.0268

TABLE 6b

Sensitivity of Ranks of Lambda's over e

e=	0	0.5	1.0	2.0	5.0
1. Wheat	20	1	1	1	1
2. Atta M)	1	3	8	12	14
3. Atta (R)	3	7	12	18	17
4. Rice	17	18	13	2	2
5. Sugarcane	12	13	11	8	3
6. Cotton	13	16	16	15	18
7. Fertilizer	18	19	19	16	13
8. Sugar (M)	15	15	14	13	11
9. Sugar (R)	4	10	15	19	19
10. Pulses	16	17	18	14	15
11. Maize	8	14	17	17	20
12. Meat	11	9	7	6	6
13. Milk	14	12	10	9	8
14. Vegetables, etc	10	11	9	11	10
15. Edible Oils	19	20	20	20	16
16. Tea	5	4	6	10	9
17. Housing	6	6	5	7	12
18. Clothing	2	2	2	4	7
19. Other Food	7	5	3	3	4
20. Non-Food	9	8	4	5	5

sugar, clothing and tea appear attractive as candidates for taxation using efficiency criteria but unattractive using distributional criteria. The attractiveness of rationed commodities using efficiency criteria arises from the similarity to lump-sum taxation which carries no deadweight loss. The general conflict between efficiency and distribution when selecting candidates for taxation is captured by the low negative coefficients in Table 7.

The interaction of efficiency and distributional considerations is captured by our λs (see Table 6). The correlations between the rankings of the λs as e increases are presented in Table 7. We also see that the correlation between the λs and D's increases as our concern for distribution increases. The correlation coefficients increases from 0.08 when e = 0.5 to 0.88 when e = 5. So the rankings of the λ_i are dominated by the distributional characteristics as our aversion to inequality increases. We should see this as an appealing feature of our results. In empirical analysis we are usually much more confident about our information on the distribution of consumption than our estimates of tax elasticities.

TABLE 7a

Correlation of Ranks of D's over e

e=	0	0.5	1.0	2.0	5.0
0.0	1.000				
0.5	–	1.000			
1.0	–	0.992	1.000		
2.0	–	0.947	0.961	1.000	
5.0	–	0.871	0.890	0.971	1.000
Lambda (e=0)		-0.471	-0.498	-0.543	-0.562

TABLE 7b

Correlation of Ranks of Lambda's over e

e=	0	0.5	1.0	2.0	5.0
0.0	1.000				
0.5	0.638	1.000			
1.0	0.397	0.886	1.000		
2.0	-0.041	0.498	0.807	1.000	
5.0	-0.233	0.329	0.672	0.913	1.000
Lambda: D	–	0.080	0.457	0.749	0.884

An important debate in developing countries centers around the desirability or otherwise of subsidies to agricultural inputs such as chemical fertilizers. Once we introduce into our analysis the inability of government to tax all consumption and production separately in the agricultural sector, and treat all farmers as consumers then we leave open the question of whether fertilizers should be taxed or subsidized. Our results indicate that from an efficiency point of view taxation of fertilizers is undesirable. One of the main reasons for this is the fact that an increase in the price of fertilizer leads to a fall in government procurement of commodities which are heavily taxed with a consequent fall in revenue. For example, an increase in the relative price of fertilizer decreases government procurement of wheat leading to a larger requirement for more costly imports. Notice that with high taxes on agriculture output fertilizer subsidies become a useful way of counteracting these distortions. The unattractiveness of fertilizer as a source of additional revenue does not disappear even at high levels of inequality aversion. It is important to remember, however, the crude method employed in selecting levels of fertilizer use per acre over farm size. It may be that some low-income unirrigated farms do not apply any fertilizer or apply it at levels much lower than those imposed on the sample. This would make a decrease in the fertilizer subsidy a more attractive proposition as our concern for income distribution increases.

