Income Distribution in Missouri

MSCDC Economic Report Series No. 9602

May 1996
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Introduction: Income Distribution and the PUMS

This is a brief and simple statistical study of income distribution in the state of Missouri from 1979 to 1989. The data on which it is based are the 1980 and 1990 decennial census Public Use Microdata Samples (PUMS). PUMS represent an invaluable research resource, currently available for decennial censuses as far back as 1850. Standard net searches will now point to many sites that make PUMS data accessible to the general public at no charge. A good place to begin PUMS research is at the Census Bureau web site.

For each decennial census, completed long-form questionnaires are obtained for about 15% of the U.S. population. The long forms are the basis for two PUMS extracts for each state: the 5% 'A' sample, and the 1% 'B' sample. These extracts are carefully designed and weighted in such a way that all population characteristics measured by census long form data can be accurately estimated (with calculable standard errors) down to county-level geography, subject to a minimum population constraint of 200,000. This minimum population constraint is required for compliance with statutory provisions of individual confidentiality for all information gathered in the decennial census. Counties with total populations of less than 200,000 are aggregated into larger PUMAs (Public Use Microdata Areas).

In contrast to the processed form in which other census information is disseminated, PUMS are subsets of the "raw" data--individual records--of the census. Using PUMS, researchers are not limited to standard Census Bureau tabulations: they can produce precise estimates of quantifiable statistical accuracy for any characteristic combinations or population subset possibilities of interest which are represented in the raw data.

One drawback to the use of PUMS is also a function of its greatest advantage: these are BIG files. Working with them requires a PC with plenty of horsepower, at least a gigabyte of disk storage, and software on the order of SAS or its equivalent in handling very large datasets. The simple statistics used for this study were generated from the Missouri 5% 'A' samples for 1980 and 1990--available over the Internet. These files produced SAS datasets of between 10 and 20 megabytes each; they contained observations on approximately 100,000 households and 250,000 persons.

Of course, the greatest advantage to the availability and use of these large datasets is the detail and accuracy of the estimates which can be obtained from them. All statistics together with their calculated standard errors derived from the Missouri PUMS for this report are tabulated (see Tables 1, 2, and 3) for the reader's convenient reference.

Income Distribution . . . the Basics

The Census Bureau measures *income* as pre-tax monies received. Non-cash items and benefits, including food stamps, are excluded; items such as social security, veteran's benefits, worker's compensation, various cash forms of public assistance and other transfer payments are included.

Income can be measured, analyzed, and reported for individual *persons*, for *families*, and for *households*. Households are the aggregate of individual persons living in a single housing unit. Households can be family or non-family households, and can contain more than one family. Persons in *group quarters* are counted as individual households. Detailed definitions of these terms can be found published on the Census Bureau's web site.

This report deals only with household income (excluding individuals in group quarters.) Since many individuals who have little or no income are nevertheless members of households with income, and since a significant number of households are non-family households, household income is often preferred to individual or family income when overall social well-being is of interest.

The analysis of household income distribution by race/ethnicity, gender, and age characteristics is based on the relevant characteristics of the head of household, or *householder*, without regard to the relevant characteristics of other household members.

The distribution of characteristics in a population is typically represented by a *frequency curve*. Values of the characteristic of interest are plotted on a horizontal axis and their frequency of occurrence in the population is plotted on a vertical axis. In a characteristic distribution, values have a tendency to cluster around their center. We use three different measures of this *central tendency*--the *mean*, the *median*, and the *mode*. The *mean* is the arithmetic average, or *expected value*, of the characteristic; the *median* is the value with the same number of values above it as below it--i.e. it is the value "in the middle" of the population; the mode is the most frequently occurring value of the characteristic in the population.

One very commonly encountered frequency curve is that which reflects a *normal distribution*. (See Figure 1.a) The normal distribution is symmetric. Its mean, median and mode are equal, or *coincident*. The normal distribution can thus be described as *symmetric* around the mean.

Measured incomes are a characteristic of the population of households (or families, or persons) but they are *not* normally distributed, and their distribution is *not* symmetric. The distribution of incomes in a population is asymmetric, or *skewed*, toward the upper (right-hand) tail. In a such a skewed distribution, the mean, median, and mode are *not* coincident. (Refer to Figure 1.b)

The skewness of income distribution reflects the degree of income inequality in the population. This is reflected in the difference between mean and median values. In an income distribution, mean value is biased by extremely high values, and is thus always higher than the median value. For this reason, median income is the preferred measure of central tendency in the analysis of income distribution, since it reflects a position in the middle of the population. In this study, we will compare mean and median values of income as a reflection of the skewness of income distribution.

