Do Price Increases for Staple Foods Help or Hurt the Rural Poor?

Martin Ravallion

In the short run the rural rich in Bangladesh are likely to gain, and the rural poor to lose, from an increase in the relative price of food staples in a food producing economy. But in the long run the welfare of a typical poor household will be neutral to such price increases (after allowing for wage adjustments), and the poorest households will benefit somewhat.
The effect on the poor of changes in the price of staple foods is a central issue in debates on development policy.

One argument is that while low food prices clearly benefit urban groups, the rural population that depends primarily on food agriculture is likely to be worse off. High food prices may benefit the rural poor by raising rural wages, even when the poor are net demanders of food.

The counterargument is that the rural poor are net demanders of food. In rural South Asia, for example, they do not produce enough food for their own consumption, typically supplementing their own farm incomes with earnings from agricultural labor. Under conditions of partial equilibrium, they cannot benefit from high prices.

There is little agreement about how responsive agricultural wages are to food prices, so the author has examined the effects of changes in food prices under induced wage responses for rural Bangladesh based on an econometric model of agricultural wage determination.

The results:

Partial equilibrium analysis suggests that the rural rich are likely to gain, and the rural poor to lose, from an increase in the relative price of food staples.

Steady-state equilibrium analysis suggests a different result: that the rural rich will probably gain from such a price increase, but in the long run the welfare of a typical poor household is more likely to be neutral to changes in the price of rice.

The long-term effect on welfare will vary among the poor, however. In the long run, welfare in the poorest households would seem to improve more from such a price increase than would welfare in households that are less poor.

Typically, three or four years must pass before a price increase for rice stops having a negative effect on the welfare of the poor.

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by

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1. **Introduction**

The welfare effects in a food processing economy of changes in the price of food have been central issues in numerous debates on development policy. The governments of many LDCs have used their control over external trade to hold domestic food prices below world prices. A commonly held view is that, while low food prices clearly benefit urban groups, the rural population who depend primarily on food agriculture are likely to be worse off. Against this view, it has been noted that, in many countries, the rural poor are actually net demanders of food; a great many of the poor in rural South Asia, for example, do not produce sufficient food for their own consumption, typically supplementing their own farm incomes with agricultural labour earnings. Under regular partial equilibrium conditions, such persons cannot benefit from high food prices.

This conclusion is contentious when other welfare relevant prices and quantities are responsive to changes in food price. In particular, it has been argued that, by stimulating food production and the demand for agricultural labour, high food prices may benefit the rural poor through the induced wage response, even when the poor are net demanders of food; see, for example, Brown (1979), Tyagi (1979) and Lipton (1984).

But there has been little agreement on how responsive agricultural wages are to food prices. Contrast, for example, the recent views of Sah and Stiglitz (1987) with those of de Janvry and Subbarao (1984, 1987). Both pairs of authors aim to model the distributional effects of food pricing policies in economies in which the rural poor depend heavily on
their earnings from supplying agricultural labour. Sah and Stiglitz contend it to be "plausible" that the food price elasticity of the agricultural wage rate is close to unity, implying that "... a movement in the terms of trade against (in favour of) agriculture hurts (helps) everyone in the sector, whether rich or poor" (p.111). On the other hand, de Janvry and Subbarao (1984, 1986) assume that the nominal wage rate in agriculture is exogenously fixed, implying zero food price elasticity, and, hence, quite adverse effects on the rural poor of higher food prices. Neither study presents any empirical evidence to support their assumptions.

This paper examines the rural welfare distributional effects of changes in food prices under induced wage responses for rural Bangladesh. The approach falls short of a fully fledged general equilibrium analysis of welfare effects with flexible prices; rather, attention is focused on the more tractable (and arguably most important) issue of the labour market responses to changes emanating from food markets. An effort is made here to base the analysis on a consistent model of farm-household behaviour for which crucial parameters can be estimated with readily available data. Section 2 outlines the theoretical conditions for a vector of small price changes to be welfare improving for a stylized agricultural household. This permits identification of the critical value of the elasticity of the agricultural wage rate with respect to the price of food necessary for an increase in food price to be welfare improving. The critical value of that elasticity depends solely on variables which can be measured from any standard income-expenditure survey. Section 3 applies the theoretical results to available income-expenditure data and econometric estimates of the wage-price elasticity for Bangladesh and discusses the implications for the welfare distributional effects of foodgrain price changes. Finally, section 4 offers some conclusions.
2. **Markets and Peasant's Welfare**

