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RESEARCH NOTES

Structure of Rural Income Inequality: A Study in Western Uttar Pradesh

Ever since the introduction of new farm technology, issues concerning growth and income distribution have been at the centre stage of rural development policies in most of the developing countries. Given the unequal distribution of land, it has been increasingly realised that growth in agriculture alone may not bring about substantial reductions in the levels of rural poverty but it may have adverse effect on distributional equity (Frankel, 1971; Griffin, 1974; Sarma, 1982). Thus growth promoting policies have been supplemented with equity oriented measures so as to counterbalance the economic inequalities due to uneven distribution of land.

Disaggregating income inequality by source provides meaningful estimates of the contribution of the income sources to total inequality and direction of change in inequality due to change in income from a source. Recently new methodologies have been developed to examine the extent to which different income sources influence total inequality (Kakwani, 1977; Pyatt, *et al.*, 1980; Shorrocks, 1982; Lerman and Yitzhaki, 1985). Using different decomposition techniques a number of studies have been carried out to assess the impact of various income sources on total inequality (Ahearn *et al.*, 1985; Paul, 1989; Adams and Alderman, 1992). Such studies are of considerable use in policy analysis as they help to identify spatial and temporal changes in the structure of income inequality.

Using household level data, this paper attempts to examine the structure of rural income inequality in Western Uttar Pradesh. The method of measurement and decomposition of inequality is discussed in Section I. Section II presents data set. The access of rural households to different income sources and estimates of decomposition are presented in Section III, followed by conclusions in Section IV.

I

MEASUREMENT AND DECOMPOSITION OF INEQUALITY

To provide a quantitative estimate of the importance of different income sources requires a summary measure of inequality. One such measure that has been used extensively in income distribution studies is the Gini index. Gini index is based on the concept of Lorenz curve which relates the cumulative proportion of income units to the cumulative proportion of income received when the recipients are ranked in ascending order of their income. Geometrically, Gini index is the area between Lorenz curve and a diagonal representing perfect equality as a proportion of the area of the triangle below the diagonal. If the income is perfectly equally distributed, the Lorenz curve coincides with the diagonal and the Gini index equals zero; if the distribution is perfectly inegalitarian, the Lorenz curve coincides the right angled sides of the triangle and the Gini index equals one.

Gini index has certain desirable properties that any inequality measure should have. They are: (1) Pigou-Dalton transfer sensitivity; (2) mean independence; (3) symmetry; (4) population homogeneity; and (5) decomposability. Pigou-Dalton transfer sensitivity condition is satisfied if the measure of inequality decreases when there is a transfer of income from a higher income unit to a lower income unit. Mean independence implies that the measure of inequality is invariant to proportional changes in income. The condition of symmetry requires the measured level of inequality to remain unchanged when income units switch places in income order. Population homogeneity holds if increasing or decreasing population

size across all income levels leaves the measured level of inequality unaffected. The property of decomposability allows inequality to be partitioned either over sub-populations or sources. An inequality measure is decomposable by source if total inequality can be broken down into weighted sum of inequality by source. Also any source decomposable measure must take into consideration the covariances among income sources since a source is less likely to be independent of others that comprise total income.

The decomposition of Gini index by source can be traced to Kakwani (1977) wherein a given source's contribution to total inequality is the product of its share in total income and the pseudo-Gini (concentration ratio). Extending derivations of Kakwani (1977), Lerman and Yitzhaki (1985) measure the contribution of a source to total inequality as the product of its share in total income, source Gini and the correlation between source and total income. An important feature that makes Lerman-Yitzhaki decomposition technique attractive to use in empirical studies is that it enables us to measure the marginal impact of a change in income source on total inequality. Absolute Gini index, A is defined as twice the covariance of total income, y to its cumulative distribution F(y), i.e.,

$$A = 2 \text{ cov } [y, F(y)] \quad \text{....(1)}$$

Dividing equation (1) by mean income, $\bar{y}$ yields the conventional Gini coefficient or the relative Gini index, G.

$$G = 2 \text{ cov } [y, F(y)] / \bar{y} \quad \text{....(2)}$$

If there are $y_1, y_2, \ldots, y_k$ sources that comprise total income, then

$$y = \sum_{k=1}^{K} y_k \quad \text{....(3)}$$

On substitution of equation (3) into equation (2), we get

$$G = 2 \sum_{k=1}^{K} \text{cov}(y_k, F)/ \bar{y} \quad \text{....(4)}$$

where cov (y_k, F) is the covariance of income source, k with cumulative distribution of total income. In equation (4) multiplying and dividing each source, k by cov (y_k, F_k) and by $\bar{y}_k$ yields decomposition of total inequality by source:

$$G = \sum_{k=1}^{K} [\text{cov}(y_k, F)/\text{cov}(y_k, F_k)] \; [2\text{cov}(y_k, F_k)/ \bar{y}_k] \; [\bar{y}_k / \bar{y}] \quad \text{....(5)}$$

