Accounting for the Importance of Nonfarm Income on Farm Family Income Inequality in New York

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As the proportion of farm family income due to nonfarm sources continues to grow nationally, it is important to understand how farm families in various regions or states are affected. This paper develops a better understanding of the contribution of income from nonfarm sources to the level and distribution of income among farm families in New York. In analyzing income distribution, the Gini ratio is decomposed to determine the effects of marginal changes in income by source to overall inequality. The results are compared with the simulated changes in income inequality due to changes in income by source as measured by an "adjusted" Gini ratio which accounts specifically for negative farm incomes. Differences in the policy implications from both procedures are compared. The relationships among sources of income and policy implications can be brought into sharper focus by examining both measures.

Nonfarm sectors of the rural economy are inextricably tied to agriculture through input and output markets and as a source of employment for displaced agricultural labor. Families remaining in agriculture also depend increasingly on nonfarm sources of income. Nationally, about one-third of farm family income was from nonfarm sources in the 1950s; about 60% of farm family income now comes from nonfarm sources. Incomes of farm families rose from 50% to 80% of that of the nonfarm population between the 1950s and the 1980s (U.S. Department of Agriculture 1986; Johnson, Hemmi, and Lardinois).

Increased reliance on nonfarm income has been one way for many farm families to participate in the nation's overall economic growth, but for others, it may be necessary to offset recent financial problems in production agriculture. In addition to closing the gap between incomes in the farm and nonfarm sectors, nonfarm employment may affect the overall income inequality within the farm sector itself. The effects will differ regionally as well as by state (Findeis and Reddy).

The purpose of this paper is to examine the importance of income from nonfarm sources to farm families in New York, particularly in terms of its effect on income inequality. The analysis focuses on 1985 and 1986, the first two years in which nonfarm income information was collected as part of the Cornell University farm management records system. Special attention is given to two major subgroups of the sample—those with nonfarm sources of income and those without.

Although it is impossible to summarize all the important features of an income distribution in a single statistic, the Gini ratio continues to be a useful initial indicator of underlying changes in income dispersion. Our ability to understand the contribution of individual components of income to total income inequality has been enhanced recently by Pyatt, Chen, and Fei, and Lerman and Yitzhaki in their decomposition of the Gini ratio.

Despite the advantages afforded by the decomposition, comparisons of inequality remain difficult when, as is the case in today's agriculture, farm incomes can be negative in a given year. The problems arise because the Gini ratio is no longer bounded between zero and unity. In some past studies, negative incomes were set to zero, recognizing that inequality may be underestimated (Ahearn, Johnson, and Strickland; Kinsey; Carlin and Reinsel). The magnitude of the underestimate is an empirical question.

More recently, Chen, Tsaur, and Hai (1982) have proposed an "adjusted" Gini ratio that is bounded between zero and unity when some incomes are negative. This is a distinct advantage in comparing ratios of inequality over time or across populations. Unfortunately, this "adjusted" Gini ratio cannot

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be mathematically decomposed by income source. The important methodological question is whether the advantages afforded by this adjustment in making comparisons across populations are sufficient to justify its use. As it turns out, the two years for which New York farm income data are available are quite appropriate for such an analysis. In relative terms, 1986 was a better year for New York agriculture than was 1985. Thus, the incidence and severity of negative net farm incomes are quite different between the two years. This is exactly what is needed to understand how the adjusted measure of inequality differs from the conventional measure.

The remainder of the paper begins with a short discussion on inequality measurement; a reiteration of the decomposition properties of the Gini measure; a presentation of the "adjusted" Gini ratio; and a description of a procedure for simulating the decomposition of the "adjusted" ratios. This is followed by a description of the data and the empirical results from decomposing New York farm family income using both the conventional and "adjusted" Gini measures. A comparison of the differential policy implications to be derived from the two decomposition procedures is then followed by a statement of the paper's major conclusions.

Measuring Inequality

The Gini ratio, usually defined as the ratio of the area between the Lorenz curve and the 45° line (which represents the fraction of total income possessed by the holders of the smallest p^{th} fraction of income) and the area under a 45° line (Gastwirth), is one of the most widely used measures of inequality. As such, it has also been the subject of much criticism, the most serious being that for income distributions with the same mean, it is impossible to find an additive social-welfare function that ranks distributions by their Gini ratios (Chipman). This type of criticism can be levelled at most rankings based on only two parameters of the distribution and at a theoretical level; what is needed is a multivariate measure that accounts for the heterogeneity of contemporary populations.