There can be little doubt that many poor households in rural areas of South Asia and elsewhere are highly vulnerable to at least the initial impact of an increase in the price of staple foods; indeed, a sizeable proportion of the excess mortality observed during famines in this setting can be attributed to a sharp fall in the food purchasing power of incomes, associated with higher food prices (Ravallion, 1987a, b). It is plausible that survival chance is the over-riding determinant of individual welfare at such times; little else would seem to matter. But at other times, and for certain sorts of policy discussions, one may reasonably prefer to base the analysis on more familiar and (arguably) more general measures of economic welfare.

Past discussions of the welfare effects of price changes have often focused on a single relative price or income, considered to be a good welfare indicator; a common example in this setting is the food purchasing power of the agricultural wage. However, it is well-known that, when more than one traded good is consumed, no single relative income or price variable will measure individual welfare changes exactly, and, indeed, the errors involved in doing so may be large.

The welfare of a farm-household is measured here by the maximum utility the household can be presumed to attain under fairly regular assumptions about its preferences, own production processes, and the constraints imposed by the prices it faces in markets, and its endowments, including available time. The model is general enough to encompass the
constraints facing both "rich" and "poor" agricultural households. Within these constraints, the stylized farm-household is assumed to be free to choose the quantities relevant to its consumption, production and labour supply decisions. All prices (including wage rates) are taken as given when making individual quantity choices. All households face the same prices, which do not vary according to whether one buys or sells the commodity in question.

The realism of some of these assumptions can be questioned. There is, for example, a widespread belief that involuntary unemployment exists in lean season in poor agrarian economies. Thus some households may be rationed in their labour supply decisions and demand side responses may then become crucial in assessing welfare effects. It has also been claimed that wage rates vary according to whether one hires in or hires out labour, due to the existence of costs of transaction and supervision. There are numerous alternative behavioural assumptions that might be made here and the most realistic and yet consistent choice remains unclear. Nonetheless, the undistorted competitive model of the farm-household is at least an interesting starting point for investigating the welfare effects of price changes in this setting.

The agricultural household is assumed to hold continuous convex preferences over food consumption \((x)\), consumption of other goods \((y)\) and hours of leisure \((L_1)\). Those preferences are represented by an increasing and strictly quasi-concave utility function \(u(x,y,L_1)\). The maximization is constrained by the household’s available time and a regular (convex) budget set, parametized by the prices of food and other goods \((p \text{ and } q\) respectively) and the agricultural wage rate \((w)\). The budget constraint can be written as
\[ px + qy + wH \leq wL_2 + pX + Z \]  

(1)

where \( H \) is hired labour time, \( X \) is the food output from the household's own land, \( L_2 \) is household labour supply (time spent in outside employment valued at the same wage rate as \( H \) and \( Z \) is any other potential source of consumption (such as non-farm businesses, remittances or dissaving). Own-output is assumed to be a strictly quasi-concave function of both land-holding \( h \) and the total labour time devoted to own-production, comprising the farm-household's own time \( (L_3) \), plus any hired labour time from outside the household. Following common practice in this context, land-holding is treated as an exogenously given non-traded good. On incorporating the household's time constraint, \( L_1 + L_2 + L_3 = T \), and optimizing out labour inputs to own production, equation (1) implies that full-expenditure is:

\[ px + qy + wL_1 \leq Y \]  

(2)

where

\[ Y = wT + \pi(p,w,h) + Z \]  

(3)

is the household's full-income and \( \pi \) is the maximum profit from food production using the household's own land when labour input \( (L_3+H) \) is optimal. (Note that the utility maximization problem is recursive: first \( L_3 + H \) is chosen to maximize profit on own land, giving \( \pi \), and then \( x, y \) and \( L_1 \) are chosen to maximize utility subject to all prices (including \( w \)) and full-income (including \( \pi \)). The farm-household's welfare given these constraints is measured by the corresponding indirect utility function:
\[ u = v(p, q, w, Y) \]  \hspace{1cm} (4)

which is the maximum value of \( u(x, y, L_1) \) with respect to \( x, y \) and \( L_1 \), subject to (2).

