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PRICE SCISSORS AND THE STRUCTURE OF THE ECONOMY

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ABSTRACT

A basic problem faced by most economies at early stages of their development is how best to raise the investible surplus for rapid accumulation: to what extend should the burden be placed on those in the agricultural sector (by lowering the price of their output relative to the industrial products), and to what extent should the burden be borne by industrial workers. This question was central to the early Soviet state (where it was debated as the problem of price scissors) and it is central to many of today's LDCs, whether socialist or not. The answer depends in an important way on the salient features of the economy; among the features of the economy which we emphasize here are: the trade environment faced by the economy, the mechanisms which determine wages and earnings, and the effects of wages and prices on the productivity of workers. Under alternative representations of these features, we analyze the consequences of changing the terms of trade (on peasants, on industrial workers, and on the investible surplus) and identify several intuitive properties of the optimal terms of trade.

We examine two other issues which have remained controversial. The first issue concerns the effect of changes in the terms of trade on the intrasectoral distribution within agriculture (for example, on the welfare of landless workers versus that of landlords). We delineate simple conditions to determine who gains and who loses. The second issue concerns which agricultural inputs and outputs should be taxed, and which should be subsidized. We present powerful rules for reform in the prices of cash crops and production inputs. These rules are Pareto improving (that is, everyone in the society becomes better off); moreover, they are highly parsimonious with respect to the information required to implement them.

We also use the insights obtained in our analysis to interpret certain aspects of the Soviet industrialization debate (1924-28), and the subsequent collectivization of agriculture.

PRICE SCISSORS AND THE STRUCTURE OF THE ECONOMY

By Raaj Kumar Sah and Joseph E. Stiglitz*

A basic problem faced by the early Soviet state was how best to raise the revenues required if rapid capital accumulation was to be achieved. To what extent should the burden be placed on the peasants, by lowering the price they receive for their output (relative to the price of industrial goods), and to what extent should the burden be placed on the industrial proletariat? This question of the appropriate terms of trade between the urban and rural sectors (the 'price scissors') was central in the Soviet industrialization debate (1924-28). In recent years, the same question has been intensely debated in the People's Republic of China, with a widespread view that (to use the economists' language) the rural sector was too heavily taxed during the Cultural Revolution, and that both sectors could be made better off by reducing the size of the scissors.

In an earlier paper (1984a), we constructed a model which, we believe, captured well the central issues concerning the price scissors in a less developed socialist economy. We posited a closed dual economy in which the government has two instruments of control: the terms of trade and the industrial wage.[1] Within this model, we identified the role of incentives, the effect of the terms of trade on how industrial wages must be set, and the effect of different value judgments (concerning the welfare of peasants versus proletariat) on the appropriate size of price scissors. Also, our model allowed us to interpret the scissors policy advocated by some of the key participants in the Soviet debate.

The question of the appropriate price scissors is, of course, central to most less developed countries, whether socialist or not; simply because this question represents a fundamental trade off in the process of development. The nature of the trade off (that is, the effects of changing the terms of trade, and the characteristics of the optimal terms of trade), however, depend critically on the structure of the economy; in particular, on the hypotheses concerning the institutional features of the economy. Among the features of the economy on which we focus in this paper are the international trade environment faced by the country, the nature of mechanisms which (endogenously) determine wages and earnings (and the government's role in it), and the consequences of changes in prices and wages on the productivity of workers.

Whether LDCs should be viewed as open or closed economies has been long debated. What is critical, however, is not the level of trade (say relative to the national income) but the ability of the government to change the level of trade at the margin. If the government can not do so (for instance, because the demand for the country's exports is very inelastic in the short run, or because the country faces constraints in the international credit market which limit its ability to trade) then the analysis of the price scissors in these economies is quite similar to that in a closed economy. In particular, we had argued in our earlier analysis that, in a closed economy, a change in the terms of trade must be accompanied by a change in the industrial wage. If the industrial wage cannot be altered, then the government has no ability to change the terms of trade. Similar conclusions hold if the economy is closed at the margin. By contrast, if the economy is open at the margin, then the terms of trade can be set independently of the industrial wage. This, as we

shall see, has important implications on the consequences of alternative terms of trade policies.

Concerning the determination of industrial wage, we consider two alternative contexts. In a 'socialist' economy, the government presumably has the prerogative of setting industrial wage. In contrast, most LDCs have mixed economies in which private firms and unions play a major role in wage determination and, moreover, the level of wage is sensitive to the prices which the industrial workforce faces. Therefore, in determining the effects of changes in the terms of trade, one needs to take into account the indirect effects (on individuals' welfare as well as on the investible surplus) of induced changes in industrial wage.

Several hypotheses have been advanced in the literature which contend that the wages received by workers may affect their net productivity.[2] The corresponding effects of prices on productivity have not received the same attention. Here we develop a simple way of representing both of these productivity effects (for brevity, we refer to both effects as 'wage-productivity' effects). We incorporate these effects into our analysis, and show how specific types of wage-productivity effects (for example, when food consumption affects productivity 'more' than the consumption of other goods) influence the analysis of the terms of trade.

The first objective of this paper is thus to determine the incidence of the terms of trade under these various assumptions concerning the structure of the economy, to analyze the optimal terms of trade, and to relate them both to the structure of the economy and to society's value judgments. We do this in Sections I to III.

Another objective of this paper is to address two issues of vital interest to LDCs today. The first issue concerns the intrasectoral

distributional consequences of the terms of trade: which groups in the agricultural sector (landless workers, or landlords, for example) are helped or hurt by a movement of the terms of trade against, or in favor, of agriculture. This question has been a source of controversy in many LDCs.[3] In Section IV, we delineate conditions which determine who will gain and who will lose, due to a change in the terms of trade. Also, we demonstrate that under plausible circumstances, a movement in the terms of trade against (in favor of) agriculture hurts (helps) everyone in this sector, whether rich or poor. Further, we show that our basic characterization of the optimal terms of trade can be modified in a simple way to include the distributional consequences.

The second issue concerns which of the agricultural inputs and outputs should be taxed or subsidized. The answer, as one would expect, depends in part on the social weights to be associated with the incomes of different persons (that is, on the value judgments implicit in the social welfare function), because changes in the prices of different goods have different distributional consequences.

Agreements on social weights are, however, difficult to achieve among policy makers and government officials. In Section V, therefore, we have derived Pareto improving rules for reform in the prices of cash crops (sugar cane and cotton, for example) and agricultural inputs (fertilizer and tractors, for example). These reforms make the society better off without hurting anyone; moreover, the reforms can be conducted on the basis of extremely limited information. Our analysis of the structure of prices within the agricultural sector also leads us to argue that there is a case against taxing some cash crops and agricultural inputs, while subsidizing others.

The last two sections are devoted to additional interpretations and extensions. In Section VI, we use parts of our analysis to interpret many of the propositions (concerning price scissors) advanced by the Soviet economist Evgeny Preobrazhensky (1965) in the context of the pre-collectivization USSR. We also look at certain aspects of the Soviet collectivization of agriculture. In Section VII, we show how our analysis in this paper can be extended to include several other features of the economy (such as sharecropping, migration and unemployment) as well as other instruments of policy. Concluding remarks are presented at the end of the paper.

I. PRICE SCISSORS IN AN OPEN ECONOMY

In this section, we describe the basic model of the economy, analyze the effects of changes in the terms of trade, and characterize the optimal terms of trade. The model is that of an open dual economy in which the urban wage may either be rigid, or be set optimally by the government. (In Section II, we drop the assumption that the economy is open; and in Section III, endogenous determination of urban wages is considered.)