Despite this criticism, Lerman and Yitzhaki and others argue that the Gini ratio remains an important tool for examining income distribution because: (a) Gini's mean difference and the mean permit one to form the necessary conditions for stochastic dominance of income distributions; (b) an extended Gini index can be used to reflect increasing social aversion to inequality in much the same way as Atkinson's index of inequality; and (c) the Gini ratio can be decomposed, thus isolating each source's contribution to inequality and the marginal change in income by source on overall inequality. This latter point is particularly attractive because despite one's inability to find additive social welfare functions consistent with a "mean-Gini" ranking, more general multivariate formulations still lead to social-welfare functions whose partial derivatives are positive with respect to the mean and negative with respect to the Gini (Cumming, cited in Chipman). Thus, ceteris paribus, changes in a Gini ratio due to marginal changes in income by source can be interpreted unambiguously.

Gini Ratio and Its Decomposition

Lerman and Yitzhaki demonstrate that the Gini ratio can also be derived directly from the formula for Gini's mean difference:

$$(1) \qquad A = \int_a^b F(Y)\,[1 - F(Y)]dY,$$

where Y is income ($a \leq Y \leq$ b) and $F(Y)$ is the cumulative distribution. Through integration by parts and variable transformations, they show that

$$(2) \qquad A = 2\,\mathrm{cov}[Y, F(Y)].$$

The Gini ratio (G) is then formed by dividing A by mean income (μ_Y).

Letting $Y_1, \ldots, Y_K$ be components of income such that $Y = \sum_k Y_k$, and using the properties of the covariance of the sum of random variables (Mood, Graybill, and Boes):

$$(3) \qquad A = 2 \sum_k \mathrm{cov}(Y_k, F(Y)).$$

Dividing (3) by μ_Y and multiplying and dividing each component by $\mathrm{cov}(Y_k, F(Y_k))$ and μ_k yields the Gini decomposition on total income:

$$(4) \qquad G = \sum_k [\mathrm{cov}(Y_k, F(Y))/\mathrm{cov}(Y_k, F(Y_k))] \cdot [2\mathrm{cov}(Y_k, F(Y_k))/\mu_k] \cdot [\mu_k/\mu_Y] = \sum_k R_k G_k S_k,$$

where R_k is the correlation between Y_k and the cumulative distribution of Y, G_k is the Gini ratio for Y_k, and S_k is Y_k's share of Y. Pyatt et al. prove that $-1 \leq R_k \leq 1$, and R_k takes on its extreme values when an income source is a decreasing (-1) or increasing ($+1$) function of total income and is zero if Y_k is a constant.

To determine the change in inequality due to a marginal change in Y_k, Lerman and Yitzhaki, and Stark, Taylor, and Yitzhaki consider a change in each person's income from source k equal to e_kY_k where e_k is close to 1. Then,

(5) $\partial G/\partial e_k = S_k(R_kG_k - G)$, and

(6) $[\partial G/\partial e_k]/G = [S_kG_kR_k/G] - S_k.$

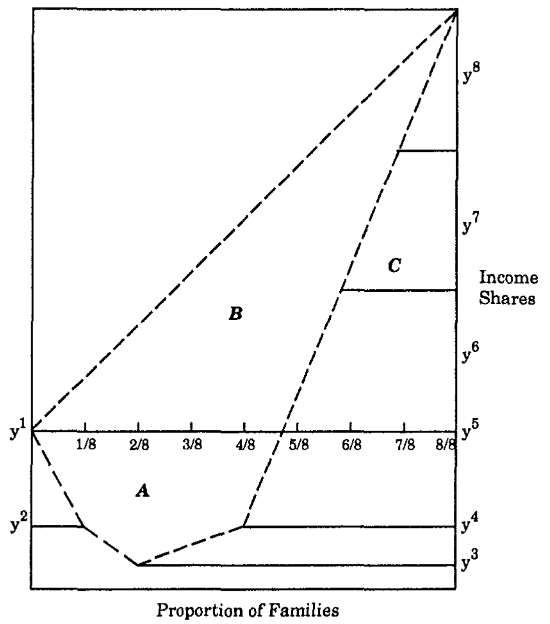
These elasticities in (6) sum to zero because a proportional increase in income from all sources would leave income inequality unaffected.