The sensitivity of our results to the elasticity of demand for fertilizer (F) is also examined. To maintain consistency the cross-price elasticities with agricultural supply and the own supply elasticities of individual crops are also appropriately adjusted. Given the crude way in which these elasticities are adjusted the analysis should be viewed as instructive as to the forces driving the results and the results not taken as precise estimates. Table 8 presents the results over various assumptions about the elasticity of fertilizer demand. The relevant elasticities for the tax analysis are presented in Appendix (Table 4). Let us concentrate first on fertilizer. The effect of higher elasticity for fertilizer on its λ can be separated into two elements. Firstly, a higher elasticity means a larger shift away from commodity with a high subsidy so that fertilizer looks more attractive as a source of revenue, i.e., lower λ. Another way of putting this is that with a larger elasticity the present subsidy has a higher deadweight loss associated with it making a reduction in the subsidy more desirable. Secondly, a higher elasticity implies that an increase in the price of fertilizer leads to a greater fall in agricultural output which is highly taxed making an increase in the fertilizer price less attractive i.e., a higher λ. So we have two factors pulling the λ in opposite directions. Our results show that it is the latter (the indirect effect on revenue) which dominates so that an increase in the price of fertilizer is less attractive as a source of revenue. The same applies to a lower elasticity of fertilizer with directions reversed.

The results therefore emphasize that any discussion of the taxation of such commodities as agricultural outputs and inputs in a partial equilibrium framework can be severely misleading, especially when large price distortions already exists. This may also be magnified by our focus, in certain cases, on surplus rather than supply or demand elasticities alone. Thus tax reforms analysis should be set in a general equilibrium framework. Contrast this with other final commodities, such as categories 18–20, where cross-price elasticities are usually small (at least for broad categories of goods and given present estimating techniques) and therefore ignoring them as we do in partial equilibrium analysis may not lead to misleading conclusions. However, notice that although the marginal social cost of raising an extra unit of revenue through increasing the price of fertilizer changes substantially its ranking is unaffected. This aspect of the results is quite welcome since we may be very uncomfortable setting a precise value for the fertilizer elasticity but more willing to accept that it lies within a range as large as 0.2–0.8.

A higher elasticity for fertilizer also implies higher crop supply elasticities. In the case of crops we again have two forces pulling the cost of using them as sources of revenue in opposite directions. With a higher supply elasticity, a fall in crop prices leads to a larger decrease in the supply of these highly taxed commodities (and consequently a smaller increase in revenue) so they become less attractive as a source of revenue, i.e., a higher λ. However, there is also a greater shift away from subsidized fertilizer (with a positive effect on revenue) making crop taxation more attractive i.e., a lower λ. For wheat, rice and cotton it is the former with dominates our results reflecting the relatively high tax rates on agricultural production. However, the striking feature of the results is that the ranking of these crops (and of fertilizer) is very insensitive to the elasticity of fertilizer. In the case of sugarcane it is the indirect effect on revenue which dominates. This arises because we have chosen a marginal social cost of production for refined sugar such that the implied tax rate is zero. Consequently, the ranking of sugarcane fall as the elasticity of

TABLE 8

Lambdas and Ranks for various Fertilizer Elasticities (e=0)

Sector	Fertilizer Elasticity (F) 0.2	0.5	0.8
1. Wheat	2.2047 (19)	3.5286 (20)	3.7290 (20)
4. Rice	1.4400 (17)	1.5829 (17)	1.7571 (17)
5. Sugarcane	1.4035 (16)	1.3350 (12)	1.2728 (09)
6. Cotton	1.3264 (12)	1.3445 (13)	1.3631 (16)
7. Fertilizer	1.5446 (18)	1.8609 (18)	2.3403 (18)

fertilizer increases, from 16 when the fertilizer elasticity is 0.2 to 9 when it is 0.8. If we had taken a lower marginal social cost of production for sugar, implying a tax on the industry (i.e., production of refined sugar domestically is socially profitable) the ranking would not have been as sensitive.

