Rising Family Income Inequality: The Importance of Sorting

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Abstract:
Family income reflects the distribution of personal income and the composition of families. Theoretical and empirical research suggests that changes in family structure and work behavior have contributed to rising family income inequality. Demographic and labor market changes have also changed the relationship between personal and family income. We develop a non-parametric measure of the impact of changes in family income relationships on the distribution of family income. Using data from the March CPS (1968-2003), we find that changes in "income sorting" account for more than half of the increase in family income inequality over the last three decades.

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There is a substantial literature on rising income inequality in the United States. Most research on the determinants of rising inequality has focused on the distribution of personal income, especially male earnings. Family income is an important alternative measure of economic wellbeing. In this paper we introduce the concept of "income sorting." Income sorting describes the combining of personal incomes to produce the distribution of family income. We use the concept of income sorting to measure the impact of demographic, labor market and behavioral changes on the way in which the personal income distribution is transformed into the family income distribution.

Theoretical and empirical research on family behavior suggests that changes in marriage, child-bearing and married women's labor supply have contributed to rising family income inequality (for reviews see Bergstrom, 1996 and Lam, 1997). For example, rising rates of female-headed families and the disproportionate decline in marriage rates for low-earning men will tend to increase family income inequality all else equal (Mare, 1992; Karoly and Burtless, 1995; Burtless, 1996). Labor market changes also affect family income inequality apart from their impact on the distribution of personal income. For example, when the education of husbands and wives are positively associated, rising wage returns to education increase family income inequality among married couples.

Income sorting provides a new approach to understanding and measuring the impact of changes in family income relationships on family income inequality. Taking the personal income distribution among adults as given, our income sorting measure combines adults and children into families based on adult income ranks (separately by sex). When high-income adults tend to live with low-income adults, the income sorting process is more equalizing than if adults lived with others of similar income.

Several studies have shown that growth in the correlation of spousal incomes has increased family income inequality (Karoly and Burtless, 1995; Cancian and Reed, 1998, 1999). Our income sorting measure includes the rise in the rank correlation of spousal incomes and also incorporates a much broader set of changes. Income sorting encompasses whether a person of a given income rank lives with other adult family members (e.g., single-person, married-couple or extended family dwelling), the income rank of any related adults he or she lives with, and whether there are children in the family. In addition, while studies of the impact of correlation changes are limited to a small set of decomposable inequality measures, we introduce a non-parametric measure of income sorting that simulates the entire distribution of family income, allowing for the computation of any inequality measure.

Changes in income sorting are not the same as changes in family structure (i.e., people sorting). For example, the rising correlation of spousal incomes may reflect an increase in the propensity to marry someone of similar characteristics, known as assortative mating, a form of people sorting. Alternatively, it may reflect an increase in the propensity for the wives of high-earning men to work -- a reduction in the "income effect" of husbands' earnings on wives' labor force participation. Or it may reflect other changes such as the rise in returns to education or the aging of the population.

We pose the counterfactual, "What would be the level of family income inequality if income sorting had not changed since the late 1960s, all else equal?" We find that if income sorting had not changed, the increase in family income inequality would have been much smaller. Our results illustrate the substantial importance of changes in family income relationships for explaining rising family income inequality.

I. Methods and Data

In this section we develop a non-parametric method of quantifying the impact of changes in income sorting on family income inequality. Our analysis divides the change in the distribution of family income over the last three decades into two parts: change resulting from changes in the distribution of personal income and change resulting from changes in income sorting.

The role of each of these parts cannot be ascertained simply by comparing the overall change in family income inequality to the overall change in personal income inequality. For example, consider the effect of an increase in the mean of female earnings and a rise in the variance of male earnings. Inequality in the distribution of personal income will fall if the increase in inequality within male earnings is more than offset by the reduction in earnings inequality between males and females. At the same time, family income inequality may rise if male earnings constitute most of family income. Under some conditions these changes can occur without a change in income sorting into families. In those cases, our approach properly attributes the rise in family income inequality to changes in the distribution of personal income, even when personal income inequality declined.

Let male adult i have income y_i. We assign to each male adult i a rank R_i that gives the millicile in the distribution of income across males (i.e., ranks range from 1 to 1000).[1] We calculate the vector of income associated with each rank as the mean income of all men sharing that rank. For $r \epsilon \{1,2,...1000\}$, let

$$\mu(r) = \sum_{i \mid R_i = r} y_i \Big/ \#\{i \mid R_i = r\} \qquad (1)$$

[1] For men who have the same income, we randomly assign rank. Our results are robust to changing the assignment of ties to be based on the rank of sum of family income less y_i. or the inverse of that sum.