Adjustments for Negative Incomes

Gastwirth shows that the Gini ratio is still defined when some incomes are negative but mean income remains positive. Then, the bounds on the Gini ratio range from $0 \leq G \leq (\mu - a)(b - \mu)/\mu(b - a)$, where a and b are defined by equation (1). The situation arises because when there are negative incomes, the Lorenz curve does not cross the horizontal axis (Figure 1) until negative incomes have been balanced by positive incomes (Chen et al. 1982). Therefore, instead of the Gini ratio being defined by the area B divided by B + C (as in the case where no incomes are negative), it is now the area A + B divided by B + C. The area A + B now has no maximum size, implying that the Gini ratio may now be greater than unity and overestimate income inequality.

The magnitude of the overestimate is an empirical question and will certainly vary from application to application. One strategy that has been used to facilitate comparisons across distributions with negative incomes is to set the negative observations to zero and recalculate the Gini ratios (Ahearn et al.). The one advantage of this strategy is that it preserves the decomposition properties, but unfortunately, there is no way of knowing whether this procedure has over- or undercompensated for the overestimate mentioned in the paragraph above. The effect may differ significantly across applications and may be particularly important when a large proportion of incomes are negative.

Figure 1. A Lorenz Curve with Negative Incomes



Source: Chen et al. 1982

Alternatively, Chen et al. (1982) propose a normalization of the Gini ratio. This "adjusted" Gini ratio, G^*, is derived by writing the conventional Gini ratio in terms of the mean difference. Let $Y^j = j^{th}$ family's income, where $Y^1 \leq \ldots \leq Y^n$; some $Y^j < 0$; but

(7) $$\sum_{j=1}^{n} Y^j > 0 \text{ and } \mu_Y = \sum_{j=1}^{n} Y^j/n > 0.$$

Then, the income share of the j^{th} family can be written as

(8) $$y^j = Y^j/n\mu_Y, \text{ and}$$

(9) $$G = 1/n \sum_{j=1}^{n} \sum_{i<j} (y^j - y^i),$$

or by expanding:

(10) $$G = 1/n \sum_{j=1}^{n} \sum_{i<j} y^j(2j - (n + 1)).$$

To examine the range in G, define m so that $\sum_{j=1}^{m} y^j = 0$ and rewrite (10):

(11) $$G = 1 + (2/n) \sum_{j=1}^{m} jy^j - (1/n) \sum_{j=m+1}^{n} y^j [1 + 2(n - j)].$$

Written in this way, it is apparent that with $y^j \lesseqgtr 0$, then $G \lesseqgtr 1$ depends on

(12) $$(2/n) \sum_{j=1}^{m} jy^j \gtrless (1/n) \sum_{j=m+1}^{n} y^j (1 + 2(n - j)).$$

A natural adjustment to G is to divide (11) by one plus the left side of (12):

(13) $$G^* = \left[1 + (2/n) \sum_{j=1}^{m} jy^j\right.$$

$$- 1/n \sum_{j=m+1}^{n} (1 + 2(n - j))\Bigg]$$

$$\left[1 + (2/n) \sum_{j=1}^{m} jy^j\right]^{-1},$$

which equals G if all $y^j \geq 0$ since the left side of (12) vanishes. Chen et al. (1982) also show that as all income is concentrated in one family, $G^* = 0$, and as $n \rightarrow \infty$, $G^* \rightarrow 1$. Thus, G^* ranges between zero and unity as does G.

Chen et al.'s (1982) geometric interpretation provides the best intuitive explanation of the adjustment implied by G^*. As stated above, with negative incomes, $G = (A + B)/(B + C)$, and it can be greater than one because the area above the Lorenz curve and the 45° line has no upper bounds on its size. To compensate, the adjustment adds the area above the Lorenz curve but below the horizontal axis (A) to the denominator of the ratio (e.g., $G^* = (A + B)/(A + B + C)$. It is readily apparent that the adjustment reestablishes an upper bound of unity on G^*.

From a computational point of view, it is necessary to identify the subset of families (when ranked in ascending order by income) whose combined incomes equal zero (e.g., $\sum_{i=1}^{m} y^j = 0$), but this situation would be unlikely to occur in empirical data. A more likely situation is where this sum of incomes over the first m families is negative and the first $m + 1$ families is positive. To account for the fact that the Lorenz curve crosses the horizontal axis in this case between the m and $m + 1$ families, Berrebi and Silber show that the "adjusted" Gini should be calculated as

$$(14) \quad G^* = \left[(2/n) \sum_{j=1}^{n} jy^j - (n + 1/n)\right]$$

$$\left[1 + 2/n \sum_{j=1}^{m} jy^j + 1/n \sum_{j=1}^{m} y^j \frac{\sum_{j=1}^{m} y^j}{y^{m+1}} - (1 + 2m)\right]^{-1}$$