Equation (5) can be written as

$$G = \sum_{k=1}^{K} R_k \, G_k \, S_k \quad \text{....(6)}$$

where R_k is the Gini correlation between income source, k and total income, i.e., $R_k = \text{cov}(y_k, F)/ \text{cov}(y_k, F_k)$. The relative Gini index of source, k is given by the expression, $G_k = 2 \text{ cov}(y_k, F_k) / \bar{y}_k$; and S_k represents source k's contribution to total income, $\bar{y}_k/ \bar{y}$.

The properties of Gini correlation resemble that of Pearson and rank correlations. Like both, the Gini correlation ranges between -1 and +1. A monotonically increasing (decreasing) function yields a value of +1 (-1). Thus Gini correlation equals 1(-1) when an income source is increasing (decreasing) function of total income. When an income source is constant the Gini correlation equals zero implying that a source's share of Gini is zero. The covariance term, cov (y_k, F_k) can be substituted by the covariance of income source with the rank (r) of income source (in ascending order) divided by the number of observations, since r/n represents $F(y_k)$. The Gini correlation R_k is then defined as the ratio of covariance of income source with the rank of total income to the covariance of the income source to its rank. The

effect of a change in income source on total inequality is measured by taking partial derivative of overall Gini (equation 6) with respect to a percentage change (e) in k-th income source (see, Lerman and Yitzhaki, 1985):

$$(\delta G/\delta e_k) = S_k (R_k G_k - G) \quad \ldots(7)$$

Dividing equation (7) by G gives us marginal effect of the source relative to overall Gini, which can be written as the inequality contribution of the source as a proportion of the total Gini minus the source's share of total income:

$$[(\delta G/\delta e_k)/G] = [R_k S_k G_k/G) - S_k \quad \ldots(8)$$

Adding up marginal effects of different sources yields zero, and multiplying all sources by e does not affect the overall Gini.

II

DATA SET

Observations in this paper are based on primary data collected from 150 rural households selected from three villages of Moradabad district in Western Uttar Pradesh. The district has experienced tremendous growth in its agriculture during the last twenty-five years. It is well-served by irrigation, credit, agricultural extension, transportation and marketing infrastructure. About 58 per cent of the total workers in the district are engaged in cultivation and 11 per cent are agricultural workers. The distribution of land is highly inegalitarian as 80 per cent of the holdings are of less than two hectares in size and account for 41 per cent of the total area. Whether animal husbandry is a primary or secondary source of income, it is one of the important occupational activities in the rural areas. There are about 230 animals per 100 hectares of land with buffalo and cattle as the dominant species.

The information on various aspects of income sources was obtained from the selected households for the agricultural year 1991-92. The sample consisted of 51 landless, 75 marginal (less than 2.5 acres), 10 small (2.5 - 5.0 acres), 11 medium (5 - 10 acres) and 6 large (more than 10 acres) farm households. However, three households (one each from landless, medium and large category) have been dropped in the analysis due to incomplete information. The sources that comprise the income of the selected households are as follows:

1) Agriculture	- Includes income in crop production.
2) Livestock	- Includes income from livestock.
3) Farm labour	- Includes wage receipts by the household members in return for their supply of labour for farm work.
4) Non-farm labour	- Includes non-farm wage earnings of the households.
5) Business and artcrafts	- Include income from business and artcrafts (shop-keeping, trading, pottery, carpentry, blacksmithy, etc.).
6) Salaries	- Include salaries of the households if employed in public or private sector.
7) Transfers	- Include internal and external remittances by family members (other than the head of the household), gifts, pensions, etc.

III

RESULTS AND DISCUSSION

Access of Rural Households to Income Sources

Table I shows the distribution of households having access to different income sources. Most of the households earn income from more than one source. Agriculture, livestock and wage labour are the main sources of income in the selected villages. Agriculture undoubtedly is one of the main occupations of the land owning households, however many of the marginal land holders also work as wage labourers. The landless households earn their livelihood mainly by working as wage labourers. As such, 34 and 25 per cent of the households have reported having received income by working as wage labourers in and outside agriculture respectively. Livestock-keeping is an important occupation for both farm and non-farm households as 77.33 per cent of the sample households reported livestock as one of their income sources.