The Model: The rural and urban populations are denoted by N^1 and N^2 .[4] A is the total agricultural land owned equally by homogeneous peasants. The output of the agricultural good per peasant is $X = X(A/N^1, L^1)$, and L^1 is the variable number of hours a peasant works. (x^1, y^1) denote a peasant's consumption of the agricultural and industrial goods. $Q = X - x^1 > 0$, is the surplus of the agricultural good per peasant. p represents the terms of trade, that is, the price of the agricultural good in terms of the industrial good. A peasant's budget constraint is

(1) $pQ = y^1$.

If a peasant's indirect utility is denoted by $v^1(p)$ then, from Roy's identity, $\partial v^1/\partial p = \lambda^1 Q$, where λ^i is the (positive) marginal utility of income of a person in sector i . $\varepsilon^1_{Qp} = \partial \ln Q/\partial \ln p$ is the elasticity of surplus per peasant with respect to its price. We assume that this elasticity is positive.[5]

An industrial worker's consumption is denoted by (x^2, y^2) , and his wage rate and (fixed) labor hours are w and L^2 .[6] A worker's budget constraint is

(2) $px^2 + y^2 = wL^2$.

If $v^2(p, w)$ denotes the indirect utility of an urban worker, then $\partial v^2/\partial p = -\lambda^2 x^2$, and $\partial v^2/\partial w = \lambda^2 L^2$. $m = wL^2$ denotes a worker's income and $\varepsilon^2_{xp} = -\partial \ln x^2/\partial \ln p$ and $\varepsilon^2_{xm} = \partial \ln x^2/\partial \ln m$ denote, respectively, the elasticities of his consumption of the agricultural good with respect to price and income. These elasticities are positive since consumption goods are assumed to be normal.

The output of an industrial workers is denoted by Y . It depends on the capital stock per worker, k , and the labor hours per worker, L^2 . In addition, we take account of wage-productivity effects. These effects have been typically studied in the context of fixed prices, and it has been hypothesized that productivity is increasing in wage income because, for example, higher consumption increases workers' efficiency. A natural generalization suggests that price changes also affect workers' productivity. The wage-productivity effects are thus represented through the last two arguments of the following reduced form expression

(3) $\quad Y = Y(k, L^2, p, w)$.

For later use, we define $\sigma_m = \frac{\partial Y}{\partial w}\frac{1}{L^2}$, and $\sigma_p = -\frac{\partial Y}{\partial p}\frac{1}{x^2}$, to represent productivity gains from an increase in wage income and from a reduction in the terms of trade, respectively.

Since the effects of prices on productivity are not predictable, in general,[7] we consider here two representative specifications: (i) Productivity depends on, and increases with, the level of utility; that is, $Y = Y(v^2(p, w))$. In this case, $\sigma_m = \sigma_p$. (ii) Productivity depends on, and increases with, the consumption of food (agricultural good); that is, $Y = Y(x^2(p, w))$. In this case, $\sigma_m - \sigma_p = -\frac{\partial Y}{\partial x^2}\frac{\varepsilon^{2u}_{xp}}{p}$, where $\varepsilon^{2u}_{xp} = -\partial \ln x^{2u}/\partial \ln p$ denotes the own-price elasticity of the compensated food consumption of an industrial worker. From Slutsky properties, $\varepsilon^{2u}_{xp} = \varepsilon^{2}_{xp} - \alpha^2_x \varepsilon_{xm} > 0$.[8] Thus, $\sigma_m < \sigma_p$. The latter specification can be seen as a polar case of the view that productivity is 'more' sensitive to food consumption than to the consumption of other goods. Under both representations, σ_m and σ_p are positive.

If T_x and T_y denote the net imports of the two goods, then trade balance implies $T_y = -PT_x$, where P is the (fixed) international terms of trade. The investible surplus, defined in terms of the industrial good, is: $I = N^2Y - N^1y^1 - N^2y^2 - PT_x$. Substitution of (1) and (2) in the preceeding expression yields

(4) $\quad I = N^2(Y - wL^2) + p(N^2x^2 - N^1Q) - PT_x$.

The quantity balance of the agricultural good is represented by

$$(5) \qquad N^1Q + T_x = N^2x^2 \ .$$

There are no constraints on external trade in the present model. Therefore, (5) can be substituted into (4) to yield

$$(6) \qquad I = N^2(Y - wL^2) + (p - P)(N^2x^2 - N^1Q) \ .$$

That is, the investible surplus equals the profit from industrial production, plus the tariff revenue from external trade. Note here that, in (6), p and w can be altered independently of one another. This independence, as we shall see later, plays a critical role in determining the consequences of changes in the terms of trade in an open economy.

Effects of Policy Changes: The effects of changing p on individuals are obvious: lowering the terms of trade hurts peasants and helps industrial workers. The effects on investment can be ascertained from (6). The derivative of (6) with respect to p can be rearranged to yield

$$(7) \qquad \partial I/\partial p = N^2x^2[\theta - s\{(1 - \theta)\varepsilon^1_{Qp} + \varepsilon^2_{xp}\} - \sigma_p]$$

where $\theta = T_x/N^2x^2$ is the net import of the agricultural good as a fraction of its consumption in the industrial sector. A negative (positive) θ implies that the country exports (imports) the agricultural good. Also, $1 > \theta$, from (5) and from $Q > 0$. $s = (p - P)/P$ represents the tax or subsidy rate on the agricultural good. A negative (positive) s implies that the peasants are being taxed (subsidized) whereas the industrial workers are being subsidized (taxed).

There are three distinct implications of raising the terms of trade.

First, raising p increases or decreases the tariff revenue depending on whether, at present, the country is an importer or an exporter of the agricultural good. Second, a higher p implies a larger rural surplus and a smaller urban demand and, hence, a lower net import of the agricultural good. As a result, the tariff revenue increases or decreases depending on whether, at present, the agricultural good is being taxed or subsidized. Finally, a higher p reduces the investible surplus because of its deleterious effect on productivity. These distinct effects can be seen separately in the right hand side of (7).

The overall impact of the terms of trade on the investible surplus, of course, depends on the combination of the above effects. It appears unlikely, however, that lowering the terms of trade below some critical level would increase the investible surplus. This is because the country would be importing food (that is $\theta > 0$) at a sufficiently low p, and s would be a large negative number. Thus, if the marginal gain in industrial productivity from lowering p is negligible when p is sufficiently low, then (7) will be positive.

Next, consider the effects of changing the urban wage. A higher w helps industrial workers, and it has no effect on peasants. Its effect on the investible surplus is given by the derivative of (6) with respect to w. This derivative can be rearranged as

$$(8) \qquad \partial I/\partial w = N^2L^2(-1 + s\alpha_x^2\varepsilon_{xm}^2 + \sigma_m)$$

where $\alpha_x^2 = px^2/m$ is an industrial worker's budget share on the agricultural good. Clearly, $1 > \alpha_x^2 > 0$. Once again, the right hand side of (8) is easily interpreted. A higher urban wage reduces I directly

because the profit from industrial production is reduced. A higher urban wage increases the urban consumption of the agricultural good which, in turn, increases or decreases the tariff revenue depending on whether the urban workers are (at present) paying a tax or receiving a subsidy on this good. Finally, a higher urban wage increases the investible surplus due to its positive effect on productivity.

The importance of wage-productivity effects can be seen as follows. Suppose $\varepsilon^2_{xm} \leq 1$ at a given p and w, and that wage-productivity effects are insignificant. Then, the expression (8) predicts that a further lowering of the urban wage increases the investible surplus, regardless of the current terms of trade. This is because, by definition, $s < 1$ and $\alpha^2_x < 1$ and, hence, the right hand side of (8) is negative if σ_m is negligible. This conclusion would, however, be reversed if wage-productivity effects are significant, particularly at low levels of urban wage where the productivity loss due to a further wage reduction may be sufficiently large to offset other gains in the investible surplus.