Under such conditions it is well known shown that (to a first-order approximation) a vector of price changes \((dp, dq, dw)\) will be welfare improving if and only if the induced change in income exceeds that of expenditure, holding all quantities constant; on applying the envelope theorem (Roy's identity) to the budget constraint (1), the necessary and sufficient condition for a welfare gain is that

\[ L_2dw + Xdp + dZ > xdp + ydq + Hdw \]  \hspace{1cm} (5)

A complete analysis of the welfare effects of a food price change would require information on how non-food prices and incomes as well as agricultural wages respond. It is not implausible (for example) that higher food prices would increase village level demand for the petty trading and service activities typically supplied by the poor. Patrons may also become more generous to the poor. In a relatively closed economy the prices of non-food goods can also be expected to respond.

However, the following analysis will focus solely on the labour market responses to a food price increase. This restriction on the analysis is justifiable on two counts: it appears likely that the quantitatively most significant aspect of market responses would involve agricultural wages,
and (more pragmatically) we have little or no data to guide empirical
analysis of the effects on other (non-food) prices and incomes.

The condition for a welfare gain after a small increase in the price
of food holding non-food prices and incomes constant \( (dq = dZ = 0) \) can
usefully be written in the following form:

\[
du/dp \geq 0 \text{ as } p(X-x) + w(L_2-H)\eta = qy + (\eta-1)w(L_2-H) - Z \geq 0 \quad (6)
\]

where \( \eta = pdw/(wp) \) is the elasticity of the agricultural wage rate to the
price of food. (Note that \( X-x \) and \( L_2-H \) are the household's net supplies of
food and labour respectively). Similarly, the monetary value to a farm-
household of a change in the food price is given by

\[
du/\lambda = [p(X-x) + w(L_2-H)\eta]dp/p \quad (7)
\]

where \( \lambda \) denotes the marginal utility of full-income.

A number of remarks can be made about the conditions in (6):

i) In the special case discussed by Sah and Stiglitz (1987,
Proposition 7), an increase in food price will benefit all agricultural
households (whether rich or poor) if \( \eta \) is sufficiently close to unity and
\( Z=0 \). This follows immediately from (6), noting that \( qy > 0 \).

ii) For a farm-household which is a net supplier of agricultural
labour \( (L_2>H) \), (6) can be used to derive the critical minimum level of the
price elasticity of the wage rate necessary for the household to benefit
from a food price increase. In particular
\[
du/dp \geq 0 \text{ as } \eta \geq \eta^* 
\]

where

\[
\eta^* = \frac{p(x-X)}{(w(L_2-H))} + 1 + \frac{(Z-qy)}{(w(L_2-H))} 
\]  

is the ratio of food expenditure on markets to wage income. In words: the necessary and sufficient condition for an agricultural worker to benefit from a small increase in the price of food is that the elasticity of the wage rate to the price of food exceeds the ratio of the worker's net food expenditure (after deducting the value of own production) to labour earnings.

**iii)** For a net employer of labour \((L_2 < H)\), the second set of inequalities in (6) is reversed; \(\eta^*\) is then the maximum value of \(\eta\) consistent with a welfare gain from an increase in food price. Note also that \(\eta^* > 1\) for \(L_2 < H\) and small \(Z\); values of \(\eta\) less than or equal to unity then imply that a price increase is welfare improving.

**iv)** Under these conditions, the standard partial equilibrium result that a net supplier (demander) of a good will benefit (lose) from an increase in its price must be modified as follows. For any farm-household which is a net demander of food and a net supplier of labour the conditions in (ii) apply; the partial equilibrium result requires \(\eta < \eta^*\). For a net supplier of food who is also a net demander of labour, the conditions in (iii) apply and so the partial equilibrium result requires \(\eta > \eta^*\). If the household is either a net supplier of both food and labour or a net
demander of both then $\eta^* < 0$ and so the partial equilibrium result holds for all $\eta > 0$.