The case of sugarcane highlights the impact of industry profitability on pricing policy. The desirability or otherwise of taxation of cane producers is determined mainly by the social profitability of domestically produced refined sugar. The higher (lower) the social profitability of refined sugar production the less (more) attractive is cane as a source of revenue. Figures 1–3 presents diagrams showing the movement of λ for cane as we increase the social cost of sugar production (i.e., as we decrease the social profitability of sugar production). The sensitivity of the λ will also depend on the elasticity of government procurement of cane with respect to its procurement price. Three values for this elasticity are used: 1, 2 and 3.61. The largest value is

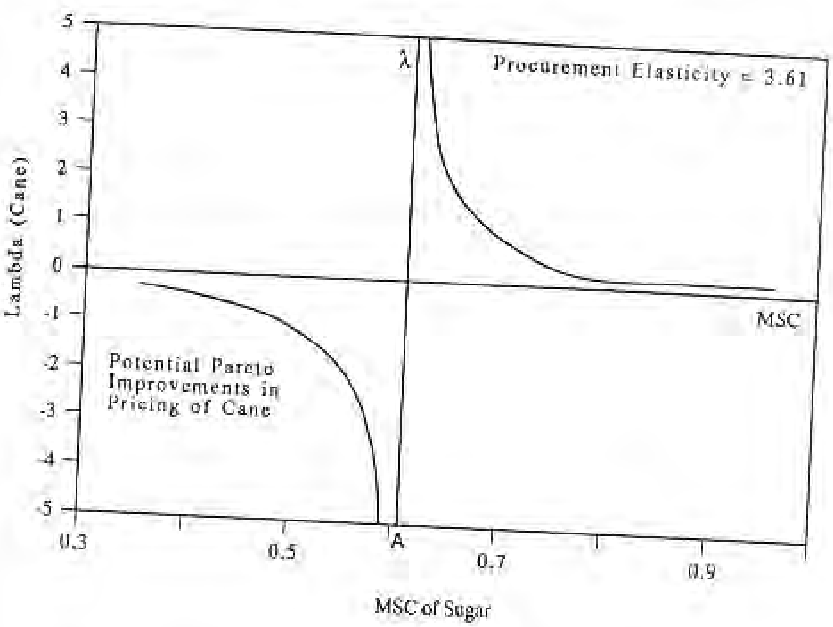

FIGURE 1
Lambda for Cane and MSC of Sugar

Notes :

λ = Marginal social cost of raising one extra unit of shadow revenue by changing the procurement price of cane.

MSC = Marginal social cost of sugar (refined) production. The value on the x-axis is strictly an accounting ratio, i.e., marginal social cost of production divided by actual cost. As the MSC increases the social profitability of domestic sugar production declines.

A = 0.60 approx.

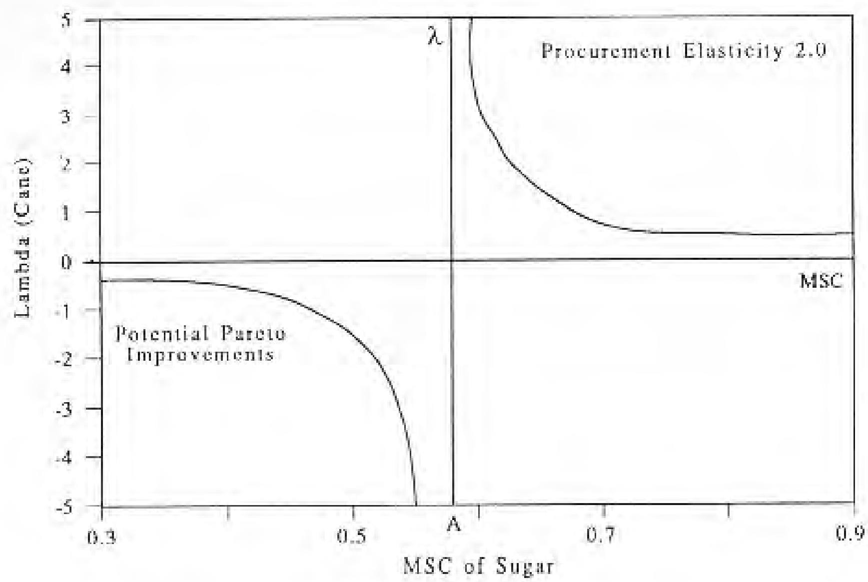

FIGURE 2
Lambda for Cane and MSC of Sugar

A = 0.57 approx.