The Quintile Distribution of Income

Perhaps the most common representation of income distribution is by quintile shares. This method orders the household population by income, then divides it into fifths, or *quintiles*; each quintile thus represents 20 percent of the population. The income of all households in each quintile is summed, making possible a comparison between the ranked population quintiles and their *aggregate income shares*.

Figure 2 presents the quintile distribution of household income for both Missouri and for the whole United States in 1979 and in 1989.[1] The typical pattern of skewness in income distribution is apparent in this graph. The bottom 20 percent of the (household) population receives only around 4 percent of aggregate income; the middle three quintiles (60 percent of the population) receive around 50 percent of income, and the top 20 percent of the population claims around 46 percent of income. Detailed percentages are displayed just below the graph in Figure 2. We can see from a study of this data that the actual income distribution in 1979 for both Missouri and the U.S. was very close to 4 percent to the lower quintile, 52 percent to the middle three quintiles, and 44 percent to the upper quintile.

This distribution changes between 1979 and 1989. Reflecting an already well-documented trend[2] that has been in place since the mid-seventies, income distribution for both Missouri and the U.S. as a whole has become noticeably more skewed over the ten year period between decennial censuses. With the numbers for both Missouri and the U.S. again staying very close to one another, the income share of the lowest quintile has fallen well below 4 percent; the middle quintiles have fallen below 50 percent, while the upper quintile has boosted its take to almost 47 percent.

Mean and Median Incomes

Mean and median incomes for all households, and for households by race and hispanic origin, in both Missouri and the U.S. in 1980 and 1990, are presented in Table 5.[3] (Figures for 1979 are adjusted to reflect real income in terms of 1989 dollars.)[4] In Figure 3, the percentage changes in these values between 1979 and 1989 are plotted. Several points of interest are readily observable.

In contrast to the quintile distribution, there are pronounced differences between Missouri and the U.S. as a whole in the changes between 1979 and 1989 incomes. For the U.S. as a whole, mean and median incomes across the racial and hispanic origin spectrum showed a similar increase. Mean incomes increased at about twice the rate as did medians; this is consistent with our discovery of increased skewness in the quintile distribution. In Missouri, however, the picture is dramatically different. While most median incomes for the U.S. did show a slight increase (median hispanic household income actually showed a .24

[1] It should be noted that the decennial census measures income of the prior year. Thus, the 1980 census measures 1979 income, and the 1990 census measures 1989 income. Figures for U.S. quintile distribution are for income years 1979 and 1989, obtained from historical Table H-1, published on the Income and Poverty page at the Census Bureau's web site.

[2] See the analysis of trends in income distribution published on the Income and Poverty page at the Census Bureau's web site.

[3] U.S. mean and median income figures for income years 1979 and 1989 are from historical Table H-3, published on the Income and Poverty page at the Census Bureau's web site.

[4] The index used for this adjustment is the Bureau of Labor Statistics Consumer Price Index for Urban Wage Earners, Series ID CWUR0000SA0. Detailed information on this index series can be found on the CPI pages at the BLS web site.)

percent decrease), median incomes in Missouri fell sharply across the board. Median hispanic income declined by 32.45 percent.[5] Furthermore, in addition to across the board declines in median income for all Missourians, for blacks and hispanics, mean incomes as well posted a significant decline. A possible explanation for the dramatic shift of hispanic incomes in Missouri will suggest itself when we return to the subject of income shares.

Figures 4 and 5 graph similar measures of mean and median income in Missouri by gender. Figure 4 presents actual income levels; Figure 5 plots their percentage changes from 1979 to 1989. Here, we see that not only did the increase in mean income for women significantly outpace the increase for men, but that women's median income increased, while that for men actually declined.

Mean and median incomes by age for Missouri in 1979 and 1989 are presented in Figure 6. Percentage changes are graphed in Figure 7. A consistent pattern of distribution by age is evident in Figure 6. Every measure of income, mean and median for both 1979 and 1989, shows a smooth curve across age cohorts, increasing from under age 20, peaking between ages 40 and 49, followed by a smooth decrease to ages 65 and over.

