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Household Economies of Scale and Changes In the Distribution of Income:

The Declining Middle Segment

By JAMES A. BUSS*

ABSTRACT. A household's position in the *distribution* of income depends not only on that household's *disposable income* but also on the degree to which *economies of scale* in operating a *household* exist. Since the magnitude of these "scale effects" has never been definitively measured, three sets of assumptions about equivalent household sizes are used to construct three income distributions for 1980 and 1986. Economies of scale in operating a household are assumed to be strong, weak, and non-existent. In a given year, as these scale effects are reduced, the size of the middle segment declines. It is also observed that over time, with each set of assumptions, the size of the middle segment declines. Moreover, the sizes of the households found in each tail of the distribution are very sensitive to the assumption relating to economies of scale in operating a household.

I

Introduction

IN THE PAST FEW YEARS, considerable attention has been directed towards the issue of whether or not the "middle class" in the United States has decreased. Bradbury, Lawrence, Thurow, and others think that it has and that the United States is becoming more economically polarized.¹ Levy, Rosenthal, along with Kusters and Ross, have a different opinion.² They believe the size, the earnings, and the types of jobs held by the middle class have not suffered any significant erosion during the post-1970 period.

The studies mentioned have very few common features. The time periods considered are not identical, although most concentrate their attention on the post-1970 period. Moreover, the types of income considered, the income receiving units observed, and the definition of the middle class are not the same across these studies. These variations, in part, account for the different conclusions they reach.

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This present study continues in the tradition of being quite different from its predecessors. Four important aspects distinguish it from those cited above. The first difference involves the type of income which is considered, since after-tax income is used rather than pre-tax income, annual earnings, or hourly compensation.

The second difference, an important one, is that households rather than families or wage earners are considered. Households are more inclusive than families. Nearly everyone belongs to a household while only 87% of Americans live in families.³ Also, all households receive some income while many income recipients earn no wages. Thus, this study uses a broader group of income recipients than do the studies cited which consider families or wage earners.

None of the studies mentioned above explicitly consider the number of persons residing in each income receiving-unit. This omission is a serious flaw that should be corrected. Furthermore, this study assumes that joint consumption opportunities or economies of scale in operating a household may exist. Thus a third difference is the use of the concept, "equivalent household sizes." This is discussed in detail in Section III.

The fourth difference centers on the definition of the middle class that is used. Here the middle class is defined to include all persons whose incomes range from one-half, up to one and one-half, times the median income level. A more detailed discussion of this matter appears in Section IV.

Two goals are pursued. The first goal is to determine what changes have taken place in the sizes of three segments of the income distribution, the middle class and those segments below and above it. The second goal is to see if these changes are affected by the economies of scale of operating a household. When this second goal is achieved, the sizes of the households which comprise each segment of the distribution will become apparent.

II

Problems With the Income Data

THE DISTRIBUTION OF AFTER-TAX INCOME used in this study is that published by the Bureau of the Census.⁴ Since this data series was initiated in only 1980, the time frame of this study is rather short: 1980 to 1986. To obtain after-tax income from the estimates of before-tax income, the Census Bureau removed four types of taxes and added an estimate for net capital gains income. The four taxes deleted from before-tax income were federal and state individual income taxes, property taxes on owner occupied housing, and payroll taxes.

The after-tax income variable used in this study has several limitations. One is that no allowance has been made for non-cash transfer payments, such as

food stamps and medicaid. Another limitation is that the value of fringe benefits is excluded from the concept of income used by the Census Bureau. In addition, no adjustments have been made for the ages of household members.

Two other factors need to be mentioned. The first concerns regional differences in the costs of living, the second concerns the use of nominal rather than real income figures.

According to figures published by the Bureau of Labor Statistics, the cost of living in 1980 in the most expensive city (Boston) was about 30% above that of the least expensive area (Dallas).⁵ Moreover, spatial cost of living differences increased after 1980. Buss and Nantz estimated that the spread between the lowest and highest costs of living in major metropolitan areas increased to 36% by 1986.⁶ However, almost 80% of the population lives in areas where the cost of living varies by less than 5% from the nation's average. Also, these regional cost of living differences do not appear to have a significant impact upon the Gini coefficient calculated for the country as a whole.⁷ Accordingly, these regional cost of living differences are disregarded here.

The income categories used to construct the frequency distribution that will appear were not adjusted to compensate for the inflation that occurred from 1980 to 1986. In other words, nominal rather than real income categories were used. This procedure does not constitute a serious flaw. As inflation occurs, one should expect fewer persons to be located in the lowest nominal income categories. Since the increases in nominal incomes that accompany inflation do not occur at the same rate across households, inflation is one of the factors at work that causes the shape of the income distribution to change through time. But the root causes of the changes in the distribution of income lie in the myriad of factors which causes the nominal incomes of some households to expand at faster rates than others. Thus, while inflation is one of the factors that must be considered, it is certainly not the only or the most important factor at work.