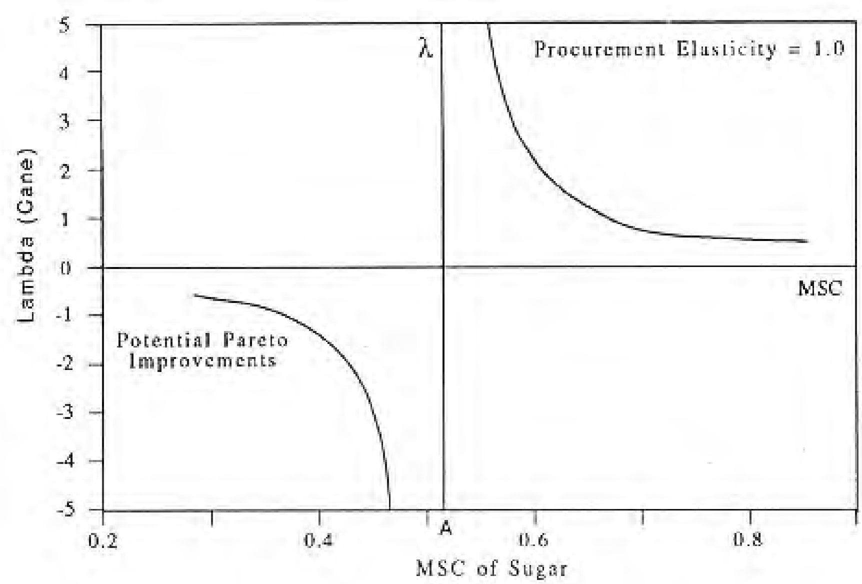

FIGURE 3
Lambda for Cane and MSC of Sugar

A = 0.50 approx.

probably more representative of the situation as in 1976, so we focus mainly on Figure 1. The top right-hand quadrant shows how λ declines as the marginal social cost (MSC) increases (for MSC > 0.6). The line MSC = 0.6 is an asymptote so that as MSC approaches 0.6 from above, λ approaches plus infinity. For MSC < 0.6 there exists a potential pareto improvement as regards the pricing policy of cane – λ becomes negative. For these values an increase in the procurement price would lead to a net increase in revenue due to the increased profits from sugar production (which swamps the fall in revenue from increased payments to farmers) and cane producers would also be made better off. However, it is widely thought that sugar production in Pakistan is socially unprofitable because of the low recovery rate of sugar from cane and other inefficiencies. Domestic production of sugar is privately profitable only because of the high price facing consumers in the domestic market. Appendix (Table 13) presents some of the numbers behind Figures 1–3 with the ranking of λ in brackets. From these we see that at a high elasticity of procurement, the ranking is very sensitive and cane quickly becomes an attractive source of revenue as MSC increases.

The adjustment of the wheat procurement elasticity to reflect a higher elasticity for fertilizer also resulted in a potential pareto improvement in the pricing of wheat purchases by the government, i.e., the tax was greater than its revenue maximizing level. However, in the results presented above we selected a lower elasticity (1.7 rather than the calculated 2.6 at a fertilizer elasticity of 0.8). The possibility of a pareto improvement appears for an elasticity somewhere between 2.1 and 2.2. So we can take it that tax on wheat is very near its revenue maximizing level, and is therefore an unattractive source for additional revenues using efficiency criteria. (Strictly speaking we should not use the term 'pareto improvement' here since for any change in the procurement price of wheat there are both gainers and losers).

Finally, we ran through another set of results using 'corrected' prices. Total expenditure was recalculated using average prices and a new set of welfare weights were derived (see Table 4b). The results were very similar to those presented above, and the correlation coefficients were never lower than 0.98. Changing the β^h only effects the distributional characteristics. Although in general the results changed very little two sectors exhibited significant changes in the ranking. The ranking for 'tea' went up from 5 to 11 when e rose from 0.5 to 5.0, whereas using the old welfare weights it went up from 5 to 9. The change in the ranking of fertilizer is more dramatic going from 18 to 9 as opposed to 18 to 13 with the old welfare weights. The net effect is therefore that fertilizer becomes a more attractive source of revenue when distributional considerations are taken into account, with tea becoming less attractive than before.