Optimal Terms of Trade: The current value of the discounted aggregate social welfare is represented by the Hamiltonian

$$H = \phi + \delta I \tag{9}$$

where I is given by (6), δ denotes the (positive) social value of the marginal investible surplus, and $\phi = N^1W(V^1) + N^2W(V^2)$ is an additive Bergson-Samuelson social welfare function.[9] $\partial\phi/\partial p = N^2x^2[(1 - \theta)\beta^1 - \beta^2]$, and $\partial\phi/\partial w = N^2L^2\beta^2$, where $\beta^i = \lambda^i\partial W/\partial V^i$ denotes the social weight on on the marginal income of an individual in sector i. We take the derivative of (9) with respect to p, keeping w fixed, and use (7). A rearrangement of this derivative yields the following characterization of

the (internal) optimal terms of trade

$$(10) \qquad s = \frac{(\beta^1 - \beta^2) + \theta(\delta - \beta^1) - \delta\sigma_p}{\delta[(1-\theta)\varepsilon^1_{Qp} + \varepsilon^2_{xp}]} .$$

The internal optimum of (9) with respect to w, keeping p fixed, is characterized by

$$(11) \qquad \beta^2/\delta = 1 - \sigma_m - s\alpha^2_x\varepsilon^2_{xm} .$$

When p and w are both being set optimally, then the substitution of (11) into (10) allows it to be rewritten as

$$(12) \qquad s = \frac{-(1-\theta)(1-\beta^1/\delta) + (\sigma_m - \sigma_p)}{(1-\theta)\varepsilon^1_{Qp} + \varepsilon^{2u}_{xp}} .$$

Now recall that $1 > \theta$, and $\sigma_m \leq \sigma_p$. From (12), therefore, s is negative if $1 > \beta^1/\delta$. On the other hand s is positive if $1 < \beta^1/\delta$, and σ's are negligible. Further, consider the special case in which the society maximizes the investible surplus, that is $\beta^i/\delta \to 0$. In this case, s is negative from (12) and, hence, $\sigma_m > 1$ from (11). The following results are immediate; these results are entirely independent of the volume or the direction of trade.

(i) Peasants are taxed if the social weight on their income is smaller than that on the investible surplus.

(ii) Peasants are subsidized if the social weight on their income is larger than that on the investible surplus, and if wage-productivity effects are not significant.[10]

(iii) In an economy concerned solely with maximizing the investible

surplus, peasants are taxed, and the wage and prices faced by industrial workers are such that an increase in their wage would increase their output more than proportionately.

The last result appears counterintuitive at first sight, because one would expect that the society should be willing to increase the industrial wage if it can recover, through increased productivity, more than what it paid. The reason why this is not true is that an increased industrial wage also increases the food consumption of industrial workers. This, in turn, leads to a loss in the public revenue because the (optimal) domestic food price is lower than the international food price. This indirect revenue effect makes it undesirable for the society to take full advantage of the productivity gains from increasing the industrial wage.

The expression (12) provides additional insights which are important but somewhat partial. For instance, recall that $(\sigma_m - \sigma_p)$ is zero when productivity depends on workers' utility, and it is negative when productivity depends on food consumption. Expression (12) thus suggests that the optimal terms of trade are lower if productivity is 'more' sensitive to workers' food consumption than to their consumption of other goods.[11] This is what one would expect, since the marginal social gain from lowering the food price is higher if workers' productivity is more sensitive to food consumption.

The expression (12) also suggests that the magnitude of the optimal tax or subsidy rate is smaller if the peasants' surplus elasticity is higher. This is intuitive since a higher ε^1_{Qp} implies that there is a larger change in the net import of the agricultural good (and hence in the tariff revenue) due to a given change in the terms of trade.

II. CONSTRAINTS ON TRADE

Many LDCs face imperfect trade environments, such as quantity constraints imposed by their importing partners and borrowing constraints in the international credit market. Also, many developing countries consider it essential to maintain a certain degree of self-sufficiency in specific goods. These and other similar circumstances can often be formulated as constraints on pricing policies. If such a constraint is binding, then its primary implication within the context of the above model is that p and w can no longer be changed independently of one another. We briefly examine here the case in which the traded quantities are fixed at the margin, that is, T_x and T_y are fixed. The implication of other types of constraints can be similarly studied. A change in terms of trade must now be accompanied by a change in the urban wage, to maintain the quantity balance, (5), in the market for the agricultural good. If $\varepsilon_{wp} = d\ln w/d\ln p$ represents this change in wage, in an elasticity form, then a perturbation in (5) shows that

$$(13) \qquad \varepsilon_{wp} = [(1 - \theta)\varepsilon^1_{Qp} + \varepsilon^2_{xp}]/\varepsilon^2_{xm} > 0 \ .$$

Thus: <u>In an economy with constraints on traded quantities, a decrease in the term of trade must be accompanied by a decrease in the urban wage</u>. The reason is simple. Lowering the terms of trade leads to a smaller supply of rural surplus and a larger urban food demand. To balance the demand and supply, therefore, the urban wage must be reduced. Further, as we would expect, (13) shows that: <u>The reduction in the urban wage, corresponding to a decrease in the terms of trade, is larger if the peasants' surplus elasticity is larger, or if the net import of the</u>

agricultural good is smaller in relation to its urban consumption.

The industrial workers thus face a lower price, but also a lower wage, when the terms of trade are lowered. The overall effect on their welfare is $\frac{dv^2}{dp} = \frac{\partial v^2}{\partial p} + \frac{\partial v^2}{\partial w}\frac{dw}{dp}$. This can be expressed as

$$(14) \qquad dv^2/dp = \lambda^2 x^2 \rho$$

where $\rho = -1 + \varepsilon_{wp}/a_x^2$. Using (13), $\rho = [(1-\theta)\varepsilon_{Qp}^1 + \varepsilon_{xp}^{2u}]/a_x^2\varepsilon_{xm}^2 > 0$ and hence, (14) is positive. Thus: In an economy with constraints on the traded quantities, a decrease in the terms of trade hurts peasants as well as industrial workers.

The impact of the terms of trade on the investible surplus is quite easy to analyze in the present case. Lowering the terms of trade implies lowering the urban wage which, in turn, increases investment. The effect on productivity, however, is ambiguous since a lower food price increases productivity whereas a lower urban wage decreases productivity. The total effect can be obtained from $\frac{dI}{dp} = \frac{\partial I}{\partial p} + \frac{\partial I}{\partial w}\frac{dw}{dp}$, where (13) gives the change in wage and, from (4), investment is given by:
$I = N^2(Y - wL^2) + (p - P)T_x$. This yields

$$(15) \qquad dI/dp = -N^2x^2[(1-\theta) - (\sigma_m - \sigma_p) + (1 - \sigma_m)\rho]$$

A sufficient condition for the above to be negative is $\sigma_m < 1$. But, clearly, (15) will be negative so long as σ_m is not too large compared to one. Hence: In an economy with constraints on traded quantities, a decrease in the terms of trade increases investment, provided wage-productivity effects are not too significant.[12]

The Hamiltonian in the present case is

$H = \phi + \delta I + \eta[N^1Q + T_x - N^2x^2]$, where I is given by (4), η/δ is the shadow price of the agricultural good in terms of the industrial good, and the last part of H represents the constraint (5).[13] If $s = (p - \eta/\delta)/p$, that is, the tax or subsidy is now defined with respect to the shadow price, then it is easily verified that the optimal terms of trade continue to be characterized by (10), (11), and (12), and the corresponding interpretations hold in the present case as well. Finally, it should be obvious that a special case of the present model is a closed economy. The corresponding results can be obtained simply by substituting $\theta = 0$ into the expressions (10) to (15).[14]

III. ENDOGENOUS INDUSTRIAL WAGE

In this section, we examine the consequences of changing the terms of trade in an economy in which the urban wage is determined endogenously, rather than being set by the government. In most such situations, the wages industrial workers receive are sensitive to the prices which they face and, therefore, a change in the terms of trade has an induced effect on the urban wages. This induced effect, in turn, affects the investible surplus as well as the welfare of workers. We begin with a general formulation which is consistent with several alternative hypotheses concerning how the urban wage is determined; moreover, this formulation has the advantage of identifying the central implications of the endogeneity of the urban wage. We also present some special cases of this formulation. Our analysis in this section assumes that there are no constraints on external trade.[15] The urban wage rate is represented in reduced form as

(16) $\quad w = \bar{w}(p)$.