The distribution of $\mu(r_j)$ closely approximates the distribution of male income. For example, the Gini coefficient of inequality is the same up to four digits for the actual and the approximate distribution of male income. The rank assignments are made for each year and a similar calculation is done for female income (for convenience we suppress year and sex subscripts). By summarizing the male and female income distributions with 1000 points in each year instead of using one point per adult, the approximation allows us simulate changes between years with different population sizes.

Let q_f be a list of the income rank of every adult resident of family f. Let c_f be the number of children living in family f. Needs-adjusted family income F_f is calculated as

$$F_f = \sum_{j \in q_f} \mu(R_j) \Big/ p(\#(q_f) + c_f) \qquad (2)$$

where the function $\boldsymbol{p}$ translates family composition into income needs using the poverty line for that size and composition of family.[2] The distribution of F_f closely approximates the actual distribution of family income (e.g., the Gini coefficient is the same up to three digits).

We evaluate the distribution of adjusted family income across people as opposed to across families. Consider a society in which low-income people live in pairs in year 1 and in year 2 they live in single-person families each with half the income of their former families. We do not consider this a fifty percent reduction in their already low income and a doubling of the number of poor families. By weighting at the person level and adjusting for income

[2] We use the consumer price index, urban consumers, research series (CPI-U-RS), calculated by the Bureau of Labor Statistics, to convert incomes to 2002 dollars. The U.S. Census Bureau recently switched to the research series because it provides a more consistent series over time than was previously used (CPI-U-X1). Another advantage of the research series is that it matches more closely to the Personal Consumption Expenditure Deflator. We divide income by the 2002 poverty line and then multiply the income-to-needs ratio by the poverty line for a family of four in 2002 to convert to dollar terms. Thus, we report measures of the distribution of family "equivalent income."

needs, the method we use only incorporates the loss of economies of scale from sharing resources in year 1.[3]

To simulate the distribution of family income if income sorting had not changed since 1967, all else equal, we use family income sorting as in year 1 (1967) and the distribution of individual income as in year 2 (2002).

$$F_f^c = \sum_{j \in q_{1f}} \mu_2(R_j) \Big/ p(\#(q_{1f}) + c_{1f}) \qquad (3)$$

The vector F describes the entire counterfactual distribution of adjusted family income. We compare the counterfactual distribution to the actual distributions in years 1 and 2 using Lorenz curves as well as summary measures of inequality. We also consider the counterfactual, "What if income sorting had been the only change?" where we use income sorting as in year 2 and the distribution of individual income as in year 1.

Our method for estimating the counterfactual distribution of family income is essentially an accounting exercise. We do not attempt to measure behavioral changes. In particular, we do not consider the effect of changes in family composition on the distribution of individual income. Daly and Valletta (2004) use an alternative accounting method based on DiNardo et al (1996) to decompose changes in family income. An advantage of their method is that they explicitly model several determinants of family income including changes in women's labor force participation and family structure. However, their method does not measure changes in income sorting. For example, they model the changing propensity of people to be in married couple families, but not the

[3] Person-weighting is implemented in the data by assigning to each family the sum of the weights of persons in that family. This method is equivalent to the method used by the U.S. Census Bureau to estimate official poverty measures.

changing relationship of incomes among people in those families. The contribution of this paper is to measure directly the importance of changes in income sorting.

We use data from the March files of the Current Population Survey (CPS) from 1968 to 2003. The CPS measures only cash income. We exclude people living in "group quarters" and in institutions. Single people living without relatives are included as families of one person. We limit our analysis to families with prime-age heads: The head and spouse, if present, are ages 18 to 64 years. We account for changes in top-coding by the Census Bureau by adjusting the top codes so that in each year the same percentage of people are affected for each of the following sources: male earnings (3%), female earnings (1%), interest (0.5%), social security (0.5%), public assistance (0.5%) and other income (0.5%).

II. Trends in Inequality and Family Structure

The data reveal substantial growth in family income inequality over the last thirty years. The Gini coefficient for family income grew from 0.331 to 0.403 between 1967 and 2002 (Figure 1). Interestingly, inequality of personal income among prime-age adults actually declined with the Gini coefficient falling from 0.542 to 0.502. However, for male income, the largest source of family income, the Gini coefficient increased from 0.358 to 0.459. Compared to male income, female income has high inequality, but the Gini coefficient fell from 0.652 to 0.521.