TABLE I. COMPOSITION OF INCOME OF THE SAMPLE HOUSEHOLDS

Income source	Percentage of households having access to income source	Income (Rs./household)	Percentage of total income	Coefficient of variation in income (per cent)
(1)	(2)	(3)	(4)	(5)
Agriculture	66.67	13,240.11	47.88	108.90
Livestock	77.33	5,548.65	20.06	85.03
Farm labour	34.00	2,242.00	8.11	165.46
Non-farm labour	25.33	1,592.27	5.76	233.79
Business and artcrafts	13.33	1,766.67	6.39	273.53
Salaries	12.00	2,010.67	7.27	310.88
Transfers	17.33	1,251.33	4.53	244.03
Total	-	27,651.70	100.00	59.41

The percentages under column (2) do not add up to 100 since most of the sample households have multiple income sources.

The households which have inadequate land base or are landless take up traditional occupations like carpentry, pottery, blacksmithy, etc. A few of the landless as well as farm households are also self-employed in other activities such as shop-keeping, small scale industries, repair workshops, trading in grains, livestock and livestock products. However, these occupations constitute a source of income only for 13 per cent of the households. Similarly, there are substantial proportions of households which do not have any access to salaries and transfers. It may be noted that many of the non-farm occupations require some level of skills and/or formal education and the lack of which is responsible for the restricted access to these sources of income.

Sourcewise mean household income along with standard deviation is also presented in Table I. Agriculture is the main source of income and accounts for 47.88 per cent of the total income, followed by livestock (20 per cent) and farm labour (8.11 per cent). The non-farm sources together contribute about 24 per cent to the total income. A disaggregated view of non-farm income shows that salaries contribute the most to non-farm income. Business and artcrafts comprise the second largest component of non-farm income, followed by wages and transfers. As a result of limited access, there is a wide variability in non-farm

incomes. The coefficient of variation is the highest for salaried income, followed by business and artcrafts, transfers and non-farm labour. On the contrary, agriculture and livestock incomes showed lower degree of variability.

Structure of Income Inequality

The extent of inequality by income source and the contribution of different sources to total income inequality are presented in Table II. The Gini indices by source show that the salaried income is the most unequally distributed with an index value of 0.91. In fact the distribution of income from all non-farm sources is highly inegalitarian and the Gini index for each of the source is estimated to be above 0.85. Similarly, the farm wage earnings too are quite unevenly distributed (G = 0.76). The high Gini indices for these sources can be understood in the light of their wide dispersion as there are substantial proportions of households which do not earn any income from these sources. The income from livestock is the most equally distributed (G = 0.47), followed by agricultural income (G = 0.54). The Gini index for total income is the weighted sum of the product of the source's share in the total income, Gini index of the source and its correlation with total income. The Gini index for the total income (0.27) shows that the total income is more equally distributed than the sources that comprise it.

TABLE II. DECOMPOSITION OF INCOME INEQUALITY BY SOURCE

Income source	Income share	Gini of source	Correlation with rank of total income	Contribution to total inequality	Proportional contribution to total inequality	Relative income inequality	Relative marginal effect
	(S_k)	(G_k)	(R_k)	($R_kG_kS_k$)	($R_kG_kS_k/G$)	(col.6/col.2)	(col.6/col.2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agriculture	0.4788	0.5380	0.7476	0.1926	0.7152	1.4937	0.2364
Livestock	0.2006	0.4660	0.4545	0.0425	0.1578	0.7862	-0.0428
Farm labour	0.0811	0.7596	-0.5157	-0.0318	-0.1181	-1.4562	-0.1992
Non-farm labour	0.0576	0.8499	-0.1636	-0.0080	-0.0297	-0.5156	-0.0873
Business and artcrafts	0.0639	0.8936	0.3752	0.0214	0.0795	1.2441	0.0156
Salaries	0.0727	0.9063	0.5379	0.0354	0.1314	1.8070	0.0587
Transfers	0.0453	0.8690	0.4357	0.0172	0.0639	1.4106	0.0186
Total income	1.0000	0.2693	1.0000	0.2693	1.0000	1.0000	0.0000

The contribution of each source to total inequality is calculated as the product of the source's Gini index, its share in the total income and its correlation with total income. The higher the values of these estimates for a source, the higher will be its contribution to total inequality. Column 5 in Table II presents the absolute contribution of each source to total income inequality. The proportional contribution of a source to total inequality is the ratio of its absolute contribution to overall Gini index (col. 6). As expected, the contribution of agriculture to total inequality is the highest (71.52 per cent) because of its maximum contribution to total income and high degree of correlation with total income (R = 0.75). Since agriculture is identified as the main source of income inequality, we have estimated the inequalities in the distribution of land and its productivity - the two factors that yield total income. The Gini index for distribution of land and income per unit of land has been

estimated to be 0.40 and 0.14 respectively which indicate that the inequalities in agricultural income are mainly due to uneven distribution of land. Further, we have regressed per acre income (y) on size of land holding (x) to examine the size-productivity relationship and its implication for equity. The estimated equation is $y = 7885.11 - 279.75\ x$, ($t = 5.79$, $R^2 = 0.27$) which shows an inverse relationship between farm size and productivity. The implication is that the higher productivity on smaller farms partially counterbalances the inequality in agricultural income due to uneven distribution of land.