Denote $\bar{\varepsilon}_{wp} = d\ln \bar{w}/d\ln p$ as the elasticity corresponding to (16) and, for brevity, define $\bar{\rho} = -1 + \bar{\varepsilon}_{wp}/\alpha_x^2$. Based on (6) and (16), therefore, the effects of the terms of trade on peasants, industrial workers and the government can be easily ascertained, following our earlier analysis.

To analyze the normative aspects, note that the Hamiltonian is now $H = \phi + \delta I + \mu N^2 L^2 [w - \bar{w}(p)]$, where the last term accounts for the constraint (16), μ is a Hamiltonian multiplier, and I is given by (6). Expressions corresponding to (10), (11), and (12) can be easily obtained. For instance, the expression (12) now has an additional term $-\mu\bar{\rho}/\delta$ in its numerator. We consider the following special cases of urban wage determination.

(i) Fixed Welfare of Urban Worker: If the urban wage is determined through a bargaining between the government and a trade union, and if the union does not suffer from money illusion, that is, the union understands how the welfare of its members is affected by changes in the wage and prices, then the urban wage is defined by

(17) $\quad v^2(p, w) = \bar{v}^2$

where $\bar{v}^2$ is an industrial worker's utility, determined as the outcome of bargaining. Expression (17) is a special case of (16). By perturbing (17) we obtain $\bar{\varepsilon}_{wp} = \alpha_x^2$ and, hence, $\bar{\rho} = 0$. Thus, once again, (12) holds at the optimum, and the corresponding price and industrial wage are determined from (12) and (17). (In contrast, the expressions (11) and (12) characterize the optimum when the government can set the industrial

wage.)

How high or low the resulting terms of trade would be depends, of course, on how much the society cares about peasants. An instructive special case (which also turns out to be useful in our later interpretation of the Soviet debate) is one in which the society does not care about peasants. Denote the corresponding optimal terms of trade by p^*. Then, substituting $\beta^1 = 0$, we can reexpress (12) as[16]

$$(18) \qquad p^* = P \frac{(1-\theta)\varepsilon^1_{Qp} + \varepsilon^{2u}_{xp}}{(1-\theta)(1+\varepsilon^1_{Qp}) + \varepsilon^{2u}_{xp} - (\sigma_m - \sigma_p)} < P .$$

Thus, p^* represents the optimal terms of trade when the welfare of industrial workers is maintained at any given level, and the welfare of peasants does not matter. It must therefore be the case that p^* maximizes investment, subject to a given level of welfare of industrial workers. This is easily verified by noting that $dI/dp \gtrless 0$ if $p \lessgtr p^*$.[17] Thus: <u>For any given level of welfare of industrial workers, a decrease (increase) in the terms of trade increases the investible surplus when the existing terms of trade is above (below) a critical level, p^*, which is below the international relative price</u>.

The above result has an important implication even in those cases in which the government can set the industrial wage at whatever level it wishes, and when the welfare of peasants matters. Note that, for any level of welfare of industrial workers, a price below p^* not only reduces the investible surplus but it also hurts peasants. Therefore: <u>Any price below p^* is Pareto inefficient</u>.

(ii) <u>Fixed Urban Wage</u>: If the urban wage is fixed in terms of the

industrial good, then the optimal terms of trade is characterized by (10). If the urban wage is fixed in terms of food then, obviously, $\bar{\varepsilon}_{wp} = 1$. Dixit and Stern (1974) considered a further special case of the latter, in which the hours of work for a peasant are fixed and equal that for an industrial worker, the urban wage equals the (fixed) food output of a peasant, there are no wage-productivity effects, and the society maximizes investment. That is, X and Y are fixed, $wL^2 = pX$, $x^1 = x^2$. Substitution of these into (6) yields: $I = N^2(Y - PX) - (p - P)(N^1 + N^2)Q$. These assumptions, in effect, reduce a two-sector economy to a single-sector economy consisting of homogeneous individuals. The derivative of I with respect to p yields the corresponding result

$$s = -1/\varepsilon^1_{Qp} \quad . \tag{19}$$

IV. DISTRIBUTION WITHIN THE AGRICULTURAL SECTOR

Our earlier representation that the agricultural sector consists of homogeneous peasants is, of course, a simplifying assumption which, though allowing us to focus on the intersectoral aspects, obscures the intra-sectoral consequences of changes in the terms of trade. These consequences have often been a source of controversy, and they depend not only on the income and land distribution within agriculture, but also on the induced effects of prices on variables such as the rural wage, migration, reallocation of land entailed by migration, the terms of share-cropping and credit, and the arrangements for sharing work and output within families. For brevity, we focus here on the induced effect on the rural wage but, as we point out later, other induced effects can be

analyzed similarly.

The importance of the induced effects can be seen as follows. If there were no induced effects, then an increase in food price would hurt the net buyers of food (the landless and the farmers with small land holdings), and help the net sellers of food (large landlords, for example). Quite the reverse may be the case, as we shall see below, if the wage is highly responsive to the food price.

A person belonging to the rural group h is denoted by the superscript h. Correspondingly, A^h is the land he owns. Q^h is his surplus of agricultural good, which can be positive, negative or zero. L^{1h} is his net labor supply hours (that is, labor hours he supplies minus the labor hours employed on his farm). Thus L^{1h} is positive (negative) for the net suppliers (demanders) of labor. Clearly, $A^h = 0$, $L^{1h} > 0$, and $Q^h < 0$, for the landless. An individual's budget constraint is

$$pQ^h + w^1 L^{1h} = y^{1h} > 0 . \tag{20}$$

where $w^1(p)$ represents the rural wage per hour which, in general, would depend on the terms of trade. Let $\varepsilon^1_{wp} = d\ln w^1/d\ln p$ denote the elasticity of the rural wage rate with respect to p. Then, using (20), the Roy's identity yields:

$$dv^{1h}/dp = \lambda^{1h}(Q^h + w^1 L^{1h}\varepsilon^1_{wp}/p) . \tag{21}$$

This can be rearranged as

$$dv^{1h}/dp = \lambda^{1h}[(pQ^h + w^1 L^{1h}) + w^1 L^{1h}(\varepsilon^1_{wp} - 1)]/p . \tag{22}$$

The above expression, in combination with (20), yields the following

results.

A decrease in the terms of trade hurts (i) every rural individual, rich or poor, if the elasticity of the rural wage rate with respect to price is close to one, (ii) the net sellers (demanders) of labor if the elasticity is significantly greater (smaller) than one.[18]

Clearly, how large or small the elasticity of the rural wage rate is depends on the nature of labor market and on the labor demand and supply responses of individuals. Here we consider the case in which there are constant returns to scale in agricultural production, and the rural wage rate is determined in a competitive rural labor market, that is, from

$$(23) \qquad \sum_h N^{1h}(L^{sh} - A^h L^d) = 0$$

where N^{1h} is the number of individuals in the rural group h, $L^{sh}(p, w^1)$ is the labor supply of an individual in group h, and $L^d(p, w^1)$ is the labor employed on unit land. Thus, $L^{1h} = L^{sh} - A^h L^d$ is the net labor supply.