$$= \frac{1 + 2(A - C)}{(1 + 2A)}.$$

The major advantage of the "adjusted" Gini measure is that it retains the properties and geometric interpretation of the conventional Gini. Unfortunately, it cannot be decomposed by income source, and it is not possible to develop analytical expressions for the elasticities of the "adjusted" Gini ratio by income source comparable to those for the conventional Gini (e.g., equations (5) and (6)). To circumvent this problem, the changes in the "adjusted" Gini ratio due to a marginal change in a particular source of income can be simulated using a simple procedure. The first step in the procedure is to calculate several additional "adjusted" Gini ratios, each after one particular source of income had been changed (ceteris paribus) uniformly by 1% for each family. This change in income is added to total income before a new "adjusted" Gini ratio is calculated. The elasticity representing the change in inequality due to an increase in income by source is then calculated by subtracting the new "adjusted" ratio from the original "adjusted" ratio and dividing by the original "adjusted" ratio. This simulation strategy assumes the same type of change in income that is embodied in equations (5) and (6). However, the sum of the elasticities in the simulations will not add to zero because it was necessary to do the simulations using finite changes in income by source.

An Application to New York Dairy Farms

For many policy purposes it is desirable to analyze national farm-level data, which include the distribution of income by source, and examine regional differences (Ahearn et al.; Findeis and Reddy). During the current financial crisis in agriculture, New York and possibly other states have begun to ask for more information as part of their farm record programs. For example, 1985 was the first year that Cornell collected information on nonfarm income, assets, and liabilities as part of the Dairy Farm Business Project. Because participation in the project is voluntary and most participants are primarily dairy producers, these farms are not a representative sample of all farms in the state. However, in 1986, farm marketings of dairy products were about 60% of all New York farm cash receipts (New York Agricultural Statistical Service), and about 65% of New York's commercial farms sold dairy products (U.S. Department of Commerce). Thus, these data provide a preliminary indication of the contribution of income from different sources to farm family income inequality among commercial farms in New York. Further, by analyzing data for 1985 and 1986, the implications for farm family income inequality under different conditions in the agricultural sector are examined. For agriculture in New York, 1985 was not a particularly good year, but 1986 was somewhat better.

Table 1 includes descriptive information regarding the income of New York dairy farm families by source. The subgroups delineated in the table

Table 1. Average Income of New York Dairy Farm Families by Source

			Negative Incomes Set to Zero[a]	
Group/Source	1985	1986	1985	1986
All farms				
Farm	$19,214	$20,937	$24,185	$24,617
Government	2,585	3,457	2,585	3,457
Nonfarm	3,835	5,178	3,835	5,178
Total	$25,634	$29,572	$30,605	$33,251
Sample size	491	522	491	522
% with negative farm income	26	22	0	0
% with negative family income	18	13	0	0
Farms without nonfarm income				
Farm	$24,857	$28,177	$28,878	$30,129
Government	2,810	2,638	2,810	2,638
Total	$27,666	$30,815	$31,688	$32,767
Sample size	280	244	280	244
% with negative farm income	20	18	0	0
% with negative family income	18	16	0	0
Farms with nonfarm income				
Farm	$11,726	$14,582	$17,958	$19,779
Government	2,287	4,175	2,287	4,175
Nonfarm	8,924	9,722	8,924	9,722
Total	$22,937	$28,480	$29,169	$33,676
Sample size	211	273	211	273
% with negative farm income	34	26	0	0
% with negative family income	18	9	0	0

Source: Calculated from data on farms cooperating in the dairy farm business summary project, Department of Agricultural Economics, Cornell University. Detail may not add due to rounding.
[a]The only negative income component is net farm income. If net farm income is negative for a given family, it is set to zero and total family income is recalculated.

are important because about 60% and 45% of the sample farms in 1985 and 1986, respectively, had no nonfarm income; changes in net agricultural income, rural labor markets, and government payments may affect family incomes on farms with and without nonfarm income differently.

In 1985, average farm family income for participating farms was $25,634. For those with no nonfarm income, the average was $27,666, and for those with nonfarm income the average was $22,937. In 1986, average farm family income was $29,572, or 15% higher than in 1985. For the two subgroups, those with no nonfarm income and those with nonfarm income, family incomes were $30,815 and $28,480, respectively. For the state sample, net farm income (defined as the return to operator and unpaid family labor, management, and equity) constituted 75% of farm family income in 1985 and 71% in 1986. Nonfarm income was just over 15% of family income in the statewide sample for both years, but within the subgroup where a family member works off the farm, nonfarm income represented about 40% of family income in 1985 and 34% in 1986.[1] Direct government payments were about 10% of 1985 family income for both groups.[2]

[1] In filling out the farm business summary, individuals were instructed to report the total of nonfarm work for self and spouse, gifts, inheritances, tax refunds, and other nonfarm income. Although data on the proportion of nonfarm income by category are not available, those in charge of the survey believe that most nonfarm income reported is from nonfarm jobs.

