LABOUR MIGRATION, INCOME INEQUALITY AND REMITTANCES: A CASE STUDY OF MEXICO

by

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ABSTRACT

This paper uses the extended Gini inequality index to examine the sensitivity of measurements of impacts of migrant remittances on the distribution of household income by size to different value judgements when measuring inequality. The results illustrate the robustness of earlier findings that the impacts of migration on village income distributions differ for different types of migration and for different periods in a village's migration history. The magnitude of these impacts, however, appears to be quite sensitive to the weights attached to incomes at different points in the village income distribution. For example, in a village with considerable Mexico-to-U.S. migration experience, remittances from Mexico-to-U.S. migrants have a favorable effect on the village income distribution. However, the extended Gini analysis shows that this favorable impact decreases as more weight is attached to incomes in the poorest households. This finding is consistent with the view that barriers to high-paying Mexico-to-U.S. migration work exist for households at the bottom of the village income distribution.
The role of rural-to-urban migration in the process of urbanization and economic growth in less-developed countries (LDCs) has sparked a debate on the consequences for income distribution and welfare in the rural sending areas (Lipton (1977 and 1980), Stark (1978), Stark and Yitzhaki (1982), Stark, Taylor and Yitzhaki (1986)). This debate is prompted by several considerations: The large contribution of rural inequalities to overall income inequality in LDCs; the rural component of national poverty; and the varying impacts of development processes and policies on different segments of the rural income spectrum. In addition, the economic implications of a small change in the national income distribution occurring at the low (rural) end may be very different from the implications of a small change occurring at the urban end of the distribution, particularly with regard to investment and consumption patterns.

The full impact of migration on a village’s income distribution is multifaceted and complex, and many components of this impact may not be quantifiable. For example, estimates of migrants’ net contributions to household income need to take account of the full opportunity cost of migration, including income migrants would have contributed to their households had they not migrated. Migrants’ net contributions to household income are a subset of the overall impact of migration on the household’s resources and opportunities. For example, migration affects the household’s income risk (Lucas and Stark (1985)), the household’s production and investment decisions (Stark and Levhari (1982)), the household’s rank (Stark and Taylor (1986)), and so on. And remittances may favorably affect the distribution of income also
via a filtering down effect, e.g., if they result in an increased demand for the products and services of the poorest households within the village.

Diverging views concerning the effect of out-migration on the distribution of income by size in rural sending areas and on rural welfare reflect assumptions about both short-term and long-term externalities associated with migrants' departure from their villages, the size of migrant remittances, and the position of migrant-sending households in the rural income distribution. They also reflect value judgements, in particular the weight attached to distributional versus mean income objectives and the weight attached to incomes of households at different points in the income distribution when calculating indices of inequality.

Whereas migrants' net remittances are not likely to represent the full effect of migration on village income inequalities, they constitute perhaps the most important direct impact of migration on village household incomes, are relatively easily measured and are a logical and useful starting point for understanding the distributional consequences of migration for migrant-sending areas. In an earlier paper (Stark, Taylor and Yitzhaki (1986)) we proposed a framework and developed techniques for analyzing the impact of migrant net remittances upon the distribution of household income by size, and consequently on economic welfare in migrant-sending communities. Gini decompositions and household data were used to assign numerical coefficients to the impact of net remittances from Mexico-to-U.S. migrants and from internal migrants on income inequality in two Mexican villages. Our findings suggest that the distributional impact of migrants' remittances is favorable overall but differs for different types of migration and for different periods in a village's migration history. This impact depends critically on the degree to which migration opportunities become diffused through the village population, on the
returns to human capital embedded in remittances, and on the distribution of potentially remittance-enhancing skills and education across households.

How robust are these findings to the implicit—but nonetheless specific—distributional weights inherent in calculating the standard Gini index? For example, would a shift in weights entail a reversal of our conclusion that migrants' remittances have an equalizing impact upon the distribution of income by size in the village of origin? In the present paper we go a step beyond our earlier findings by exploring their sensitivity to different value judgements when measuring inequality. This is achieved through the use of the extended Gini inequality index (Yitzhaki (1983), Lerman and Yitzhaki (1985)). Section I describes the properties of the extended Gini index, of which the standard Gini index is a special case. In Section II we examine the sensitivity of results obtained in our earlier work to the weights attached to incomes at different points in the village income distribution. Conclusions are presented in Section III.