Denote $\varepsilon^d_{Lw} = -\partial \ln L^d / \partial \ln w$ and $\varepsilon^d_{Lp} = \partial \ln L^d / \partial \ln p$ as elasticities of labor demand on unit land with respect to wage and price. Now, if the wage rate equals the marginal product; that is, if $w^1 = p\partial X(L^d)/\partial L$, then $\varepsilon^d_{Lw} = \varepsilon^d_{Lp}$. This is what we would expect since, in the present case, the labor demand depends only on the ratio of the wage and output price. Next, define $\varepsilon^{sh}_{Lw} = \partial \ln L^{sh} / \partial \ln w$ and $\varepsilon^{sh}_{Lp} = -\partial \ln L^{sh} / \partial \ln p$ as elasticities of the labor supply, by an individual belonging to group h, with respect to wage and price. A perturbation in (23) then yields

$$(24) \qquad \varepsilon^1_{wp} - 1 = \sum_h N^{1h} L^{sh} (\varepsilon^{sh}_{Lp} - \varepsilon^{sh}_{Lw}) / (\sum_h N^{1h} L^{sh} \varepsilon^{sh}_{Lw} - AL^d \varepsilon^d_{Lw}) \ .$$

Substitution of the above into (22) makes it possible to express an individual's gain or loss from a change in the terms of trade solely in terms of the behavioral parameters which, in principle, can be estimated.

Next, note that the right hand side of (24) is zero if either L^{sh} is fixed, or if $\varepsilon^{sh}_{Lw} = \varepsilon^{sh}_{Lp}$. It is easily verified that the latter happens if the individuals' labor supply depends on the food price and on the wage, but not on the price of the industrial good. In both cases, it is obvious that the net labor supply of an individual (and hence of the entire sector) depends only on the ratio of the wage and the output price. From (22) and (24), therefore: An increase (decrease) in the terms of trade helps (hurts) every rural individual if the rural wage rate equals the marginal product and if one of the following two conditions are met (i) individuals' labor supplies are fixed, or (ii) the elasticities of an individual's labor supply with respect to wage and price are close to one another.[19]

The normative analysis in the context of heterogeneous agricultural individuals requires only a slight reinterpretation of our earlier derivations. Using (21), define the following 'average' social weight for the agricultural sector: $\beta^1 = \sum_h N^{1h} \beta^{1h} (Q^h + w^1 L^{1h} \varepsilon^1_{wp}/p)/N^1 Q$, where $Q = \sum_h N^{1h} Q^h / N^1$ is the average surplus per agricultural individual.[20] It is easy to verify then that, with this reinterpretation, expressions (10), (11), and (12) continue to represent the optimum.

V. PARETO IMPROVING PRICE REFORMS FOR CASH CROPS AND AGRICULTURAL INPUTS

The simplifying assumption that a single good is produced in each of the two sectors underlies the long-standing questions concerning the terms of trade between agriculture and industry, on which we have focussed above. Our analysis, however, can be easily generalized to a multitude of goods by interpreting Q, x, p and P as vectors. The effect of a change in the price of the i-th good on a rural individual belonging to group h is given by Roy's identity

$$(25) \qquad dv^{1h}/dp_i = \lambda^{1h}(Q_i^h + L^{1h}dw^1/dp_i)$$

where Q_i^h is this individual's surplus of good i. This, as is obvious, is a straightforward generalization of (21). The effects on the welfare of industrial workers and on the investible surplus can be assessed accordingly, and the corresponding optimal prices can be characterized following our earlier approach. The implementation of such an optimum, however, requires knowing, among other things, the distribution of income within each sector, the social weights corresponding to different groups of individuals, the own- and cross-elasticities of the consumption quantities with respect to prices, and the elasticities of the urban and rural wages with respect to various prices. Rather than focussing on the characteri- zation of this optimum, we present here a novel result which appears much more useful, which shows how Pareto improving price reforms can be conducted for certain goods on the basis of very limited information.

Consider those agricultural inputs and outputs which are not consumed, such as fertilizers, pesticides, agricultural machinery, and various cash

crops. For brevity, we refer to these goods as 'production goods.' Clearly, a change in the prices of these goods does not affect urban individuals, and it affects the consumption and the labor supply of rural individuals only through their full income and through the induced changes in the rural wage. Further, if the j-th good is a production good, and z is the vector of inputs and outputs on unit land, then $Q_j^h = A^h z_j$, where inputs (outputs) are represented as negative (positive) quantities.

We consider here the case in which the rural wage is determined in a competitive labor market, and assume that all production goods have the same (but not constant) elasticity with respect to wage.[21] That is

$$\partial z_j/\partial w^1 = g_1 z_j \ . \tag{26}$$

This assumption, as we shall see, is entirely unnecessary if the induced wage effects are not significant. Using (26), we show in Appendix I that

$$dw^1/dp_j = g z_j \ . \tag{27}$$

That is, the change in the rural wage due to a change in the price of a production good is proportional to the quantity of this production good on unit land. This result holds regardless of the nature of individuals' labor supply responses.

Next, define

$$c_j = -\sum_i s_i \varepsilon_{ji} \tag{28}$$

where $s_i = (p_i - P_i)/p_i$ represents the rates of taxes or subsidies, $\varepsilon_{ji} = \partial \ln z_j/\partial \ln p_i$ represents price elasticities of inputs and outputs

per unit of land. Thus, (28) represents the proportional change (due to taxation) in the quantity of the production good j. Using (6), (27), and (28), we show in Appendix I that

$$(29) \qquad dI/dp_j = (c_j + B)Az_j \ .$$

(The variables g_1, g and B are defined in Appendix I, but they are irrelevant for the results to be derived below.) A special case of the above is, of course, when the induced effects of price changes on the rural wage are insignificant. In this case $g = 0$ in (27) and, obviously, the assumption (26) is not needed. Expression (29) provides a basis for the following price reforms.

Consider two production goods, j and k. If their prices are changed by Δp_j and $-(z_j/z_k)\Delta p_j$, respectively, then it follows from (25) and (27) that the welfare of every rural individual remains unchanged. The resulting change in investment is obtained from (29) as

$$(30) \qquad \Delta I = (c_j - c_k)Az_j\Delta p_j \ .$$

The rules for price reforms follow immediately. Calculate c_j's for all of the production goods. If $c_j > c_k$, and j and k are both outputs (inputs), then increase (decrease) the price of the j-th good by a small amount, say Δp_j, and decrease (increase) the price of the k-th good by $(z_j/z_k)\Delta p_j$. Parallel rules apply if the j-th good is an output (input) and the k-th good is an input (output).

The above reforms lead to an unambiguous increase in the investible surplus, without affecting the welfare of any individual. Therefore: <u>The rules of reform are Pareto improving</u>. A remarkable property of these

rules is their extreme parsimony with respect to information. The required information to use these rules of reform 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.

Moreover, as should be obvious, our rules of reform take into account the induced effects of price changes on the rural wages, albeit under the assumption (26) which restricts the nature of these effects. If this assumption appears too restrictive, then the relevant empirical question is: how different are the observed induced wage effects from those with the above restriction? If the differences are not significant, then our rules of reform can be employed with extreme parsimony in information.

Finally, it is obvious from (30) that a necessary condition for the optimality of prices is that c_j's should be equal for all production goods. That is, the proportional reduction in the quantities of different production goods, due to taxation, should be equal. This has an interesting implication. 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, $\varepsilon_{ji} = 0$ if $i \neq j$). Then, from (28), $s_j \varepsilon_{jj}$ is the same for all j. Next, from the standard properties of profit functions, $\varepsilon_{jj} > 0$ for an output and $\varepsilon_{jj} < 0$ for an input. Also, from our definition of s_j, positive (negative) s_j implies a tax (subsidy) on an input and a subsidy (tax) on an output. It follows then that either all of the production goods (inputs as well as outputs) should be taxed or they should all be subsidized, but not both.

This last result is important not because we believe that the cross price effects are negligible. They are important because they cast 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, can not be justified on the grounds of equity alone; the primary justification for them should come from the importance of cross price effects.