VI. Summary and Conclusion

The recommendations made here are aimed at policy-makers aspiring to raise revenue through the indirect tax system and reforming the existing tax rates so that they are more consistent with government objectives. Reforms suggested here are based mainly on the assumption that if household h has an income level twice as large as that of household k, then the government values on extra unit of income to household h as being half as valuable as an extra unit to household k (i.e., e = 1 in our results). One should only accept the recommendations below if one is confident that the data on which they are based (e.g., elasticities) and our modeling of the various sectors in the economy are representative of the actual situation in Pakistan. Also, keep in mind that the analysis is based on the 1976-77 data.

The most attractive way to raise extra revenue appears to be through decreasing the procurement prices of wheat and sugarcane (the latter holding if the domestic production of refined sugar is socially unprofitable), and an increase in the tax rates on such goods as clothing, housing (including fuel and light), meat, tea, other food and other non-food stuffs. Some of these categories (especially the last two) are very broad encompassing a wide variety of individual commodities. It is probable that a more detailed analysis of these commodity groups will suggest the existence of certain commodities which are more attractive than other commodities in the group as sources of revenue. For example, poorer households may consume only certain types of fuel making the taxation of these fuels less acceptable applying distributional considerations. Where an individual commodity has strong substitutes one would wish to apply similar tax rates on this commodity and its substitutes, unless there are major distributional reasons for setting differential rates. Feasibility from an administrative point of view may be an important consideration here.

The attractiveness of raising revenue by reducing the procurement prices of wheat and sugarcane arises mainly from distributional efficiency considerations respectively; poorer households being net consumers of wheat, and the domestic production of refined sugar being socially unprofitable. In raising extra revenue the government should try to avoid taxing edible oils, chemical fertilizers, pulses, maize, cotton and rice (the inclusion of rice being very sensitive to our aversion to income inequality). The presence of fertilizer (a highly subsidized agricultural input) in this group may be surprising to some, and is explained by the relatively high tax rates on agricultural production. This also suggests that if policy makers are committed (say, due to exogenous forces, e.g., pressure from aid donors) to increasing the procurement prices of crops so that they more closely reflect world prices then there should be a concomitant increase in the price of chemical fertilizers (a decrease in the subsidy) facing farmers. This has indeed happened since 1980.

Whereas from a distributional point of view wheat is an attractive source of revenue, from an efficiency perspective a higher procurement price (i.e., a lower tax) is more desirable. In the mid 1970s the government relied to a large extent on subsidized rations for wheat and sugar as a major instrument of income support. However, these subsidized rations provided fixed quantities of low-cost food only to urban consumers. Low procurement prices for wheat helped to keep the rural price of wheat much lower than would otherwise have been the case. Net purchasers of wheat, e.g., small farmers and landless labourers, would be adversely affected by higher wheat prices. Therefore, if one wishes to protect these households an increase in the procurement price should be accompanied by other measures which would limit the adverse impact on these households of such a price increase. One method would be to extend the ration shops to rural areas; the elimination of rationing in the mid 1980s goes against these recommendations and those in Rogers (1988). Other schemes such as those which provide more investment and work in backward rural areas should also be examined. However, if increased crop prices led to increased wages then this conflict between equity and efficiency may be eliminated.

Higher procurement prices should also be accompanied by higher fertilizer prices and this is probably also applicable to other subsidized inputs such as water and electricity. Note that if such inputs are more accessible to larger farmers then there is an additional distributional argument for the removal of these subsidies. We have implicitly assumed that other tax instruments are, for whatever reason, unavailable to the government. If land taxes were to become feasible then these would probably be desirable from both equity and efficiency standpoints.

We have said very little about the desirability of input taxes on the manufacturing side. A general rule of the thumb is that, where possible, we should focus on the taxation of final outputs. If this is not possible then taxation of inputs may be the best proxy for output taxes, and such input taxes should be focused on materials for which there is an inelastic demand. From this viewpoint taxes on cement, for instance, may be a useful way of taxing the services accruing from housing. This is probably very desirable from a distributional stance given the large increase in construction of new houses by wealthy families many of which may be returned migrants from the Middle East. Where monopoly rents exist these should be taxed directly, if possible. Such taxes are more easily administered when monopoly profits accrue to large establishments (e.g., large factories) given the ease with which these can be identified. Output or input taxes should be regarded as second best methods for taxing such rents.