I.

Let \( v \) be an "equity weight" parameter ranging from one to infinity. The extended Gini of a variable \( Y \) is defined as:

\[
G_Y(v) = -v \frac{\text{cov}(Y,[1-F(Y)]^{v-1})}{\bar{Y}}
\]

(1)

where \( \bar{Y} \) is the mean of \( Y \). In the special case where \( v=2 \), (1) gives the standard Gini index:

\[
G_Y(2) = -2 \frac{\text{cov}(Y,[1-F(Y)])}{\bar{Y}}
\]

\[
= 2 \frac{\text{cov}(Y,F(Y))}{\bar{Y}}
\]
The extended Gini is similar to Atkinson's (1970) index of inequality. The parameter \( v \) in the extended Gini plays a role similar to that of \( \epsilon \) in Atkinson's index. The exact weighting scheme for each \( v \) is investigated in Yitzhaki (1983). For our purposes, it is worth noting the following cases:

As \( v \to \infty \), the index \( G_Y(v) \) reflects the Rawlsian criterion. That is, if \( Y \) is household income, we evaluate inequality as though we were interested in maximizing the income of the poorest household in the society. As \( v \to 1 \) we obtain an inequality index in which there is no concern about inequality at all. Graphically, the difference between the Gini index and the extended Gini index is that, while the Gini represents the area between the Lorenz curve and the 45 degree line, the extended Gini assigns different weights to different portions of this area. These weights depend on \( v \). A larger value of \( v \) implies a larger weight on incomes at the bottom of the income distribution, and vice versa.

The decomposition of the extended Gini is similar to the decomposition of the standard Gini presented in Lerman and Yitzhaki (1985) and Stark, Taylor and Yitzhaki (1986). Let \( Y = \sum_k x_k \), where \( x_k \) denotes component \( k \) of household income. Then the decomposed extended Gini is:

\[
G_Y(v) = \sum_k S_k R(k,v) G(k,v)
\]

where

\[
G(k,v) = -v \frac{\text{cov}(x_k, [1-F(x_k)]^{v-1})}{X_k}
\]

is the extended Gini corresponding to income component \( k \), \( 0 < G(k,v) < 1 \);

\[
S_k = \frac{x_k}{Y}
\]

is the share of income from source \( k \) in total household income; and

\[
R(k,v) = \frac{\text{cov}(x_k, [1-F(Y)]^{v-1})}{\text{cov}(x_k, [1-F(x_k)]^{v-1})}
\]
denotes the extended Gini correlation coefficient. The extended Gini correlation coefficient is a correlation coefficient between income from source $k$ and household rankings in terms of total income. Its properties include the following:

1. $-1 < R(k, v) < 1$, where $R(k, v) = 1 (-1)$ for all $v > 1$ if $x_k$ is a monotonic increasing (decreasing) function of $Y$;

2. $R(k, v) = 0$ for all $v$ if $x_k$ and $Y$ (in the general case) are independent or if $x_k$ is a constant;

and

3. $R(k, v) = \rho_k$, where $\rho_k$ is Pearson’s correlation coefficient, if $Y$ and $x_k$ are normally distributed. (A proof is provided in the Appendix.)

Extended Gini indices cannot be meaningfully compared for different equity weights $v$, just as absolute values of different welfare functions cannot be meaningfully compared. However, the percentage contributions of different income sources to total income inequality may be compared for different equity weights. In addition, the three properties of the extended Gini correlation listed above enable us to compare extended Gini correlations for different values of $v$. If the extended Gini correlation decreases (increases) as $v$ increases, this reveals that the correlation between income from source $k$ and total income is lower (higher) at the lower end of the income distribution. Extended Gini correlations together with relative contributions of different income sources to income inequality for different equity weights are the focus of the sensitivity analysis which follows.
II.