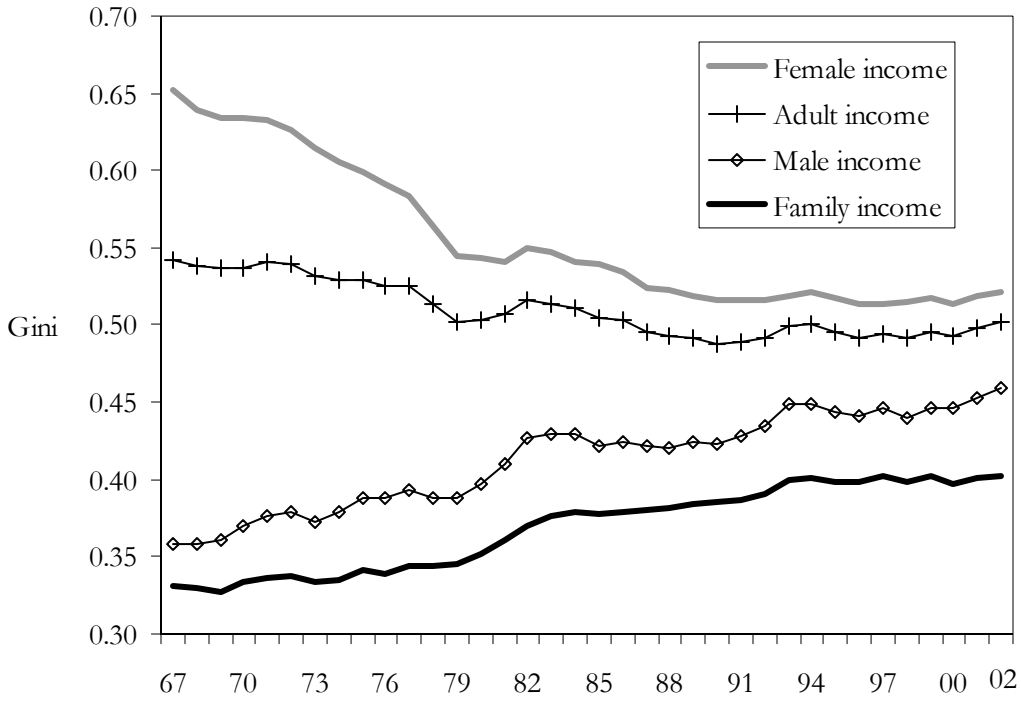

Figure 1. Gini Coefficient of Income Inequality, 1967-2002

Over this period, income sorting has also increased. For married couple families, the correlation of spousal earnings was actually negative during the late 1960s and the 1970s (Figure 2). It grew from –0.04 in 1967 to about zero in 1979 to 0.10 in 2002. All else equal, the increasing tendency for persons with similar income to be married will tend to increase family income inequality.

Figure 2. Correlation of Spousal Income, 1967-2002

Our measure of family income sorting captures changes in family composition beyond changes in correlation. Between 1967 and 2003, the share of the population living in families headed by unmarried women with children increased from 7 to 12 percent (see Table 1). This shift has increased the number of people living in families that tend to have low-incomes. Over the same period, the labor force participation of married women grew, further separating the incomes of married couple families from those of female-headed families. In 1967, it was more common for a married woman not to work than to work, by 2002, most married women were working (see bottom rows of Table 1).

Table 1 -- Population Shares and Median Income by Family Type, 1967-2002

	Share of Population		Median Family Income	
	1967	2002	1967	2002
All	100	100	36,504	59,449
Single head, no children	7	19	37,522	50,683
Single female with child(ren)	7	12	14,920	25,592
Single male with child(ren)	1	3	31,457	39,679
Married couple wife has no earnings	45	19	34,414	47,000
Married couple wife has earnings	40	47	42,943	79,519

Notes: Family type defined by the status of the head of family. Family income adjusted for needs using the poverty line. Income adjusted to 2002 dollars.

III. Income Sorting and Family Income Inequality

Changes in income sorting have had a very substantial impact on the distribution of family income. The solid black and gray lines in Figure 3 show the density distribution of the logarithm of family income in 1967 and 2002, respectively. The crossed line shows the counterfactual distribution if income sorting had not changed between 1967 and 2002. That is, we use the distributions of male and female income from 2002, sorted into families by income rank as in 1967. Under the counterfactual, median family income in 2002 would have been roughly the same as the observed median. That is, the rise in median family income since 1967 is not explained by changes in family sorting, but rather by changes in the distributions of male and female income.

At low levels of income, the counterfactual density curve is below that of the actual 2002 curve. In the absence of changes in income sorting, family income would have been higher in the lowest deciles. Looking at the high end of the distribution, if income sorting had not changed, family income would be lower in the highest deciles. Overall, the counterfactual distribution shows less variance than the 2002 distribution. That is, changes in income sorting contributed to rising family income inequality.