VI. THE SOVIET DEBATE AND COLLECTIVIZATION

The Soviet industrialization debate (1924-28) is important, despite its polemics, because it anticipated some of the difficult, but central, trade-offs which confront many of today's developing economies. There was an over-emphasis in this debate on a price squeeze of peasants as a source of investible surplus, whereas the possible increase in surplus through a wage squeeze of the proletariat was under-emphasized. This bias, however, may not be surprising, given the pro-proletariat bias of the early Soviet state. Also, among the issues which received insufficient attention in this debate, but which turn out to be central according to our analysis, are the incentives of peasants and proletariat, and the general equilibrium effects of the terms of trade.

Our main interest here is to use parts of our analysis to clarify some of the propositions advanced by Evgeny Preobrazhensky. Specifically he proposed that (i) the state can increase capital accumulation by turning the terms of trade against peasants and (ii) this can be done without hurting the proletariat. In the context of our model, these can be rephrased as: (i) $dI/dp < 0$, and (ii) $dv^2/dp \leq 0$, while $dI/dp < 0$.

In our 1984a paper we referred to the above as Preobrazhensky's first and second proposition, respectively, and showed that, in a closed economy and in the absence of wage-productivity effects, the first proposition is valid, while the second proposition is not.[22] As expressions (15) and (14) demonstrate, respectively, the same conclusions hold in an economy with external trade, if the traded quantities are constrained. Wage-productivity effects do not change our conclusion concerning the second proposition. Also, our conclusion concerning the first proposition remains unaltered provided wage-productivity effects are not too significant.

If external trade is unconstrained then the society has somewhat greater flexibility and, as one would expect, the outcome is somewhat different. Specifically, our interpretation of expressions (7) and (18) suggests that the above propositions of Preobrazhensky are valid within certain ranges of the terms of trade, but not below these ranges.

Though it is peripheral to our analysis, a question which might be of some interest to historians of economic thought is whether an economy with or without constraints on external trade is a more appropriate model to understand Preobrazhensky's propositions. According to Paul Gregory and Robert Stuart (1981, pp. 73-74), Preobrazhensky believed that even though the Soviet state would gain to some extent from external trade, their ability to trade was constrained by the lack of credits which their capitalist enemies might not provide.[23]

The Fundamental Law of Primitive Socialist Accumulation: "...the smaller the inheritance received by the socialist accumulation fund of the proletariat...when the social revolution takes place, by so much the more, in proportion, will socialist accumulation be obliged to rely on alienating part of the surplus product of pre-socialist forms of economy

and the smaller will be the relative weight of accumulation on its own production basis, that is, the less will it be nourished by the surplus product of the workers in socialist industry.'' (Preobrazhensky, p. 124)

This 'law' appears to suggest that a lower current capital stock (a) necessitates the state to put a greater price squeeze on peasants, and (b) implies that the profit from the industrial sector would be a smaller fraction of the total investible surplus. For brevity, we shall refer to the above as Preobrazhensky's third and fourth propositions, respectively. Within our model, a smaller current capital stock would imply a larger value of the social weight on investment, δ. With this interpretation, the third proposition is correct in the sense that the optimal terms of trade would tend to be lower if δ is higher [see expression (12), for example]. What this proposition does not recognize is that, regardless of the capital stock, a price squeeze on peasants beyond some level would be counter productive, not because the state likes or dislikes peasants, but because doing so would reduce investment and would hurt the proletariat [see expression (18)].

The fourth proposition may also be correct under certain circumstances. For instance, at fixed wages and prices, a lower capital stock means that the profit from the industrial sector is lower, and so is the proportion of the total investible surplus coming from that sector. But a lower capital stock affects δ, as well as the industrial wage and the terms of trade. As we have argued earlier, the precise changes in p and w (and, therefore, the changes in the proportions of investible surplus) are in part determined by the value judgments of the society concerning the welfare of peasants versus proletariat.

Collectivization: Our analysis shows that there is a limit to how low

the prices to peasants should be pushed, regardless of whether the state values them or not, and there is a corresponding limit to how large a surplus can be extracted from peasants. If a state wants to extract more surplus than this, then it must discover some alternative way of organizing the rural sector. One can interpret the Soviet collectivization as a response to these problems.[24] According to this interpretation, collectivization was seen as an organizational form which would allow a significantly larger surplus extraction from the rural sector; this would not only enable a faster accumulation of capital (deemed by early Soviet leaders to be urgently needed) but also a betterment of the proletariat. As is now well recognized, collectivization did not solve the incentive problems which are at the heart of what is at issue.

Using economic terminology, collectivization can be viewed as a substitution of a supervisory-command system for a price-incentive system. Some aspects of the comparison between the two systems (such as the workers' incentives to shirk under the former) have been extensively studied. Here, we would like briefly to raise an aspect which has received insufficient attention. Most of the literature has focussed on a comparison of the ability of alternative organizations to induce workers to achieve certain work norms. But a critical problem, particularly in agriculture (where there are wide variations in the quality of land from plot to plot, and in the climatic conditions from season to season), is the setting of norms.[25] What 'should' be the output from a plot of land? How much work is 'reasonable' to expect from someone? When individuals work on their own plots, they make these decisions for themselves. Also, supervisory systems may work better in a competitive environment, because workers can choose among a variety of farms, where

differences in pay may correspond to differences in work norms. But there is virtually no endogenous basis for norm determination in a collective economy.[26]

One method of obtaining some of the information which is critical to the determination of norms for different locations is to have private plots in the neighborhood of collectives. Another possible method is to set contests among collectives such that high performers receive large rewards whereas low performers receive significant punishments.[27] Both of these methods may, however, be inconsistent with certain interpretations of the socialist ideals.

VII. EXTENSIONS

Instruments of Policy: The analysis of pricing policies is critically influenced by what is the set of instruments which the government can or can not control. This in turn depends on the ability of the fiscal bureaucracy, as well as on the informational and administrative costs associated with alternative sets of instruments. The analysis of the terms of trade on which the present paper -- as well as previous debates -- have focussed assumes that all individuals (rural as well as urban) face the same prices. An important example of an alternative set of instruments is when the government can administer two different sets of prices in the two sectors. To be able to do so, the government must have the ability to monitor (at reasonable administrative costs) the movement of goods across the border between the two sectors. Its main implication is that a change in the prices of goods in one sector does not have a direct effect on individuals in the other sector.[28]

Another set of instruments which are employed in LDCs entail urban

rations and queues for certain goods, particularly for food. The primary consequence of such non-price instruments is that an individual's effective prices become different from the market prices he faces. In our model, for instance, if food rations are binding on homogeneous urban individuals, then the effective prices faced by them are different from those faced by peasants, even though the market prices are the same throughout the economy. The analysis of this case, therefore, is parallel to the one discussed above, in which the government can administer two sets of prices in the two sectors. Similarly, in a heterogeneous urban population facing uniform rations, those individuals whose consumption is constrained by rations would face different effective prices, depending on their personal characteristics.[29]

A tax which has often been advocated by economists in the context of LDCs is land tax. There are some serious difficulties with this form of taxation, however. If the tax is based on land area alone, and not on land quality, then it is viewed as unfair, particularly when there are significant variations in the quality composition of land holdings of different individuals. Since land quality itself is not observable, and land markets are imperfect, implementation of a tax based on quality requires the use of surrogate variables which can be observed by an outside party at a reasonable cost. Variables such as the distance from irrigation canals can perform this role to some extent but they may not have a high correlation with quality since land improvement is often a major source of productivity. Land improvement, on the other hand, is not only under individuals' control but also is only partly observable. Other variables such as inputs and outputs are also of limited use because it is difficult to infer land quality from these variables; moreover, a tax

based on these variables is no longer a 'land' tax.