In our earlier study we used the decomposed standard Gini \( G(2) \) to examine the contribution of Mexico-to-U.S. migrant remittances, of internal migrant remittances and of non-remittance income to income inequalities in two Mexican villages. The data afford a unique opportunity to compare the effects of remittances from both internal and international migrants on income inequality in villages with different degrees of migration experience. Since we shall use our earlier findings as a benchmark for our current inquiry we shall first briefly describe the villages and offer a summary of these findings.

Data for constructing the extended Gini indices were collected in 1983 in two villages in the Pátzcuaro region of the state of Michoacán, Mexico, approximately 2,000 kilometers south of the Mexico-Arizona border. The survey sample consists of 425 adults 13 years of age or older representing the total adult population in 61 randomly-chosen households, or approximately ten percent of the total number of households in each village. In no case in our sample had an entire household left the village. The households in the sample follow a migration strategy that is reminiscent of rural-to-urban migration in many LDCs (Stark, 1978): presumably in line with comparative advantage considerations, some sons and daughters migrate, remitting part of their earnings to the village household, while their parents typically remain in the village, tending to domestic affairs and managing the household farm. In some cases heads of household worked for a short term as internal migrants. However, rarely did they participate in Mexico-to-U.S. migration, which generally requires a large commitment of capital and time away from the village thereby effectively precluding raising crops in Mexico.

Although the villages we studied are only two kilometers apart and are statistically similar in several respects, for example in terms of family size,
the differences in their migration patterns are striking. Only 26 percent of Village 1 households had at least one family member working in the United States in 1982. By contrast, Village 2 households show evidence of a long tradition of Mexico-to-U.S. migration. Seventy percent of households in this village had family members who were Mexico-to-U.S. migrants in 1982, and these households had an average of 2.8 Mexico-to-U.S. migrants each, compared to an average of just 1.7 per household in Village 1. As a result, Mexico-to-U.S. migrant remittances constituted a much larger share of total income in Village 2 households (27 percent) than in Village 1 households (9 percent). This difference is significant at the .005 level.

Internal migration plays an important role in labor allocations in both villages. A significantly larger share of households participates in internal migration in Village 1 (71 percent) than in Village 2 (46.7 percent), but the average number of internal migrants per internal migrant household is significantly larger in Village 2. As a result, the difference between the shares of internal migrant remittances in households' total income in the two villages is not statistically significant.

In the discussion that follows our interest is in examining the effect of migrants' net remittances on inequality in what is essentially the short run.¹ That is, given non remittance income, we ask what will be the effect of a given increase in remittances on inequality. Of course, as already noted in the

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¹ The computations that follow are based on income per household. Calculations of standard Gini decompositions using a measure of per capita household income (household income divided by the number of household members 13 years of age or older who spent any part of the year "at home") produced no change worth noting.
introduction, the short- and long-term impacts of migration on village income inequality, both as measured by the standard Gini index and as measured by the extended Gini index, may be influenced by factors other than net remittances. A change in the sign of our findings will result only if these factors are very significant and their distributional effects run in a direction that is contrary to the direction of the effects of net remittances. At this point, we can see no empirical basis for such a possibility. Finally, we recognize the caveat that the magnitude and impact of migrant remittances also may differ depending upon the location-specific attributes of the village especially, in our case, proximity to the Mexico-U.S. border. Distance from the border can influence villagers' information about U.S. labor markets and the costs and risks of Mexico-to-U.S. migration, and thus the capacity to engage in international migration and the likelihood of success of such activity.

Extended Gini Decompositions of Village Income Inequality

The rows labelled S in tables 1A and 1B show the share of each income source in the total income of each village. Non-remittance income comprises well over half of all income in the two villages (67 percent and 60 percent, respectively). The contribution of migrant remittances to household income, however, is also significant. It ranges from 33 percent of total income in the first village to 40 percent in the second.

The rows labelled SRG/G_y in the tables show the percentage contributions of non-remittance income, internal migrant remittances and remittances from Mexico-to-U.S. migrants to total income inequality in each village, for different equity weights. These are calculated using equation 1.