Livestock which is the second largest source of income is moderately correlated to total income and contributes 15.78 per cent to total inequality. Similarly, the incomes from salaries, business and artcrafts, and transfers have a moderate degree of correlation with total income and contribute 13.14, 7.95 and 6.39 per cent respectively to total income inequality. Both the farm wages and non-farm wages are negatively correlated with total income and thus make negative contributions to total income inequality to the extent of 11.81 and 2.97 per cent respectively. Besides, whether a source is inequality-increasing or inequality-decreasing is decided by relative inequality coefficient which is defined as the ratio of proportional contribution of a source to total inequality to its share in total income (col. 7 in Table II). A value greater than one classifies a source as inequality-increasing or vice versa. Agriculture, salaries, business and artcrafts, and transfers are identified as inequality-increasing income sources, while livestock, farm- and non-farm wages reduce income inequality.

The extent to which a change in income source would increase or decrease total inequality is given in column 8 of Table II. The relative marginal effect is calculated as the difference between a source's share of inequality and its share in total income. The magnitude and direction of this relationship would give us the effect of a change in income source on total inequality on the margin. A positive sign would indicate an increase in total inequality on the margin due to an increase in income from that source. The relative marginal effect associated with agriculture is positive and the largest which implies that an increase in income from this source would add more to total inequality in comparison to other sources. However, it may be noted that an increase in income from any other source in relation to the dominant source, i.e., agriculture would tend to decrease relative marginal inequality. Like agriculture, an increase in income from non-farm sources (except non-farm wages) would tend to increase income inequality on the margin. This is due to the fact that the opportunities for non-farm works are limited to those who are endowed with some skills and human capital.

The relative marginal effect of livestock is negative, indicating thereby an improvement in distributional equity due to an increase in income from this source. Agricultural wages have the largest negative relative marginal effect on total inequality which, by and large, is a result of concentration of wages among the lower income groups. This result suggests an improvement in rural income distribution due to an increase in wage income but to what extent the wage income could be increased would depend on the nature of technological change in agriculture and the conditions of demand for and supply of labour in and outside agriculture. A labour intensive technique would increase the demand for hired labour and consequently an increase in farm wage bill. However, the opportunities for employment in

agriculture are limited by increasing population pressure on cultivable land and decreasing size of land holding. Further, the share of farm wages in the total income is small and an increase in income of any other inequality-decreasing source, particularly livestock, would weaken the effect of farm wages on total inequality. Reducing inequality through redistribution of land is a remote possibility because of decreasing size of land holding and the prevalent socio-economic and political environment. Thus the equity-oriented policy measures should emphasise on the development of subsidiary activities and non-farm employment opportunities as well as creation of other income generating activities which are less dependent on land. However, the results indicate that there is a need for an improvement in skills and formal education of the lower income groups so as to increase their access to non-farm income generating activities.

IV

CONCLUSIONS

The study has analysed the impact of income sources on rural income distribution in Western Uttar Pradesh. Though the results could not be generalised due to small sample size, yet they offer some useful insights into the dynamics of rural income distribution. Agriculture by virtue of its being the dominant source of income in the rural areas is the main source of income inequality which, by and large, is a result of uneven distribution of land. Livestock is the second largest contributor to rural income and is the most equally distributed source of income. The non-farm sources account for about one-fourth of the total income and the distribution of income from these sources is highly inegalitarian.

Agriculture, salaries, transfers, and business and artcrafts are identified as inequality-increasing sources of income, while livestock, farm wages and non-farm wages reduce income inequality. The results suggest the need for effective implementation of land reform measures, development of small farms and subsidiary activities, and increasing opportunities for employment in and outside agriculture to narrow down inequalities in rural income distribution. However, in view of the decreasing size of land holding, it may not be possible to increase the opportunities for employment in agriculture and to enlarge the productive asset base of the lower income groups by providing them more land. The policy measures thus need to emphasise on development of subsidiary activities that require little or no land and creation of opportunities for employment outside agriculture to reduce inequalities in rural income.

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