Figure 7 displays an intriguing pattern of change in mean and median incomes across age cohorts. Below age 20, mean income declined 13.9 percent and median income declined by 25.25 percent. In contrast, at ages 65 and over, mean income increased by 14.42 percent, while median income increased by 9.91 percent. Between these two extremes both mean and median display a monotonic, or smooth, pattern of change. Means shift from negative to positive in the 30 to 39 age cohort, while medians stay negative up to over age 65. From this, we can see that the consistent pattern of distribution across age is, like the overall distribution, becoming more skewed. While the incomes of age cohorts in the middle of the distribution are shifting relatively little, large shifts are taking place at the extremes, with younger ages losing income relative to the older.

Aggregate Income Shares

In addition to the comparison of median or mean incomes, another useful way to evaluate income distribution among demographic groups is to look at aggregate income shares. Using this method, we compare the percentages of the population comprised by the demographic groups of interest to the percentages of aggregate income which those groups claim.

Figure 8 presents the comparative population percentages and percentage shares of aggregate household income for householders by race.[6] It shows us that in 1979, heads of households in Missouri

[5] It should be noted that the percentage change in mean hispanic income for Missouri in 1979 is calculated on an estimate of $30,207.00 with a 95 percent confidence interval of +/- $1,723. In contrast, the same confidence interval for the estimate of $30,616.00 mean non-hispanic income is only +/- $154.00. This is due, of course, to the relatively quite small number of hispanics in the population, and hence in the long-form sample, in the 1980 census.

[6] Hispanic origin is not a component of race. Persons of hispanic origin may belong to any one of a variety of racial categories, including black or white. Thus, data tabulated on the basis of hispanic origin must be either contrasted with "non-hispanic origin", or broken down into it's own component elements, e.g. Mexican, Puerto Rican, Cuban, etc. Note that the presentation of hispanic mean and median income levels alongside racial categories in Table 5 and in Figure 3 does not violate this concept, since those data are only comparisons of independent values for the (not necessarily exclusive) groups of interest, not an evaluation of percentage shares for an homogenous population. That is, mean and median incomes for age, gender, race, and hispanic origin could all have been presented alongside each other in any random order

were around 90 percent white and 9 percent black, but that those households received close to 92 percent and 7 percent, respectively, of aggregate household income. By 1989, in contrast, while black and white householder income shares has remained fairly stable, the population percentages had shifted so that income shares were more equal to population percentages. That is, in 1989, aggregate percentage income shares for black and white householders in Missouri has become not only more equal, but nearly equal. This is an interesting finding--in contrast to the performance of mean and median incomes--which could perhaps benefit from further examination.

Aggregate shares for hispanics and non-hispanics are presented in Figure 9. We note that the percentage of hispanic-headed households in Missouri, in contrast to that of black householders, has increased dramatically. While we observe that racial and hispanic characteristics are not exclusive categories, there is probably some relation between these two movements. This dramatic increase in the percentage of hispanic households in Missouri probably also has some explanatory power for the equally dramatic decline in hispanic mean and median incomes observed earlier.

Finally, in Figure 10, aggregate shares for male and female heads of household are presented. This is, in some ways, the most telling statistic of all. At least, here we see the most significant inequality of aggregate income shares of all the demographic categories we have examined. Remember that this dramatic inequality in aggregate income shares persists in spite of the sharp increases in mean and median income for females relative to males which was observed earlier.

Summary

Comparison of quintile distributions for both the U.S. and Missouri in 1979 and 1989 show that the broad and long-range trends in shifting income distribution for the U.S. population as a whole are closely mirrored in the Missouri population. Significant variations from the national trends do emerge, however, with closer examination of various demographic groups.

In Missouri, the proportion of hispanic households in the population seems to be growing at the expense of black households. In the context of this growth, hispanic households are receiving a significantly smaller share of aggregate income, while that of black and white households is tending to equalize, in spite of continuing differences in mean and median incomes.

The income distribution by age cohorts in Missouri has shifted in a significant way between 1979 and 1989 from the younger cohorts to the older. Significant income disparities in households headed by men and women persist in spite of gains by female householders in mean and median income levels.

Overall, real median income in Missouri declined for all households, while real mean income did increase. This is in contrast to increases in both mean and median real income at the national level.

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without compromising the integrity of the data. The conventional presentation is more conceptually useful, however. The hispanic/non-hispanic presentation of aggregate income shares follows in Figure 9.