The results illustrate the robustness of the general findings in our
earlier paper with respect to value judgements concerning inequality. In
Village 1, where many households contain internal migrants but few have
experience migrating to the United States, remittances from Mexico-to-U.S.
migrants represent a relatively large share of overall income inequality, while
remittances from internal migrants account for a much smaller part of total
inequality. The reverse is true for Village 2, with its extensive migration
networks to the United States and hence, more ready access to U.S. labor
markets. Here, remittances from Mexico-to-U.S. migrants account for a small
share of income inequalities. Remittances from internal migrants, however,
represent a comparatively large share of inequalities in Village 2. One
plausible explanation for this finding is that in this village internal migrant
remittances contain a large returns-to-schooling component, and education is
concentrated significantly in high-income households (Stark, Taylor and
Yitzhaki (1986)). These findings hold for all equity weights appearing in the
tables.

However, these findings appear to be quite sensitive to the weights
attached to different points in the village income distribution.

In both villages, non-remittance income represents a fairly constant share
of overall income inequality as \( v \) increases from 1.5 to 4.0. The percentage
contribution of non-remittance income to inequality rises from 59 to 62 percent
in Village 1 and declines slightly, from 61 to 58 percent, in Village 2 as \( v \)
goes from 1.5 to 4.0. Thus, the percentage contribution of non-remittance
income to income inequalities is not very sensitive to the weight attached to
incomes at the lower end of the village income distribution.

Obviously, this also applies to the proportionate contribution of
remittance income. However, as regards the foreign or domestic origin of
remittances, in Village 2, where Mexico-to-U.S. migrant remittances represent a
relatively small share of income inequalities, this share is a positive function of $v$. That is, the more weight we give to households at the lower end of the Village 2 income distribution, the greater the percentage contribution of Mexico-to-U.S. migrant remittances to income inequality. The share of inequality attributable to Mexico-to-U.S. migrant remittances rises more than 100 percent over the range of weights considered, from 8 percent for $v=1.5$ (a weight slightly favoring inequality) to 17 percent for $v=4.0$ (a weight strongly favoring households at the bottom of the income distribution). The explanation for this result can be found in the extended Gini correlation coefficients, which appear in the row labelled $R$. These more than double, from 0.25 to 0.58, over the range of $v$ considered. Although Mexico-to-U.S. migrant remittance income is not limited to households at the top of the Village 2 income distribution, high-paying Mexico-to-U.S. migration opportunities do not appear to be accessible to the poorest Village 2 households. Even in a highly-experienced Mexico-to-U.S. migrant village, migration to the United States is essentially a middle-class phenomenon.

This result is consistent with the findings of other studies that Mexico-to-U.S. migrants in general do not originate from households at the very top nor at the very bottom of the rural income distribution (Cross and Sandos (1981:76), Taylor (1986), Stark and Taylor (1986)). Households at the top of their village income distribution, in general, have weak motives for sending migrants to the United States compared with households at the bottom and middle of the income distribution. The former typically enjoy both income-earning opportunities and social status without having to incur the material and psychological costs associated with sending family members, usually clandestinely, into an unfamiliar foreign labor market. At the other income extreme, while the poorest rural households might stand to benefit
significantly from high-paying Mexico-to-U.S. migrant jobs, they often lack the resources and economic security to finance and bear the risk of sending members illegally across international frontiers. Members of these households are more likely to supplement their families' income through seasonal migration within Mexico, often returning home to assist in major agricultural tasks on the family farm.

Although remittances from internal migrants comprise a relatively large share of inequality in Village 2, this share declines somewhat as more weight is attached to incomes in the poorest households. This relative decline in the contribution of internal migrant remittances to inequality is due largely to the rapid rise in the contribution of Mexico-to-U.S. migrant remittances to inequality. The extended Gini correlation between internal migrant remittances and total income, which is very high overall, actually increases (from 0.82 to 0.92) as v goes from 1.5 to 4.0. This reflects the extent to which high-income households in this village, with their relatively large endowment of human capital, reap high returns from internal migration.