Features of the Economy: For brevity, our analysis in this paper has abstracted from many important features of the economy. A particularly important omission concerns the migration of labor between sectors and unemployment which might be created by such migration.[30] This, however, can be easily incorporated into our model. A key consequence of migration is that various elasticities are adjusted to reflect the fact that the sectoral populations are sensitive to policy changes. For example, the rural surplus elasticity would now represent the increase in the surplus of a farmer due to a price increase, as well as the effect on the surplus due to the price-induced migration between the two sectors.[31]

Another part of the model which we have simplified is the specification of the agricultural sector. We have analyzed an agricultural sector consisting of heterogeneous individuals who buy and sell labor services, and in which the rural wage is endogenously determined. The main point of this model was to show how an induced effect of price change can be determined and how this, in turn, can be used to determine the welfare consequences on different individuals in the rural sector. It should be clear, however, that the wage effect is only one of the numerous induced effects, and that the specific model one should construct to study the relevant effects should reflect the institutional features of the economy under consideration. For example, while family farming may predominate in some countries, sharecropping or parastatal based agriculture may be more typical in others. Furthermore, credit arrangements, and the intra-household arrangements for sharing work and consumption may differ widely across societies. For an analysis of the effects of changes in the terms of trade, the central step in each case is to determine the induced effect

of price change (for example on the terms of sharecropping, on the terms of credit, etc.).

VIII. CONCLUDING REMARKS

A question of vital importance to most LDCs is how best to raise the funds required to finance a rapid accumulation of capital. In addition, LDC governments face a constraint that very few instruments of policy are available to them; not only their fiscal authorities have limited abilities, but also sophisticated instruments of policy are infeasible because of their informational and administrative costs. It is not surprising, therefore, that the terms of trade between agriculture and industry has been viewed as a primary instrument for raising the investible surplus in economies at early stages of their development. The issue of the appropriate terms of trade was central in the Soviet industrialization debate (we interpret some aspects of this debate using our analysis). More recently, the terms of trade has been a source of controversy in non-socialist as well as socialist LDCs.

In this paper, we have presented a general equilibrium model, within which we identify the consequences of changing the terms of trade (on those in the rural sector, on those in the urban sector, and on the investible surplus) as well as the qualitative properties of the optimal terms of trade. We show that the conclusions (positive as well as normative) concerning the terms of trade depend in an important way on the salient features of the economy; among the features of the economy which we have emphasized in this paper are the external trade environment faced by the country, the mechanism for the determination of industrial wages

and earnings, and the effects of changes in prices and wages on the productivity of workers.

We have obtained a number of results delineating conditions under which the agricultural sector would be taxed (or subsidized). Also, we have delineated conditions which predict who within the rural sector (landless workers or landlords, for example) will gain or lose from a change in the terms of trade. In addition, we have proposed powerful rules for reform in the prices of cash crops and production inputs; these rules are not only parsimonious in the information required to use them, but also they are Pareto improving; it is desirable to use them regardless of what the social welfare function might be.

LDCs differ widely in what are the salient features of the economy and, therefore, it is not feasible to incorporate every potentially important feature in a single analysis. We have, however, indicated how our model can be extended in a number of directions. Also, we have not pursued here some of the important uses to which an analysis such as the present one can be put. For instance, governments often justify the particular policies which they pursue with equalitarian rhetoric. It is important, then, to examine whether significant redistribution from the rich to the poor is possible through the set of policy instruments which a government is constrained to employ (or which it chooses to employ).[32]

Our model can also be used (with reasonable values of parameters representing the economy) to identify the circumstances under which the existing policies in a country can possibly be consistent with an equalitarian social welfare function. We conjecture that at least in many cases (particularly in those widely prevalent cases in which the government 'appears' to subsidize everyone) important inconsistencies

will be detected. Whether identifying such inconsistencies is more likely to affect the policy, or the rhetoric, is a moot question.

APPENDIX I

Denote the unit profit function as $G = G(G^1(p^1, w^1), G^2(p^2))$ $= pz - w^1L^d$, where p^2 is the vector of production goods' prices. Then, for the production good j , $\partial z_j/\partial w^1 = -\partial L^d/\partial p_j = g_1 z_j$, where $g_1 = \frac{\partial^2 G}{\partial G^1 \partial G^2} \frac{\partial G^1}{\partial w^1} / \frac{\partial G}{\partial G^2}$. Therefore, the elasticity $\partial \ln z_j/\partial \ln w^1 = g_1 w^1$ is the same for all j .

The labor market clearing condition is $\sum_h N^{1h} L^{1h}(p, w^1) = 0$, which, upon differentiation, gives $dw^1/dp_j = -(\sum_h N^{1h} \partial L^{1h}/\partial p_j) / \sum_h N^{1h} \partial L^{1h}/\partial w^1$. Next, the prices of production good affect the labor supply only through the full income: $M^h = w^1 \bar{L}^h + A^h G$, where $\bar{L}^h$ is the endowment of labor. Thus $\partial L^{1h}/\partial p_j = A^h z_j \partial L^{sh}/\partial M^h - A^h \partial L^d/\partial p_j$. Now, recall that $-\partial L^d/\partial p_j = g_1 z_j$. It follows that: $dw^1/dp_j = g z_j$, where $g = -\sum_h N^{1h} A^h (g_1 + \partial L^{sh}/\partial M^h) / \sum_h N^{1h} \partial L^{1h}/\partial w^1$.

Using the last expression and the symmetry property $\partial z_i/\partial p_j = \partial z_j/\partial p_i$, the derivative of (6) can be expressed as (29), where $B = -1 + (p - P) \sum_h N^{1h} \left[A^h \frac{\partial x^{1h}}{\partial M^h} - g \frac{\partial Q^h}{\partial w^1} \right] / A$, and x^{1h} is the consumption vector for person h . Further $g = 0$, if there are no induced wage effects.

FOOTNOTES

*Department of Economics, Economic Growth Center and School of Organization and Management, Yale University; and Department of Economics, Princeton University, respectively. We thank Leon Podkaminer, Michael Montias, and Gordon Tullock for their useful suggestions. Support from the National Science Foundation is gratefully acknowledged.

1. Other instruments of policy are discussed later. Note, in particular, that the long-standing debates on price scissors (as well as the present analysis) are based on the assumption that the government can not set two different sets of prices in the two sectors. This assumption may not be appropriate for some LDCs, like India and South Korea; later, we discuss the corresponding formulations.

2. For example, due to the effect of wages on workers' efficiency, quality and turnover. See Stiglitz (1982), Yellen (1984), and the references therein.

3. In India, for instance, Ashok Mitra (1977) has argued that higher agricultural prices have a deleterious effect on distribution, whereas A. S. Kalhon and D. S. Tyagi (1980) have argued that the opposite is the case.

4. The superscripts 1 and 2 denote the agricultural and industrial sectors.

5. This formulation can be easily extended to include household production goods or so-called 'Z-goods,' which peasants produce and consume but do not trade, presumably because of high transactions costs.

Though the precise consequences of such goods would depend on the substitution possibilities in production and consumption, it is plausible that the surplus elasticity, ε^1_{Qp}, will be smaller in the presence of such goods than without them.

6. The analysis corresponding to variable labor hours of workers in the urban sector can be easily worked out.

7. For example, if productivity is increasing in the consumption quantities of various goods, then a change in the price of one good increases the consumption of some goods (gross substitutes) and reduces the consumption of other goods (gross complements). The overall effect of a price change on productivity, therefore, can not be predicted without additional restrictions.

8. To avoid trivial details, we assume that there are some substitution possibilities in consumption; that is, $\varepsilon^{2u}_{xp} > 0$.

9. W is concave and increasing in V. If the social welfare function is not anonymous between rural and urban individuals, then W will be superscripted by $i = 1$ and 2, respectively.