Nothing has been said yet about how $\eta$ is determined. Following Sah and Stiglitz (1987) it can be assumed that the way wages respond to a change in food price is determined by the labour market clearing condition. Letting $F(h)$ denote the distribution function for land, and assuming this to be continuous, the long-run market clearing wage rate ($w^*$) solves

$$0 \frac{\partial}{\partial w^*} (p, q) \frac{\partial}{\partial w^*} + \frac{\partial}{\partial w^*} f(p, q, w^*) h dF(h) = 0$$

(10)

where $L_2 - H = L(.)$ is an individual farm-household's net labour supply function and $\Psi(.)$ is the corresponding aggregate excess supply function. The implicit wage rate solving (10) is:

$$w^* = w(p, q)$$

(11)

The assumptions made so far are not strong enough to sign either of the slopes of this function. It is plain from (10) that the elasticity of $w^*$ to $p$ will be positive if (and, under the above assumptions, only if)

$$\psi_p = \int (L_p + L_y X) dF$$

and

$$\psi_w = \int (L_w + L_y (L_3 + H)) dF$$

have opposite sign. For $\eta$ to not exceed unity, it is necessary and sufficient that $-p \psi_p / (w \psi_w) \leq 1$, and the elasticity is unity if this holds with equality.

3. **Evidence for Bangladesh.**

The theoretical conditions derived above for signing the welfare effects of a price change are empirically testable using time series
data on actual wage and price movements (to estimate $\eta$) and consumer income and expenditure surveys (to estimate $\eta^*$). This section brings together results from various sources to determine for Bangladesh the directions and magnitudes of the rural welfare effects of a change in the price of staple foodgrains under induced wage responses.

In a companion paper to this one, Boyce and Ravallion (1987) have estimated a dynamic econometric model of agricultural wage determination in Bangladesh over the period 1949-50 to 1980-81. The long-run equilibrium of their model can be interpreted as a log-linear approximation of equation (11). This was embedded within a short-run dynamic process which permits sluggishness in wage adjustment and lags in response to changes in the market clearing wage rate. The long-run agricultural wage rate was assumed to depend on the prices of rice (also interpreted as a proxy for other staple foodgrains), cloth and jute, the manufacturing sector wage rate, agricultural yields per acre, and a quadratic function of time. The long-run equilibrium was found to be homogeneous of degree zero in all nominal prices. The fitted model performed well by all diagnostic tests performed on its residuals (including the Durbin-Watson, Box-Pierce, and Breusch-Godfrey tests for residual autocorrelation, Engle's test for ARCH type heteroscedasticity and the Jarque-Bera test for normality; for details see Boyce and Ravallion). Checks were also made for simultaneity bias using a generalized instrumental variables estimator in which only the lagged values of wages and prices were included in the set of instrumental variables. A model was also estimated in which the manufacturing wage rate was assumed to be influenced by the price variables, so as to pick-
up any further (indirect) effects of these variables on agricultural wage rates. The estimates obtained for both the short and long-run elasticity of the agricultural wage rate to the price of rice were found to be highly robust to changes in model specification. The preferred model under the data consistent parameter restrictions is:

\[
\Delta w_t^a = 0.045 + 0.22(p_t^r - p_t^c) + 0.47(w_t^m - w_t^a) - 0.32(w_{t-1}^m - p_t^c) - 0.00037t^2 + \hat{\nu}_t \\
(5.7) \quad (8.6) \quad (9.8) \quad (2.9)
\]

\[R^2 = 0.83; \quad \text{SEE} = 0.046; \quad \text{D-W} = 1.75; \quad Q(6) = 2.34; \quad \text{J-B}(2) = 1.29; \quad n = 31\]

where \(w^a\) and \(w^m\) are the logs of the agricultural and manufacturing wage rates respectively, and \(p^r\) and \(p^c\) are logs of the prices of rice and cloth respectively, and \(t\) is a time trend (expressed as the deviation from midpoint). The preferred estimates of the short-run (instantaneous) elasticity of the wage rate to the price of foodgrains is 0.22 (t=5.7) and that for the long-run (steady state) elasticity is 0.47 (t=5.0).

Following the arguments of Section 2, the welfare implications of these results will depend in part on whether the household is a net supplier of labour or net demander. I shall identify the former group as the rural "poor" and the latter as the rural "rich". For Bangladesh, this stylization is plausible.

The results quoted above indicate that \(\eta\) is significantly less than unity, in both the short- and long-run; t-ratios for the null hypothesis \(\eta=1\) are 20.2 and 5.6 respectively. Thus all net employers of agricultural labour with negligible non-farm income (\(Z\)) will unambiguously gain from an increase in the price of foodgrains.
For net suppliers of labour or net demanders with significant non-farm income, the welfare effects of a change in foodgrain price depend crucially on both the expenditure share devoted to foodgrains and the income shares from agricultural labour and own-production of foodgrains. These can be estimated from standard income-expenditure surveys. The present discussion will be mainly based on results of the 1978-79 household expenditure survey for Bangladesh as reported in BBS (1984), although supplementary data from other sources will also be considered.