[2] The direct government payments exclude the indirect payments through the dairy support program. In the initial stages of this research, we tried to use existing estimates of free-market milk prices to isolate the size of this subsidy and add it to direct government payments. However, the sizes of these subsidies appeared unrealistically high and implied negative farm incomes for the vast majority of farms. Thus, they seemed to reflect more a short-term price change rather than a price that would be obtained after any structural adjustment would occur. We elected not to incorporate these estimates into the analysis in this paper.

For 1986, such payments were 10% of family income for those without nonfarm income and 15% of family income for those with nonfarm income. To help evaluate strategies for dealing with negative incomes, Table 1 also reports the average incomes by source when calculated with negative incomes set to zero.

Evaluation of Negative Income Adjustments

Tables 2 and 3 contain three separate decompositions of inequality by source. The first decomposition ignores the potential problems arising from negative incomes and applies the decomposition outlined in equations (1) through (6). The second applies the same decomposition after setting all negative incomes to zero and recalculating farm family incomes. The third utilizes the "adjusted" Gini coefficient (equation (14)) to account for negative incomes; the decomposition is based on simulated changes in income rather than derived analytically. These methods are evaluated both in terms of the reasonableness of the results and their usefulness for policy analysis.

To assess the different methods for measuring inequality when components to family income are negative, it is useful to focus initially on the results for 1985. In this year, about 26% of the farm families in the sample had negative net farm incomes; nearly 18% of them had negative family incomes (Table 1). In 1986, just under 22% of the farmers in the sample had negative net farm incomes, but the magnitude of the losses was much smaller. On only about 13% of the farms were there negative family incomes. Interestingly, in both years a larger proportion of families with some nonfarm income had negative farm incomes than did those families with no sources of off-farm income; the proportion of these families with negative family incomes was about the same as for the families with no nonfarm income in 1985 and substantially lower in 1986.

The significance of these relatively larger proportions of negative farm incomes in measuring inequality is reflected in the various Gini ratios reported in Tables 2 and 3. In comparing the conventional Gini ratios of total income with those for which negative farm incomes are set to zero, it is clear that such a procedure can lead to a serious

Table 2. Three Alternative Decompositions of Farm Family Inequality on New York Dairy Farms, 1985

		All Farms		Farms Without Nonfarm Income		Farms With Nonfarm Income	
Decomposition	Income Source	Gini of Source G_k (R_k)	Elasticity of Total Inequality	Gini of Source G_k (R_k)	Elasticity of Total Inequality	Gini of Source G_k (R_k)	Elasticity of Total Inequality
Conventional	Farm	1.011 (0.949)	0.213	0.808 (0.991)	0.077	1.493 (0.901)	0.402
	Gov.	0.800 (0.194)	−0.080	0.792 (0.226)	−0.007	0.808 (0.141)	−0.085
	Nonfarm	0.824 (0.101)	−0.133			0.591 (0.236)	−0.317
	Total	0.747		0.737		0.753	
Negative income components set to zero	Farm	0.622	0.088	0.568	0.040	0.685	0.127
	Gov.	0.795	−0.037	0.792	−0.040	0.808	−0.032
	Nonfarm	0.824	−0.051			0.591	−0.096
	Total	0.518		0.535		0.487	
"Adjusted" Gini	Farm	0.817	0.145	0.722	0.059	0.927	0.274
	Gov.	0.800	−0.058	0.792	−0.044	0.808	−0.056
	Nonfarm	0.824	−0.101			0.591	−0.216
	Total	0.690		0.682		0.695	

Source: Calculated from data on farms cooperating in the dairy farm business summary project, Department of Agricultural Economics, Cornell University.
Note: G_k is defined by equations (1) through (4). The numbers in parentheses below the conventional Gini ratios by source are (R_k) from equation (4), the correlation with the rank of total income. The elasticity by source is from (6), except for the "adjusted" Gini in which case incomes by source were increased by 1% ceteris paribus, and added to total income. The "adjusted" Gini ratio for total income was then recalculated to identify the percentage change in inequality. The "adjusted" Gini comes from equation (14).