The contributions of migrant remittances to inequality are somewhat less sensitive to changes in equity weights in Village 1. However, the percentage contribution of internal migrant remittances, while small overall, increases by nearly two-thirds (from 8 percent to 13 percent) as v ranges from 1.5 to 4.0. The extended Gini correlation between internal migrant remittances and total income increases from 0.26 to 0.45 over the range of equity weights. Although internal migrant remittances play a small role in Village 1 income inequalities, it appears that the highest-paying internal migrant jobs are more available to middle-income households than to households at the bottom of the village income distribution. The increased share of income inequality attributable to internal migrant remittances in Village 1 is mirrored by a
slight drop in the relative contribution to inequality of remittances from Mexico-to-U.S. migrants.

Impacts of Changes in Remittances on Income Inequalities

The effect of a small percentage change in income from a particular source on the extended Gini index of inequality can be calculated using the decomposition formula given by (1). Taking household labor and production decisions as given, consider an exogenous change in each household's income component $j$ by a factor $e$, such that $y_j(e) = (1+e)y_j$. Then

$$\frac{\partial G_Y(v)}{\partial e} = \sum_j [R(j,v) G(j,v) - G_Y(v)]$$  \hspace{1cm} (2)

where $S_j$, $R(j,v)$, $G(j,v)$ and $G_Y(v)$ denote, respectively, the $j$'th income share, extended Gini correlation and extended Gini coefficients prior to the marginal income change. Dividing throughout by $G_Y(v)$, we obtain:

$$\frac{\partial G_Y(v)}{G_Y(v)} = \left[ \sum_j R(j,v) G(j,v) / G_Y(v) - S_j \right]$$  \hspace{1cm} (3)

Equation (3) states that the relative effect of a marginal percentage change in income component $j$ upon the extended Gini index of inequality equals the relative contribution of component $j$ to overall inequality minus the relative contribution of this component to total income.

2. In the derivation of Equation 2, the derivative of the extended Gini with respect to a small percentage change in income from a particular source is completely analogous to the derivative of the standard Gini (that is, for $v=2$). The latter can be found in Stark, Taylor and Yitzhaki (1986).
In our earlier study we calculated the derivatives (3) for each income source in the two villages on the basis of the standard Gini \((v=2)\). These, together with the derivatives for the other four equity weights, appear in the last row for each income source in the tables. In each village, a one percent increase in non-remittance income for all households reduces income inequality for every value of \(v\), with one exception: inequality increases slightly in Village 2 if the importance of incomes at the bottom of the distribution is discounted heavily \((v=1.5)\). In this case, non-remittance income is highly correlated with total income, and this correlation is highest at the top of the village income distribution. Thus, a small increase in income from this source exerts an adverse effect on equality when incomes in the poorest households are discounted.

The calculations for both types of remittance income reported in the tables confirm our general findings based on the standard Gini. Differences between the two villages with respect to the impacts of small changes in the remittance components upon inequality are striking. A one percent increase in remittances by Mexico-to-U.S. migrants increases inequalities in Village 1 but reduces inequalities in Village 2 for every value of \(v\). A one percent increase in remittances from internal migrants, on the other hand, reduces inequalities in Village 1 while sharpening inequalities in Village 2 for every value of \(v\).

As before, however, the strength of these results is sensitive to value judgements underlying the extended Gini calculations. The more weight we attach to incomes of the poorest households, the smaller the improvement in Village 2 income inequalities that results from a one percent increase in remittances from Mexico-to-U.S. migrants. The latter drops from 0.13 percent when little weight is attached to incomes of the poorest households to just 0.05 percent when a large weight is attached to the lower end of the village income.
distribution. Conversely, while a one percent increase in internal migrant remittances sharpens income inequalities in Village 2, this adverse effect declines as more weight is placed on incomes of the poorest households. This decrease is from 0.12 percent for \( v=1.5 \) to 0.06 percent for \( v=4.0 \). The latter result might seem surprising in light of the increase in the extended Gini correlation for internal migrant remittances over the same range of \( v \) in Village 2. The explanation for this result can be found in the extended Gini correlation of Mexico-to-U.S. migrant remittances in the village. It increases at such a rapid rate over the range of equity weights that a marginal increase in internal migrant remittances, which raises the share of internal migrant remittances in total household income (and hence, lowers the share of Mexico-to-U.S. migrant remittances), has a progressively smaller adverse effect on village income inequality as more weight is attached to the poorest households.