The conclusions drawn from our analysis ought to be seen as instructive rather than precise recommendations. We have focused mainly on the agricultural sector and some manufacturing firms in which agricultural outputs are a major input. Even with these commodities some crude assumptions have been made in order to generate preliminary results. Further work will attempt to be more detailed in this respect. Finally, it may be the case that more industry commodity specific studies are necessary for some of the more aggregate sectors in our analysis.

London School of Economics
University of London

References

Ahmad, E., and N.H. Stern, 1984, Theory of reform and Indian indirect taxes, Journal of Public Economics, 25(3): 259-295.

Ahmad, E., and N. Stern, 1986, Tax reform in Pakistan: Overview and effective taxes for 1975-76, Pakistan Development Review, 25(1): 43-72.

Ahmad, E., and N. Stern, 1990, Tax reform and shadow prices for Pakistan, Oxford Economic Papers, 42(1): 135-159.

Ahmad, E., D. Coady and N. Stern, 1988, A complete set of shadow prices for Pakistan: Illustrations for 1975-76, Pakistan Development Review, 27(1): 7-43.

Ahmad, E., H.M. Leung and N. Stern, 1987, The demand for wheat under non-linear pricing in Pakistan, Journal of Econometrics, 36(1&2): 35-65.

Ahmad, E., and S. Ludlow 1987, Aggregate and regional demand response patterns in Pakistan, Pakistan Development Review, 26(4): 645-655.

Askari, H., and J. Cummings, 1976, Agricultural supply responses: A survey of the econometric evidence, New York: Praeger.

Chemonics, 1985, Pakistan fertilizer policy, Chemonics Consulting Division, Washington, D.C.

Cheong, K., and R. D'Silva, 1984, Prices, terms of trade and the role of government in Pakistan's agriculture, World Bank Staff Working Paper No.643.

Coady, D., 1990, Pricing policies in developing countries, Discussion paper No.115, AERC, University of Karachi, Pakistan.

Diamond, P., and J. Mirrlees, 1971, Optimal taxation and public production: Part 1, Production efficiency; Part 2, Tax rules, American Economic Review, 61(1): 8-27, and 61(2): 261-278.

Dreze, J., and N. Stern, 1987, The theory of cost-benefit analysis, in: A. Auerbach and M. Feldstein, (eds)., Handbook of Public Economics, Vol.II, North-Holland.

Government of Pakistan, Ministry of Agriculture, Agricultural Statistics of Pakistan, 1977 and 1985, Islamabad.

Government of Pakistan, 1979, Planning Commission, Micro-Nutrient Survey 1976/77, Islamabad.

Newbery, D., 1987a, Agricultural taxation: The main issues, in: D. Newbery and N. Stern, (eds)., The theory of taxation for developing countries, Chapter 13.

Newbery, D., 1987b, Identifying desirable directions of agricultural price reform in Korea, in: D. Newbery and N. Stern, (eds)., The theory of taxation for developing countries, Chapter 18.

Newbery, D., and N. Stern, 1987, (eds)., The theory of taxation for developing countries, Oxford University Press and World Bank.

Ramsey, F., 1927, A contribution to the theory of taxation, Economic Journal, 37(1): 47-61.

Rogers, B., 1988, Pakistan's rationing system: Distribution of costs and benefits, in: Per Pinstrup-Andersen, (ed)., Food subsidies in developing countries, John Hopkins University Press.

Stern, N., 1987, Aspects of the general theory of reform, in: D. Newbery and N. Stern, (eds)., The theory of taxation for developing countries, Chapter 3.

APPENDIX

TABLE 1a

Procurement, Marketed Surplus and Elasticities

Sector	% of Output			r=Y/S	S/G
	Procured	Consumed On Farm	Sold to Open Market		
Wheat	0.25	0.60	0.15	2.50	1.60
Rice	0.30	0.20	0.50	–	–
Sugarcane	0.30	0.70	–	3.33	–
Cotton	1.00	–	–	1.00	–

Source: ASP (1985) and MNS (1976).