Table 3. Three Alternative Decompositions of Farm Family Inequality on New York Dairy Farms, 1986

		All Farms		Farms Without Nonfarm Income		Farms With Nonfarm Income	
Decomposition	Income Source	Gini of Source G_k (R_k)	Elasticity of Total Inequality	Gini of Source G_k (R_k)	Elasticity of Total Inequality	Gini of Source G_k (R_k)	Elasticity of Total Inequality
Conventional	Farm	0.865 (0.899)	0.212	0.685 (0.984)	0.035	1.136 (0.839)	0.386
	Gov.	0.809 (0.346)	−0.062	0.842 (0.473)	−0.035	0.779 (0.266)	−0.091
	Nonfarm	0.778 (0.113)	−0.150			0.583 (0.126)	−0.295
	Total	0.598		0.650		0.544	
Negative income components set to zero	Farm	0.600	0.071	0.582	0.018	0.605	0.104
	Gov.	0.809	−0.014	0.842	−0.018	0.779	−0.002
	Nonfarm	0.778	−0.057			0.583	−0.102
	Total	0.482		0.560		0.406	
"Adjusted" Gini	Farm	0.758	0.188	0.659	0.032	0.843	0.338
	Gov.	0.809	−0.051	0.842	−0.016	0.779	−0.075
	Nonfarm	0.778	−0.120			0.583	−0.263
	Total	0.584		0.632		0.533	

Source: Calculated from data on farms cooperating in the dairy farm business summary project, Department of Agricultural Economics, Cornell University.

Note: G_k is defined by equations (1) through (4). The numbers in parentheses below the conventional Gini ratios by source are (R_k) from equation (4), the correlation with the rank of total income. The elasticity by source is from (6), except for the "adjusted" Gini in which case incomes by source were increased by 1% ceteris paribus, and added to total income. The "adjusted" Gini ratio for total income was then recalculated to identify the percentage change in inequality. The "adjusted" Gini comes from equation (14).

underestimate of inequality. For all farms in 1985, the conventional ratio for total income was 44% above the ratio calculated assuming all negative incomes were zero. The difference was even more dramatic (55%) for the subsample of farms that reported some nonfarm income. The differences are still substantial, but less dramatic, in 1986. (In all cases, these Gini ratios are above the "adjusted" ratios, suggesting that setting negative incomes to zero overcompensates for the upward "bias" in the conventional Gini ratios when negative incomes are present.)

In both years, the differential results for this sample of New York dairy farms are more pronounced than those discussed by Ahearn et al. For their work at the national level, negative farm incomes in one part of the agricultural economy are likely to be offset by higher returns in other sectors of agriculture. Thus, even though the size of the differential might vary by application, it is probably safe to conclude that setting negative income components to zero would always be more problematic at the regional or state level.

A comparison between the conventional Gini ratios and the "adjusted" Gini ratios is not as straightforward (Table 4). If one is only concerned about inequality in total income, the two measures yield remarkably consistent results across years and groups of farms. For 1985, the conventional ratio is consistently 8% above the "adjusted" ratio; it is 2% above the "adjusted" ratio for 1986. However, this consistency disappears once attention is focused on the individual sources of income. Since neither government payments nor nonfarm incomes are negative, the respective conventional and "adjusted" Gini ratios for these income sources are identical. Differences appear only in the two ratios for farm income. For farms without nonfarm income in 1986, the conventional Gini measure was only about 4% higher than its "adjusted" measure. This is in contrast to the 61% difference for families with nonfarm income in 1985. The larger differences between the two measures in 1985 are obviously explained by the higher incidence of negative farm incomes in that year.

Although differences in the two types of Gini ratios are important in comparisons of inequality across groups, it is the elasticities of income by source which have the most direct implications for policy. Despite the fact that only one of the three Gini ratios by source is affected by the "adjustment" in equation (13), all the elasticities of in-

Table 4. Comparison of Elasticities of Total Family Income Inequality by Income Source Using the Conventional and "Adjusted" Gini Measures of Inequality

Groups	Ratio of Conventional Gini to "Adjusted" Gini[a]		Ratios of Elasticities of Total Family Income Inequality by Income Source (Conventional/"Adjusted")		
	Total Income	Farm Income	Farm	Gov.	Nonfarm
All farms					
1985	1.083	1.237	1.469	1.380	1.317
1986	1.024	1.141	1.128	1.216	1.250
Farms without nonfarm income					
1985	1.081	1.119	1.305	1.750	—
1986	1.028	1.039	1.094	2.188	—
Farms with nonfarm income					
1985	1.083	1.611	1.467	1.518	1.468
1986	1.021	1.348	1.142	1.213	1.122