It is clear that, on average, non-foodgrain expenditures (qy) dwarf non-farm incomes (Z) in rural areas for all except the very poor households; see, for example, BBS (1984, Tables 15.18 and 15.28). Thus it can be safely assumed that \( \eta^* > 1 \) for net demanders of labour, and so they will unambiguously gain from an increase in the price of foodgrains.

The welfare effect on net suppliers of labour is more contentious. From BBS (1984, Table 15.28) one finds that the mean share of wages in income for the poorest 55 per cent of rural households in 1978-79 was 0.48, although this varies a good deal according to income, falling sharply from 0.62 for the poorest households to 0.38 for the least poor households (Table 1). The same source gives estimates of imputed incomes from non-market activities for this group of households; this has a mean of 0.28 and, as can be seen from Table 1, varies little by income (0.24 to 0.30). "Business income" varies a good deal more, tending to increase with income (Table 1).
Table 1: Summary Data and Estimated Welfare Changes for Rural Poor, Bangladesh, 1978-79

<table>
<thead>
<tr>
<th>Monthly household income (Taka)</th>
<th>Cumulative percent households</th>
<th>Expenditure (% income)</th>
<th>Income by source (%)</th>
<th>Welfare effects of a 10% price increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Food (total)</td>
<td>Wages</td>
<td>Business income</td>
</tr>
<tr>
<td>&lt;300</td>
<td>8.7</td>
<td>70 46</td>
<td>62</td>
<td>11</td>
</tr>
<tr>
<td>300-399</td>
<td>19</td>
<td>72 48</td>
<td>57</td>
<td>16</td>
</tr>
<tr>
<td>400-499</td>
<td>31</td>
<td>72 47</td>
<td>48</td>
<td>21</td>
</tr>
<tr>
<td>500-749</td>
<td>55</td>
<td>73 47</td>
<td>38</td>
<td>26</td>
</tr>
</tbody>
</table>

Sources: Expenditure data are from BBS (1984, Table 15.25) and are given as a proportion of income, using the ratios of mean expenditure (BBS, 1984, Table 15.25) to mean income (BBS, 1984, Table 15.28). Income data are from BBS (1984, Table 15.28). Welfare changes are estimated using the fact that, from equation (7), the monetary value the welfare effect (expressed as a % of income) of a 10% foodgrain price increase is given by

\[
10 \times \begin{bmatrix}
\text{income share from foodgrain} & \text{income share on foodgrain production} & \text{wage rate elasticity wrt foodgrain consumption} & \text{income share from wage price}
\end{bmatrix}
\]
Further assumptions are necessary when interpreting the income decomposition data in Table 1. In particular, I shall assume that the "rural poor" are not only net labour suppliers, but also net demanders of food, i.e., they do not produce a positive marketable surplus. This is reasonable for Bangladesh. Thus the category "business income" should not include any income from the poor household's own-farm production, which will be found entirely under "imputed income". Furthermore, I shall assume that all imputed income is the value of foodgrain production.

Assumptions such as these are generally unavoidable when using the aggregated summary data typically available from income-expenditure surveys. The categories used in the published results need not correspond exactly to the desired theoretical categories. However, the above assumptions appear to be reasonable. Casual observations suggest that business income for the rural poor in Bangladesh is largely obtained from non-agricultural cottage industries and services. And the implied estimate of 0.28 for mean farm income of the poor accords well with at least one independent survey: at a similar time, Osmani and Chowdhury (1983) obtained a mean of 0.27 for the proportion of income from agriculture in a sample of about 500 poor rural households in Bangladesh. Probably a small proportion of the imputed income from own-production is not from foodgrains; most peasants in Bangladesh typically devote a small amount of land to vegetables to be consumed at home. Thus, the assumption that all imputed income is from foodgrain production probably leads to underestimation of $\eta^*$. 
Nor is the available data ideal on the expenditure side. BBS (1984, Table 15.18) gives a figure of about 0.75 for the share of expenditure going to food by the rural poor, and this shows negligible variation according to income amongst the poorest half of the income distribution. BBS (1984) does not, however, give a more detailed breakdown of food expenditures. For an earlier (1973-74) survey, BBS (1980, Table 4.12) does give more detail. An Engel curve was calibrated to the earlier data and used to estimate expenditure shares devoted to staple foodgrains during 1978-79, assuming a stable demand function. The estimated foodgrain share of expenditure for the poorest half of the rural population is approximately 50 per cent and this varies little with income. As a proportion of income the mean is 0.47.