TABLE 1b

Crop Elasticities and Fertilizer Use

Sector	Elasticity w.r.t.		% of Total Fertilizer Sales
	Own Price	Fertilizer Input	
Wheat	0.15	0.20	0.48
Rice	0.15	0.20	0.12
Sugarcane	0.50	0.20	0.11
Cotton	0.40	0.20	0.16
Fertilizer	-0.50	–	–

Source: Askari and Cummings (1976), PSY (1985), and Coady (1987).

MBS's

TABLE 2[1]

MBS', Expenditure and Own-Price Compensated Elasticities[2]

Sector	Marginal Budget Shares			Expenditure Elasticities			ε^{c3}	
	UR	U	R	UR	U	R	U	R
Wheat.	0.027	0.025	0.054	0.2302	0.2975	0.3498	0.42	0.35
Rice.	0.031	0.026	0.050	0.7472	0.6995	1.0313	0.57	0.49
Pulses.	0.007	0.006	0.012	0.3531	0.3099	0.5343	0.38	0.54
Meat.	0.121	0.132	0.080	1.6614	1.4741	1.5168	0.99	1.22
Milk.	0.127	0.108	0.197	0.8632	0.9141	1.0806	0.64	0.73
Vegetables.	0.118	0.120	0.101	1.2574	1.0924	1.3231	0.38	0.54
Edible Oil.	0.076	0.074	0.083	0.8973	0.9783	0.8777	0.67	0.77
Sugar.	0.025	0.020	0.032	0.6462	0.4411	1.0022	0.67	0.77
Tea.	0.013	0.014	0.009	0.7134	0.8003	0.5116	0.67	0.77
Housing.	0.067	0.077	0.028	1.2890	1.0177	1.2242	0.57	0.58
Clothing.	0.114	0.112	0.120	0.9390	0.9378	0.9770	0.47	0.75
Other Foods.	0.033	0.033	0.047	0.7280	1.0064	0.7717	0.67	0.77
Other non-foods.	0.241	0.254	0.187	1.6289	1.4252	1.6620	0.47	0.75

Notes: [1] Atta is taken as urban 'wheat' and 'other foods' includes 'maize and other cereals'.
[2] MBS' = Marginal Budget Shares.
[3] ε^c = Own Price compensated elasticity.

Source: Ahmad and Ludlow, (1987).

TABLE 3

Elasticities for Tax Reform Analysis (F = 0.5)

COLUMN	ROW									
	1	2	3	4	5	6	7	8	9	10
1.	1.577	0.000	0.000	-0.143	-0.020	-0.065	-0.341	0.009	0.010	0.011
2.	0.000	-0.277	-0.012	-0.005	0.000	0.000	0.000	-0.008	-0.011	-0.004
3.	0.000	0.000	0.000	0.150	0.000	0.000	-0.100	0.000	0.000	0.000
4.	-0.025	-0.017	-0.014	-0.768	0.012	0.021	-0.023	-0.020	-0.015	-0.009
5.	-0.005	0.000	0.000	-0.016	3.610	-0.099	-0.146	0.000	0.000	0.026
6.	0.000	0.000	0.000	0.000	0.000	0.400	-0.100	0.000	0.000	0.000
7.	0.240	0.000	0.000	0.060	0.055	0.080	-0.500	0.000	0.000	0.000
8.	0.003	-0.010	-0.005	0.026	0.000	0.024	-0.022	-0.549	-0.006	-0.008
9.	-0.013	-0.008	-0.002	0.014	0.004	0.012	-0.012	-0.008	-0.011	-0.398
10.	-0.021	0.000	0.000	0.013	0.006	0.017	-0.017	-0.013	-0.015	-0.011