Source: Calculated from data in Tables 2 and 3.
[a] This ratio is unity for government payments and nonfarm income because there are no negative incomes for these two components.

equality in total income by source are affected. The corresponding elasticities retain the same sign, but the elasticities based on the conventional Gini are always higher in absolute value. Thus, in qualitative terms, the policy implications to be drawn from an examination of the elasticities of total family income from marginal changes in income by source are the same, whether they are derived analytically from the decomposition of the conventional Gini ratio or simulated from the calculations of the "adjusted" Gini ratio. However, the "bias" to the conventional elasticities for the "all farm" sample and for those farms with no nonfarm income is larger than the bias exhibited in the Gini measures themselves; exactly the opposite is true for the sample of farms with some nonfarm income.

A couple of conclusions are apparent from this analysis. First, there seems to be little reason to set negative income components to zero in empirical work. The "adjusted" Gini ratios can be compared directly across populations or time as a single relative measure of inequality. On this basis alone, it is probably the preferred measure. At a theoretical level, however, welfare comparisons are easier to infer from the conventional Gini because the partial derivative of important classes of general social-welfare functions is negative with respect to the conventional Gini. The conventional Gini has the advantage that the elasticities by income source can be derived analytically. The elasticities based on the "adjusted" Gini are not as analytically consistent because of the need to use finite changes in income in the simulations, but they suggest that the elasticities derived analytically are biased. These biases are particularly problematic because they are not necessarily of the same relative magnitudes as the Gini coefficients themselves. Therefore, in situations where there are a significant number of negative incomes, it would seem advisable to calculate both measures and their corresponding elasticities before developing policy conclusions. An understanding of how the various sources of income interact analytically is best obtained through an examination of the three components of equation (4). However, the absolute magnitude of the effects of policy are perhaps estimated more realistically through the simulated elasticities derived from the "adjusted" Gini.

Policy Implications of the Inequality Decomposition

The policy implications of the analysis are derived from both an examination of the measures of inequality, as well as the elasticities of inequality by source. Since the elasticities of inequality indicate the effects on family income inequality from a marginal change in a particular income source, the policy implications are derived in turn through the effects policy changes would have on each source of income.

With regard to the inequality measures themselves, it is clear from Tables 2 and 3 that with only a couple of exceptions, farm incomes are more unequally distributed than are either government payments or nonfarm income. However, when added together, the three sources of income generate a distribution of total family income that is less unequal than any of the individual sources. From a rural development perspective, an important implication of this result is that off-farm job opportunities for members of farm families have not only increased average family incomes, they have also reduced the income inequality among families.

To obtain a better understanding of why this happens, recall from equation (4) that the share of total income inequality due to a given source depends on the income share (S_k) and the Gini of source (G_k), as well as where the recipients of different income sources are in the total income distribution (R_k). The values of R_k in Tables 2 and 3 reflect the correlations between each source of income and total income; high positive values of R_k, ceteris paribus, imply that income source k contributes importantly to total income inequality. For both years, the differences in these correlations across sources are striking. For farm income, the correlations are 0.8 or above, while for the other two sources, the correlations range between 0.1 and 0.5. With one exception, the 1985 subgroup of farms with nonfarm income, R_k is higher for government payments than for nonfarm income. Government payments on dairy farms in New York are more equally distributed across families than is net farm income.

Our understanding of the composition of inequality can be pushed one step further by examining the elasticity of total inequality due to a small change in income from a given source. These elasticities are also shown in Tables 2 and 3. Although these elasticities assume that all individuals' incomes from that source are increased proportionately, they do provide an initial indication of how changes in rural economic conditions and public policies affecting income by source are translated into the effects on income inequality.

To illustrate, there are a number of public policies that can directly or indirectly affect farm profitability. In a state like New York, past increases and current reductions in the milk support prices are an important source of change in net farm income. More indirectly, changes in feed-grain programs that affect livestock feed prices are reflected in net farm income through changes in feed costs. Changes in interest or farm wage rates resulting from changing economic conditions or changes in farm credit policy are reflected in net farm income in a similar fashion. Any of these changes that would give rise to a 1% increase in farm profitability would also increase the disparity in total farm family income for the state as a whole by from between 0.15 and 0.19 (as measured by the "adjusted" elasticity of farm income) of 1% in the two years. The effect would be quite different by subgroup. For those without nonfarm income, the increase in inequality would be less than 0.10 of 1%, while for the second subgroup it would be between 0.27 and 0.34 of 1%.