Combining these assumptions and sources, it appears that two of the three figures necessary for calculating $\eta^*$ can be estimated with considerable precision, while the third (the income share from wage labour) appears to be rather more variable amongst the poor. I shall consider the implications of this later. At the mean points, the above sources indicate a value of $\eta^* = 0.43$ for the rural poor, again defined as the poorest 55 per cent of households according to household income.

On the basis of these results it is plausible that the rural poor will typically be worse off in the short-run after an increase in the price of food staples. Boyce and Ravallion's point estimate for short-run $\eta$ of 0.22 is well below the above estimates of $\eta^*$ and, indeed, the latter are also outside the Boyce and Ravallion 95 per cent confidence interval for short-run $\eta$ of (0.14, 0.30).
The long-run effect is less clear. At mean points, the above estimate of $\eta^*$ is negligibly different from the Boyce and Ravallion estimate for long-run $\eta^* (\eta-\eta^*=-.04)$. It appears then that the welfare of poor households would typically be fairly unresponsive to the price of foodgrains in the long-run.

The significance of differences in welfare levels amongst the poor should not, however, be underrated. It is not obvious on a priori grounds how the direction of the welfare effect will vary according to income. In Bangladesh (as elsewhere in South Asia), the poorest households in rural areas tend to have access to the least amount of food. To a first-order approximation in partial equilibrium, the welfare loss (as a proportion of income) from a food price increase will be directly proportional to the household's excess demand for food (as a proportion of income) which will tend to be greater for the poorest households. More generally, the welfare loss will be mitigated by the response of wages, and, as noted earlier, the share of income from wage labour tends to increase as income falls. From Table 1 it can be seen that the rate at which imputed income from own production falls with income amongst the poor is modest compared with the rate at which the wage share of income rises as income falls. Thus, on balance, the value of $\eta^*$ tends to vary positively with income, as can be seen in Table 1. It follows that (in contrast to the partial equilibrium result) the long-run welfare effect of a foodgrain price increase is more likely to be positive for the poorest households.

Table 1 brings together these considerations to enable estimates of the monetary values of the welfare changes due to foodgrain price...
increase for the rural poor. The calculations are done for a 10 per cent increase in the price of foodgrains, and the results are expressed as percentages of total income. The monetary value of the short-run welfare loss from such a price increase represents about one per cent of income amongst the poor. In the long-run, the poorest group gains the equivalent of slightly less than three quarters of one per cent of income while the gain to the least poor group is negligible.

Since the short-run and long-run effects of an increase in foodgrain prices on welfare of the rural poor are in opposite directions, it is also of interest to ask: how long will it take for the welfare effect to change sign? From the results of Boyce and Ravallion (1987, equation 14) one can calculate that the elasticity of the wage rate to a foodgrain price reaches a value which is negligibly different from the mean $\eta^*$ of 0.43 by the fourth year after the price increase. A typical poor person would not start to gain from the price increase before this time. The time taken for the welfare effect to change direction also varies amongst the poor; for the poorest group in Table 1, $\eta$ is negligibly different from $\eta^*$ by the second year, while for the highest income group amongst the poor, the switch point is not reached until early in the fifth year after the price increase.

4. Conclusions

The empirical results on wage formation in Bangladesh presented in Boyce and Ravallion (1987) suggest that an increase in the price of rice is very unlikely to be passed on in the agricultural wage rate, even in
the long-run. The results of this paper suggest that, with induced wage responses, it is likely that the short-run distributional effects on rural welfare in Bangladesh tend to be in the same direction as those implied by partial equilibrium analysis: the rural rich are likely to gain and the rural poor lose from an increase in the relative price of food staples. This is also likely to be the case in steady state equilibrium for the rural rich, but the welfare of a typical poor household is more likely to be neutral to the price of rice in the long-run. The long-run welfare effect will, however, vary amongst the poor and (contrary to intuitions based on partial equilibrium analyses which ignore wage responses), the effect on welfare of a price increase appears more likely to be positive for the poorest households than for those who are less poor. It would typically take three or four years before a rice price increase ceased to have an adverse effect on welfare of the poor.
Footnotes


2. Though Sah and Stiglitz do consider other outcomes in which the food price elasticity of the agricultural wage is less than unity; see their Proposition 7 (p.126).