	ROW									
COL.	11	12	13	14	15	16	17	18	19	20
11.	-0.015	-1.123	-0.040	-0.012	-0.029	-0.011	-0.012	-0.043	-0.015	0.041
12.	-0.014	0.010	-0.857	-0.001	-0.019	-0.008	-0.005	-0.027	-0.014	0.034
13.	-0.013	0.012	-0.030	-0.955	-0.023	-0.009	-0.008	-0.033	-0.013	0.034
14.	-0.011	-0.009	-0.022	-0.004	-0.788	-0.007	-0.006	-0.025	-0.011	0.028
15.	-0.007	0.006	-0.018	-0.005	-0.013	-0.569	-0.005	-0.019	-0.007	0.018
16.	-0.009	0.011	-0.031	-0.011	-0.021	-0.007	-0.882	-0.031	-0.009	0.027
17.	-0.012	0.010	-0.023	-0.004	-0.018	-0.007	-0.006	-0.797	-0.018	0.029
18.	0.000	0.009	-0.019	-0.002	-0.017	-0.007	-0.005	-0.023	-0.745	0.028
19.	0.000	0.015	-0.039	-0.010	-0.030	-0.011	-0.012	-0.043	-0.017	-1.161

COLUMN: (1) Wheat, (2) Atta(M), (3) Atta(R), (4) Rice, (5)Sugarcane, (6) Cotton, (7) Fertilizer, (8) Sugar(M), (9) Sugar (R), (10) Pulses, (11) Maize, (12) Meat, (13) Milk, (14) Vegetables, (15) Edible Oil, (16) Tea, (17) Housing, (18) Clothing, (19) Other Food, (20) Non-Food.

ROW: (1) Wheat, (2) Atta(M), (3) Rice(U), (4) Rice(H), (5) Sugarcane, (6) Cotton, (7) Fertilizer, (8) Sugar(M), (9) Pulses, (10) Maize, (11) Meat, (12) Milk, (13) Vegetables, (14) Edible Oil, (15) Tea, (16) Housing, (17) Clothing, (18) Other Food, (19) Non-Food.

TABLE 4

Elasticities for Tax Reform for Fertilizer Elasticity, F:

		ROW 1	2	3	4	5	6	7
F = 0.2	COL.							
	1	1.200	0.000	0.000	-0.143	-0.020	-0.065	-0.101
	2	0.000	-0.277	-0.012	-0.005	0.000	0.000	0.000
	3	0.000	0.000	0.000	0.060	0.000	0.000	-0.040
	4	-0.025	-0.017	-0.014	-0.768	0.012	0.021	-0.023
	5	-0.005	0.000	0.000	-0.016	2.600	-0.099	0.054
	6	0.000	0.000	0.000	0.000	0.000	0.160	-0.040
	7	0.096	0.000	0.000	0.024	0.022	0.032	-0.200
F = 0.8								
	1	1.700	0.000	0.000	-0.143	-0.020	-0.065	-0.581
	2	0.000	-0.277	-0.012	-0.005	0.000	0.000	0.000
	3	0.000	0.000	0.000	0.240	0.000	0.000	-0.160
	4	-0.025	-0.017	-0.014	-0.768	0.012	0.021	-0.023
	5	-0.005	0.000	0.000	-0.016	4.600	-0.099	-0.346
	6	0.000	0.000	0.000	0.000	0.000	0.640	-0.160
	7	0.384	0.000	0.000	0.096	0.088	0.128	-0.800

COLUMN: (1) Wheat, (2) Atta(M), (3) Atta(R), (4) Rice, (5) Sugarcane, (6) Cotton, (7) Fertilizer.
ROW: (1) Wheat, (2) Atta(M), (3) Rice(U), (4) Rice(H), (5) Sugarcane, (6) Cotton, (7) Fertilizer.

TABLE 5

Ranking of Lambda for Cane over Various MSC's for Sugar Production[1]

MSC	Cane Procurement Elasticity		
	3.61	2.0	1.0
0.550	20	20	20
0.565	20	20	29
0.595	20	20	18
0.600	20	19	18
0.605	20	18	18
0.615	20	18	17
0.620	18	18	16
0.625	18	17	16
0.630	17	16	16
0.635	16	16	16
0.640[2]	12	12	12
0.645	6	8	9
0.650	4	6	8
0.655	1	4	6
0.660	1	2	6
0.665	1	1	4
0.680	1	1	2
0.690	1	1	1

Notes: [1]MSC is the marginal social cost of refined sugar production divided by the actual (marginal) cost of production.

[2]The results in the text assume MSC = 0.640.