However, in evaluating these elasticities, it is important to remember that such a change in farm income would require differential initial changes in the individual cost or revenue components. For example, in both years, feed and labor expenses are only one-fourth and one-ninth, respectively, as large as milk sales. Thus, to effect the same percentage change in farm income, feed and labor costs would have to fall by 4 and 9 times, respectively, as much as milk prices would have to increase. The initial change in interest rates would have to be much larger still because interest costs are a relatively small fraction of total costs. These impacts are only marginally different between the subgroups.

Ignoring their indirect effects through feed prices, changes in farm programs, such as the feed-grain program, that would lead to an increase in direct government payments would reduce income inequality. The small correlation between direct government payments and total income is explained by the fact that dairy farms in New York are not major participants in feed-grain or other farm programs where direct government payments are made. The situation might be much different if it were possible to estimate the indirect government payments associated with dairy price supports, subtract them from farm receipts, and include them in this government payments category. If this were done, the incidence of negative farm incomes would rise and the differential policy implications implied by the conventional and "adjusted" Gini ratios would clearly be increased.

Changes in economic conditions in the nonfarm economy can also be evaluated in terms of their effects on farm family income inequality. As an illustration, consider a general increase in wage rates in rural nonfarm labor markets. Initially, one might expect these wage rates to be reflected in the incomes of those currently working off the farm. The corresponding initial impact on farm families would be to reduce income inequality. The "adjusted" elasticities for the statewide sample (-0.10 and -0.12 in 1985 and 1986, respectively) would be reasonable estimates of the percentage reduction in income inequality. These elasticities presume that there is no increase in the proportion of families participating in off-farm employment. If higher rural wage rates are sustained, one would expect an increase in off-farm labor market participation. To the extent that this increased participation moves the composition of family income toward the pattern exhibited in our subsample, the longer term effect on inequality may lie somewhere between the statewide elasticities and the one for the subsample which is more than two times as large.

Summary and Conclusions

As the proportion of farm family income due to nonfarm sources continues to grow nationally, it is also important to understand how farm families in various regions or states are affected. The purpose of this paper is to develop a better understanding of the contribution of income from nonfarm sources to the level and distribution of income among farm families in New York. Data used in the analysis were for 1985 and 1986, the first two years for which nonfarm income was collected as part of the Cornell farm records project.

In analyzing the distribution of income, recent developments in the decomposition of the Gini ratio are used to determine the effects of marginal changes in income by source to overall inequality. However, before attempting any policy analysis, a methodological issue surrounding the treatment of negative annual farm and family incomes due to the current financial crisis in today's agriculture was examined. As it turns out, the data used in the study were quite appropriate for resolving this issue in that 1986 was a much better year for New York agriculture than was 1985; thus, the incidence and severity of negative farm incomes were quite different for each of the years.

On the basis of this examination, there seemed to be little justification for setting negative incomes to zero and completing the analysis in terms of the conventional Gini and its analytical decomposition. Furthermore, when there is a substantial incidence of negative incomes, the conventional Gini ratios can seriously overstate inequality and the elasticities of income inequality may be affected. Thus, in making comparisons of inequality and in examining the effects of policy changes on income inequality, it is advisable to calculate the "adjusted" Gini to simulate the elasticities of inequality by source based on this "adjusted" measure of inequality. In saying this, however, it is important to remember that the three components (S, R, and G from equation (4)) remain valid statistics in their own right and help focus on the nature of the interrelationships among sources of income.

Using both these measures of inequality, this analysis clearly demonstrates that income from nonfarm sources contributes to the size of New York farm family incomes, but to a lesser degree than for the nation as a whole. This is not surprising given the predominance of labor-intensive dairy farming in the state, although the importance of nonfarm incomes would have been more important had the sample included more small or part-time farmers. Nonfarm sources of income are also larger on average than direct government payments because dairy farmers are not major participants in feed-grain and other agricultural programs where direct government payments are made. The situation would be different if it were possible to separate from farm income the indirect payments associated with dairy price supports.

In terms of the distribution of income, it is shown that agricultural or other general economic policies that increase net farm income will exacerbate income inequality among farm families. The most pronounced effect would be felt through a change in the price of milk at the farm level, followed by changes in support programs for crops that would ultimately be reflected in feed costs. However, quite the opposite is true if family incomes are improved by increasing income from nonfarm sources. Rural development efforts to promote greater off-farm job opportunities or increase rural nonfarm wage levels will likely reduce the income inequality among farm families. In New York, these opportunities will be even more critical in the future as the dairy industry contracts and rural economies try to absorb surplus labor in the face of new technology and a gradual decline in the dairy support levels.

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