3. For an introduction to agricultural household models of this type see Singh et al., (1986, Chapter 1).

4. This can be readily proved by taking the total differential of (4), noting that, by the envelope theorem, \( \frac{\delta v}{\delta p} = -\lambda x \), \( \frac{\delta v}{\delta q} = -\lambda y \), \( \frac{\delta v}{\delta w} = -\lambda L_1 \) (where \( \lambda = \frac{\delta v}{\delta Y} \)) and \( \frac{\delta \pi}{\delta p} = x \), \( \frac{\delta \pi}{\delta w} = -(H + L_3) \).

5. This need not be of negligible importance; for an analysis of the determinants of voluntary re-distribution in a similar setting see Ravallion and Dearden (1988).

6. Absolute t-ratios are given in parentheses. D-W is the Durbin-Watson test, Q is the Box-Pierce test for serial correlation and J-B is the Jarque-Bera test for normality of residuals.
7. The poor in a typical Bangladesh village are often involved in various small scale business activities. These comprise the supply of various transport and domestic services and petty trading activities, such as collecting natural fuels and selling prepared beverages.

8. One may be able to avoid these problems in future work with access to unit record data.

9. The following Engel curve was calibrated to 1973-74 data (from BBS, 1980, Table 4.11) for 11 expenditure groups (the top two were excluded to give more precise estimates for lower income groups):

\[ \hat{S} = 0.33 + 0.14 \ln E - 0.015 (\ln E)^2 \]
\[ R^2 = 0.90 \]
\[ (5.5) \quad (6.0) \quad (6.7) \]

where \( \hat{S} \) = share of total food expenditure devoted to foodgrains, \( E \) = mean monthly expenditure on all foods, and absolute t-ratios are given in parentheses. Mean food expenditures by income group for 1978-79 were deflated to 1973-74 prices for use in the above formula.
References


Tyagi, D.S. (1979), "Farm Prices and Class Bias in India", *Economic and Political Weekly* 14.
**Mathematical Addendum** (Not for publication).

**Notation**

\[ x = \text{food consumption} \]
\[ X = \text{food production} \]
\[ y = \text{non-food consumption} \]
\[ Y = \text{full income} \]
\[ L_1 = \text{leisure} \]
\[ L_2 = \text{labour supply} \]
\[ L_3 = \text{own labour use} \]
\[ H = \text{hired labour time} \]
\[ Z = \text{other income} \]
\[ h = \text{land' holding} \]

**Farm-Household's Choice Problem (Section 2)**

The household's problem is to find values of \( x, y, L_i \) (\( i = 1, 2, 3 \)), and \( H \) which maximize

\[ u(x, y, L_1) \]

subject to

\[ px + qy + wH = wL_2 + pX + Z \]
\[ L_1 + L_2 + L_3 = 1 \]
and where

\[ X = X(h, L_3 + H) \]

The problem is recursive so it can be solved in two stages:

i) \( L_3 + H \) is chosen to maximize \( pX(H, L_3 + H) - w(L_3 + H) \) yielding \( \pi(p, w, h) \), with derivative \( \pi_w = -(L_3 + H) \).

ii) \( x, y \) and \( L_1 \) are chosen to maximize \( u(x, y, L_1) \) subject to

\[ px + qy + wL_1 = w + \pi(p, w, h) + Z = Y \]

**Welfare Effects of Price Changes**

The indirect utility function is

\[ v(p, q, w, Y) \]

with the usual derivatives \( v_p = -x\lambda, v_q = -y\lambda, v_w = -L_1\lambda \) where \( \lambda = v_Y \).

Taking the differential one finds that

\[ du = v_p dp + v_q dq + v_w dw + \lambda dY \]

where

\[ dY = dw + \pi_p dp + \pi_w dw + dZ \]
Thus (using the derivatives of \(v\) and \(\pi\), and the time constraint) one finds that:

\[
\frac{du}{\lambda} = (X-x)dp - ydq + (L_2-H)dw + dZ
\]

The results in (5), (6) and (7) are then readily obtained.
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