10. In fact, this result holds even if wage-productivity effects are significant, provided $\sigma_m = \sigma_p$.

11. The reason why these conclusions are partial is this. Note that equations (11) and (12) implicitly characterize the optimal (p, w), but they do not provide a closed-form solution (because (p, w) appear on both sides of these equations). A full comparative statics

analysis based on these equations is difficult because the effects of (p, w) on variables such as elasticities can not be predicted in general. Partial insights, however, can be obtained by treating β's , σ's , ε's , α and θ as fixed parameters in the neighborhood of an optimum, and by changing one parameter at a time. The resulting insights are clearly useful, but they must also be treated with some caution.

12. Also, recalling the definition of ρ , it is clear from (15) that, if $\sigma_m < 1$, then the absolute value of the right hand side of (15) is larger if ε^1_{Qp} is larger. That is, the response of the investible surplus to a change in the terms of trade is larger if peasants' surplus elasticity is larger. This should not be surprising since, in the present case, a reduction in the terms of trade necessitates a larger decrease in urban wage. Parallel conclusion does not always hold, however, when external trade is unconstrained. For instance, if (7) is positive, then whether its absolute value increases or decreases with ε^1_{Qp} depends on whether peasants are being taxed or subsidized.

13. Thus, the optimal terms of trade and the shadow prices (for social cost-benefit analysis) are determined simultaneously.

14. Our 1984a paper emphasized this case, and it abstracted from wage-productivity effects.

15. If the constraints on external trade are binding then, with completely endogenous wage, the terms of trade can not be altered without introducing additional policy instruments.

16. It is obvious from the expression (18) for p^*, that $p^* < P$.

17. To verify this, note from (17) that the change in the urban wage corresponding to a change in price is: $dw/dp = x^2/L^2$. Using this, and (6), calculate $\frac{dI}{dp} = \frac{\partial I}{\partial p} + \frac{\partial I}{\partial w}\frac{dw}{dp}$. The result follows.

18. Further, suppose we define a 'self-sufficient' farmer to be the one who neither buys nor sells labor services, that is, $L^{1h} = 0$, then it is apparent from (20) and (21) that this farmer is better-off if the terms of trade are higher. Categories such as self-sufficient farmers and marginal farmers (those who are not landless but are sufficiently poor) have often been used in policy discussions, particularly in India. It should be clear that the boundary lines of such categories, whether defined on the basis of net trade of labor or goods, or on the basis of a given level of welfare (real income), are themselves dependent on the wages and prices.

19. As should be obvious, this result holds even if the wage rate does not equal marginal product, so long as the labor demand depends only on w^1/p, that is, it is homogeneous of degree zero in the wage rate and the price.

20. The induced wage effects emphasized in this model are typically absent in the standard tax models [see Atkinson and Stiglitz (1980), for a review] which assume that the general equilibrium effects are insignificant, or that the government can control wages. Either assumption is unsatisfactory in the context of the agricultural sector of an LDC.

21. This happens if the unit (land) profit function is separable between the prices of production goods and other prices; see Appendix I. For details on the underlying production technologies, see Lau (1978).

22. Michael Ellman's important empirical studies, summarized in his 1979 book, are suggestive in this context. He assesses the contributions of peasants and proletariat to the Soviet accumulation during the First Plan period, and demonstrates that the proletariat suffered a loss during this period. (Ellman's analysis, however, refers to the post-collectivization period when the policy instrument was coercion rather than the terms of trade.) Also note here that, besides the terms of trade, Preobrazhensy discussed many other instruments of policy, such as: railroad tariffs, printing money, credit policy, etc. The centerpiece of his verbal analysis, as well as that of his critics, is the terms of trade, on which we have focussed in this paper.

23. A different question is, which one of the above models is a better representation of the Soviet economy before the debate, that is, during 1918-24. The trade volume during this period shows an extreme decline compared to the pre-World War I period [see Michael Kaser (1969)]. This evidence, however, does not provide an answer because <u>any</u> level of trade is consistent with <u>both</u> models; as we have emphasized, what is relevant is whether the economy can increase its trade at the margin.

24. This, of course, is a purely 'economic' interpretation. At the other extreme, one can argue that the reasons for collectivization were entirely 'non-economic,' such as the commitment of the Soviet state to destroy the power of potentially reactionary peasantry, or to simply abolish private property.

25. The problem of norm setting also arises in industrial production, particularly in connection with setting appropriate piece rates in the presence of changes in technology.

26. This analysis also suggests that productivity on collectives may decline over time (relative to the contemporaneous performance of price-incentive systems). In early days of a collective, historical productivity may provide a reasonable basis for norm determination; as technology changes, it provides a less and less adequate basis. Moreover, in early days, there may be a cadre of individuals committed to making the collectives work; these individuals may not need much economic incentive; as time progresses, the necessity of economic incentives may increase.

27. See Nalebuff and Stiglitz (1983), and Lazear and Rosen (1981) for analyses of contests.

28. See Sah and Stiglitz (1984a) for the corresponding analysis.

29. See Sah (1982).

30. Endogenous migration can be significant not only in LDCs but also in socialist economies, as has been pointed out by Ellman (1979, p. 94).

31. For a detailed analysis, see Sah and Stiglitz (1984a, 1984b, 1985).

32. See Sah (1983).

REFERENCES

Atkinson, Anthony B. and Joseph E. Stiglitz, 1980, Lectures on Public Economics, McGraw-Hill, New York.

Dixit, Avinash K. and Nicholas Stern, 1974, Determinants of Shadow Prices in Open Dual Economics, Oxford Economic Papers 26, 42-53.

Ellman, Michael, 1979, Socialist Planning, Cambridge University Press, Cambridge.

Gregory, Paul R. and Robert C. Stuart, 1981, Soviet Economic Structure and Performance, Harper and Row, New York.

Kalhon, A. S. and D. S. Tyagi, 1980, Inter-Sector Terms of Trade, Economic and Political Weekly 15, A173-84, Bombay.

Kaser, Michael, 1969, A Volume Index of Soviet Foreign Trade, Soviet Studies 20, 523-526.

Lau, Lawrence J., 1978, Some Applications of Profit Functions, in M. Fuss and D. McFadden, eds., Production Economics: A Dual Approach to Theory and Applications, North-Holland, Amsterdam, 133-216.

Lazear, Edward P. and Sherwin Rosen, 1981, Rank-Order Tournaments as Optimum Labor Contracts, Journal of Political Economy 89, 841-864.

Mitra, Ashok, 1977, The Terms of Trade and Class Relations, Frank Cass, London.

Nalebuff, Barry J. and Joseph E. Stiglitz, 1983, Prizes and Incentives: Towards a General Theory of Compensation and Competition, Bell Journal of Economics 14, 21-43.

Preobrazhensky, Evgeny, 1965, The New Economics, Clarendon Press, Oxford.

Sah, Raaj Kumar, 1982, Comparison of Coupons, Queues, Rations and Non-Intervention in Managing Scarcities, CADE Research Paper, University of Pennsylvania.

Sah, Raaj Kumar, 1983, How Much Redistribution Is Possible through Indirect Taxes?, Journal of Public Economics 20, 89-101.

Sah, Raaj Kumar and Joseph E. Stiglitz, 1984a, The Economics of Price Scissors, American Economic Review 74, 125-138.

Sah, Raaj Kumar and Joseph E. Stiglitz, 1984b, Taxation and Pricing of Agricultural and Industrial Goods, National Bureau of Economic Research Working Paper No. 1338, Cambridge.

Sah, Raaj Kumar and Joseph E. Stiglitz, 1985, The Social Cost of Labor and Project Evaluation: A General Approach, forthcoming, Journal of Public Economics.

Stiglitz, Joseph E., 1982, Alternative Theories of Wage Determination and Unemployment: The Efficiency Wage Model, in M. Gersovitz et al., eds., The Theory and Practice of Development, George Allen and Unwin, London.

Yellen, Janet L., 1984, Efficiency Wage Models of Unemployment, American Economic Review Proceedings 74, 200-206.