In Village 1, the favorable distributional effect of a small increase in internal migrant remittances drops from 0.10 percent to 0.05 percent when the equity weight increases from 1.5 to 4.0. The unfavorable effect of a one percent change in Mexico-to-U.S. migrant remittances in this village declines from 0.17 percent to 0.09 percent over the same range of equity weights.

Analysis of extended Gini derivatives demonstrates that the impact of marginal changes in remittances upon inequality is not unequivocal. It depends critically on where the recipients of remittances are situated in an overall village income distribution, on the share of remittances in village incomes, and on the distribution of remittances themselves. But it also depends upon the weight attached to incomes at different points of the village income distribution. Although the sign of the extended Gini derivative differs from that of the standard Gini derivative in only one case shown in Table 1, the
equity weight used in the extended Gini calculations bears importantly on the magnitude of these derivatives for particular components of household income.

III.

Our analyses of migration from and remittances into two Mexican villages provide evidence that the impact of migrant remittances on the rural income distribution by size depends critically on the degree to which migration opportunities of different types become diffused through a village population, as well as on the returns to human capital embedded in migrants' remittances and on the distribution of potentially remittance-enhancing skills and education across village households.

In this paper we have used extended Gini decompositions to explore the sensitivity of several findings to different value judgments when constructing measures of inequality. The results illustrate the robustness of the main conclusions obtained in earlier work with respect to the weight attached to incomes at the bottom of the income distribution when calculating the extended Gini index. Nevertheless, at times the strength of the conclusions can be quite sensitive to value judgments concerning inequality. For example, our earlier study reveals that in a village with considerable Mexico-to-U.S. migration experience, remittances from Mexico-to-U.S. migrants have a favorable effect on the village income distribution. However, the extended Gini analysis shows that this favorable impact diminishes as more weight is attached to incomes in the poorest households. It appears that, while remittances from Mexico-to-U.S. migrants have become generally accessible to this village's middle income groups, barriers to high-paying Mexico-to-U.S. migration work exist for households at the bottom of the village income distribution. Remittances from internal migrants in this village have an adverse effect on inequality, because
the returns to schooling are large at internal migrant destinations and education in the village is concentrated in high-income households. However, in a village where many households contain internal migrants but few have U.S. migration experience, remittances from internal migrants have an equalizing impact on village incomes. Nonetheless, the extended Gini analysis underscores the implications of the highest-paying internal migrant jobs being more available to middle-income households than to households at the bottom of the village income distribution.
### TABLE 1

Extended Gini Decompositions of Village Income

for Different Equity Weights

(A)

<table>
<thead>
<tr>
<th>Village 1</th>
<th>EQUITY WEIGHTS (v)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>v=1.5</td>
<td>v=2.0</td>
<td>v=2.5</td>
<td>v=3.0</td>
<td>v=4.0</td>
</tr>
<tr>
<td>Non-remittance Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>0.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0.85</td>
<td>0.84</td>
<td>0.84</td>
<td>0.84</td>
<td>0.85</td>
</tr>
<tr>
<td>SRG/GY</td>
<td>0.59</td>
<td>0.60</td>
<td>0.60</td>
<td>0.61</td>
<td>0.62</td>
</tr>
<tr>
<td>(\frac{\partial G_Y}{\partial e})</td>
<td>-0.08</td>
<td>-0.07</td>
<td>-0.06</td>
<td>-0.06</td>
<td>-0.05</td>
</tr>
<tr>
<td>Internal Migrant Remittances</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0.26</td>
<td>0.33</td>
<td>0.37</td>
<td>0.41</td>
<td>0.45</td>
</tr>
<tr>
<td>SRG/GY</td>
<td>0.08</td>
<td>0.10</td>
<td>0.11</td>
<td>0.12</td>
<td>0.13</td>
</tr>
<tr>
<td>(\frac{\partial G_Y}{\partial e})</td>
<td>-0.10</td>
<td>-0.07</td>
<td>-0.06</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>Mexico-to-U.S. Migrant Remittances</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0.85</td>
<td>0.86</td>
<td>0.87</td>
<td>0.89</td>
<td>0.92</td>
</tr>
<tr>
<td>SRG/GY</td>
<td>0.33</td>
<td>0.30</td>
<td>0.28</td>
<td>0.27</td>
<td>0.25</td>
</tr>
<tr>
<td>(\frac{\partial G_Y}{\partial e})</td>
<td>0.17</td>
<td>0.14</td>
<td>0.12</td>
<td>0.11</td>
<td>0.09</td>
</tr>
</tbody>
</table>
3. Extended Gini indices for different income components are not compared in the table, as this would be tantamount to comparing absolute values of different social welfare functions. Readers who are interested in computing Gini indices for different income components can do so from the values for SRG/GY reported in the table, using the following extended Ginis of total income for the two villages:

<table>
<thead>
<tr>
<th></th>
<th>Gy(1.5)</th>
<th>Gy(2.0)</th>
<th>Gy(2.5)</th>
<th>Gy(3.0)</th>
<th>Gy(4.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village 1</td>
<td>0.27</td>
<td>0.40</td>
<td>0.48</td>
<td>0.53</td>
<td>0.59</td>
</tr>
<tr>
<td>Village 2</td>
<td>0.30</td>
<td>0.46</td>
<td>0.56</td>
<td>0.63</td>
<td>0.71</td>
</tr>
</tbody>
</table>
In this appendix we derive the properties of the extended Gini correlation coefficient (EGCC). The EGCC for two random variables $x$ and $y$ is defined as:

$$R(v) = \frac{\text{Cov}(y,(1-F_x(x))^{v-1})}{\text{Cov}(y,(1-F_y(y))^{v-1})}$$

where $F_x$ and $F_y$ are the cumulative distribution functions for $x$ and $y$, respectively, and $v$ is a given parameter, with $v > 1$. For $v = 2$, the EGCC is equal to the Gini correlation coefficient. Like the Gini correlation, it is asymmetric in the variables.

The properties of the EGCC are as follow:

1. If $x$ and $y$ are independent then, for all $v > 1$, $R(v) = 0$. This property follows from the proposition that functions of independent random variables are also independent.

2. If $x$ is a monotonic increasing (decreasing) transformation of $y$ then, for all $v > 1$, $R(v) = 1 (-1)$. This property follows from the fact that if $x = g(y)$, where $g'(y) > 0$, then $F_x(x) = F_x(g(y)) = F_y(y)$. Moreover, an increasing monotonic transformation of $x$ does not affect $R(v)$. These properties render the EGCC similar to Spearman’s correlation coefficient.

3. A linear increasing transformation of $y$ does not affect the EGCC. This property follows immediately from the properties of the covariance and is similar to the property of Pearson’s correlation coefficient.

Moreover,

4. If $x$ and $y$ are normally distributed with the parameters $m_x$, $m_y$, $s_x$, $s_y$, and $r$, then for all $v > 1$, $R(v)=r$. 

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Proof: The conditional expectation of $y$ with respect to $x$, given that both variables are normally distributed, is:

$$E(y|x) = m_y + rs_y(x - m_x)/s_x$$

(See, for example, Degroot (1975:250).) Thus,

$$\text{Cov}(y, [1-F_x(x)]^{v-1}) = \text{Cov}([m_y+rs_y(x-m_x)/s_x], [1-F_x(x)]^{v-1})$$

Utilizing the properties of the covariance, we can write

$$\text{Cov}(y, [1-F_x(x)]^{v-1}) = rs_y \text{Cov}(z, [1-F_z(z)]^{v-1})$$

where $z$ is a standard normal variable with $s_z = 1$. To complete the proof all we have to do is write the denominator as a standard normal variable.

The differences among EGCCs are in the weight attached to the lower portion of the distribution relative to the higher portions. The higher $v$ is, the higher the weight given to the correlation at the lower end of the distribution. In the extreme case where $v \to \infty$, the only correlation that matters is the correlation among the poorest. (See Yitzhaki (1983) for a detailed description of the weighting scheme).

The properties that the EGCCs have the same range regardless of the value of $v$ and that they are equal in the case of the normal distribution enable us to compare EGCCs to check whether the correlation between the variables changes over the entire income distribution.
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