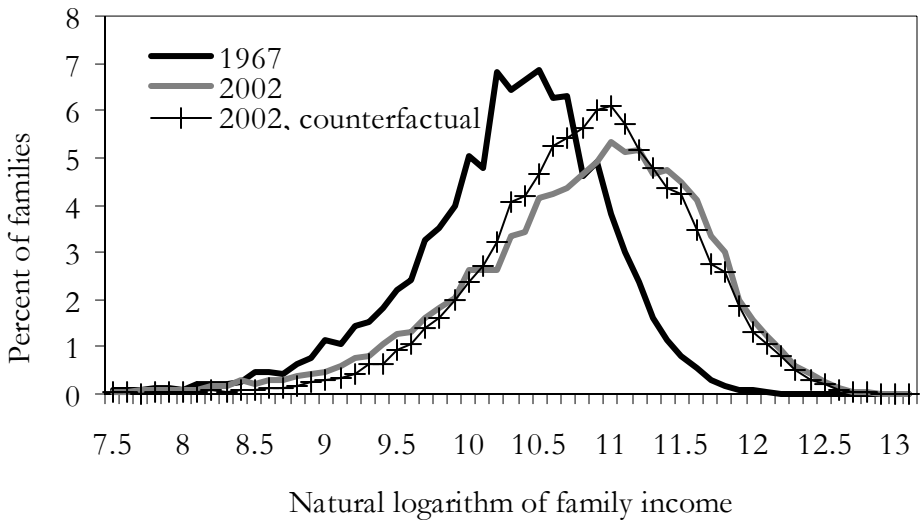

Figure 3. Density Distribution of Family Income (Natural Logarithm)

The Gini coefficient of family income increased from 0.331 to 0.403 between 1967 and 2002 (Table 2). If income sorting had not changed, the Gini coefficient would have been 0.362 in 2002. Under this counterfactual, changes in income sorting explain 57 percent of the growth in the Gini coefficient. We investigate the growing gap between middle-income and low-income families using the ratio of income at the median to income at the 20th percentile – the 50/20 ratio. The 50/20 ratio increased from 1.78 to 2.24 between 1967 and 2002. Were it not for changes in income sorting, the 50/20 ratio would have increased to 1.83. Thus, income sorting explains 88 percent of the growth in the 50/20 ratio. The 80/50 ratio measures the growing gap between upper income families at the 80th percentile and middle-income families at the median. The 80/20 ratio grew from 1.61 to 1.83 over this period. In the absence of changes in income sorting, the 80/50 ratio would have been 1.75 in 2002. Thus, income sorting explains 36 percent of the growth in the 80/50 ratio.

Table 2 -- Impact of Income Sorting on Family Income Inequality: Actual and Counterfactual

	Early Year: Actual	Later Year: Actual	Later Year: Counterfactual	Percent Explained
Counterfactual 1				
Gini	0.331	0.403	0.362	57
50/20	1.78	2.24	1.83	88
80/50	1.61	1.83	1.75	36
Counterfactual 2				
Gini	0.331	0.403	0.389	81
50/20	1.78	2.24	2.34	120
80/50	1.61	1.83	1.68	32

Note: Counterfactual 1 is "What if income sorting had not changed?" Counterfactual 2 is "What if income sorting had been the only change?"

As an alternative counterfactual we ask, "What if income sorting had been the only change?" We use the distributions of male and female incomes in 1967 and sort into families by income rank as in 2002. Under counterfactual 2, income sorting explains an even larger share of the growth in the Gini coefficient, 81 percent. If sorting had been the only change over the period, the 50/20 ratio would have grown to 2.34, even larger than the actual 2002 level of 2.24. Thus, under this counterfactual, income sorting explains all of the growth in the 50/20 ratio. The 80/50 ratio would have grown to 1.68, explaining 32 percent of the growth.

IV. Concluding Remarks and Directions for Future Research

In this paper we develop a new approach to understanding changes in the distribution of family income. We allocate changes in family income to two sources: changes in the distribution of personal income and changes in family income sorting. Income sorting captures the combining of personal incomes by income rank to create the distribution of family income.

We find that changes in family income sorting explain more than half of the increase in the Gini coefficient of family income. Income sorting explains most of the growth in the gap between middle- and low-income families and about one-third of the growth in the gap between high-income and middle-income families.

The approach developed here highlights the importance of changing family income relationships for understanding trends in family income inequality. The next step in this research is to combine the income sorting method introduced here with decomposition methods for earnings and wage equations. This will allow us to measure changes in income sorting that are related to changes in sorting based on observable characteristics, changes in the returns to those characteristics (e.g., the growing returns to education), and changes in labor force participation.

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