III

Adjustments for Household Size

A MAJOR ISSUE that needs to be resolved is the adjustment of the after-tax income data to reflect differences in household size. Vital to this adjustment process is the extent to which economies of scale exist in the operations of a household. If economies of scale are absent, the correct procedure is to calculate income per household member. If economies of scale do exist, the adjustment process is not so straight forward. This can be seen from the following relationship: $W = Y/(S)^c$. In this equation W represents welfare per household member. Y is total disposable household income. S stands for household size. The exponential

variable “e” refers to “household size elasticity of need.”⁸ This elasticity coefficient can range from zero to one. If $e = 1$ then economies of scale are absent. As e approaches zero, economies of scale in operating a household become more intense.

The denominator of the welfare ratio, S^e , represents “equivalent household size.” This variable is the multiplicand that is used to calculate the income level needed by a multi-person household to produce a well-being level identical to that of a one person unit. For everyone to have identical levels of well-being, the disposable income of multi-person households must be S^e times greater than the income of a person living alone.⁹

Researchers are not unanimous about the degree to which economies of scale in the operations of a household exist or the value to assign to e . This can be seen from Table 1 where the equivalent household sizes and the range of e from six studies are presented. In the studies surveyed, e ranges from .084 to .740.

In lieu of agreement as to the size of e , three sets of arbitrarily chosen equivalent household sizes are used. Case I assumes no economies of scale exist in the operations of a household. This is done by assigning to e a value of one. In Case II, economies of scale are assumed to be weak. Each additional household member adds the equivalent of three-fourths of a person to the unit and e ranges from .87 to .80. In Case III, economies of scale are assumed to be strong. Each additional household member adds the equivalent of only one-fourth of a person to the unit. Values of e range from .47 to .32. The equivalent household sizes for each of the three cases are shown in the last three rows of Table 1. These equivalent household sizes are used as the values for S^e .

Two additional comments about equivalent household sizes need to be mentioned. First, it is implicitly assumed that income or well-being in each unit is shared equally by all household members. No adjustments to account for age or sex differences within households have been attempted. Second, it is assumed that the largest households have only seven members. This last assumption poses no serious bias since less than one percent of the population in the United States live in households with more than seven people.¹⁰

IV

Defining the Middle Class

THE TERM “MIDDLE CLASS” has many meanings and connotations. A discussion of all of these would take us far afield. The definitions employed by Levy serve as a starting point. He maintains that, from an economic perspective, middle class can mean (a) near the middle of the income distribution or (b) being able to

Table 1
Survey of Equivalent Household Sizes

Household Size	1	2	3	4	5	6	7	"e" Range
Lazear & Michael (1)	1.00	1.06	1.28	1.47	1.69	---	---	.084 - .326
BLS (1)	1.00	1.67	2.28	2.78	3.22	---	---	.726 - .740
Orshansky (1)	1.00	1.26	1.51	1.89	2.23	---	---	.334 - .498
Buhman, et. al. (2) (a)	1.00	1.32	1.55	1.74	1.90	2.05	2.18	.4
(b)	1.00	1.52	1.93	2.30	2.63	2.93	3.21	.6
CBO (3)	1.00	1.28	1.57	2.01	2.38	2.69	3.05	.356 - .635
Hedstrom & Ringen (4)	1.00	1.50	2.00	2.50	3.00	3.50	4.00	.585 - .712
Case I	1.00	2.00	3.00	4.00	5.00	6.00	7.00	1.00
Case II	1.00	1.75	2.50	3.25	4.00	4.75	5.50	.807 - .876
Case III	1.00	1.25	1.50	1.75	2.00	2.25	2.50	.322 - .471

- (1) E. P. Lazear and R. T. Michael, "Family Size and the Distribution of Real Per Capita Income," American Economic Review (March 1980), page 102.
Bureau of Labor Statistics and Orshansky figures are from this source.
- (2) B. Buhman, et. al., "Equivalence Scales, Well-Being, Inequality, and Poverty: Sensitivity Estimates Across Ten Countries Using the Luxembourg Income Study Database," Review of Income and Wealth (June 1988), page 120.
- (3) Congressional Budget Office, Trends in Family Income: 1970-1987 (Washington, D.C.: U.S. Government Printing Office, 1988), page 6.
- (4) P. Hedstrom and S. Ringen, "Age and Income in Contemporary Society: A Research Note," Journal of Social Policy, Vol. 16, page 235.

enjoy a middle class standard of living.¹¹ Here only the first meaning is used. To label the people who fall into the middle segment of the income distribution as “middle class” may be inappropriate, since there is no intent to suggest that these people form an actual “class” in the sense that they share similar sociological traits, behavior patterns, or values. Perhaps all they have in common is an income “near the middle of the distribution.” Indeed, the phrase “middle segment of the income distribution” is a more apt description of what is being observed. Consequently, this phrase will be used instead of the ambiguous term “middle class.”

What constitutes the middle segment of the income distribution? It is the range of incomes from one-half to one and one-half times the median income level. The middle segment of the income distribution is the interquartile range. The lower tail of the income distribution contains those households whose members have less than half the median income. The top of this income range is now commonly used to define the poverty line.¹² The upper tail contains those households whose members enjoy a level of income greater than one and one-half times the median income. This is the cut-off used by Kosters and Ross in their recent study.¹³ This income level is referred to as the “affluence” line.¹⁴

v

The Methodology Used To Find Median Income

IN ORDER TO SEPARATE the income distribution into three segments it is necessary to calculate the median level of after-tax income per equivalent household member or $Y/(S)^e$. Recall that three sets of S^e values are to be used. In the remainder of this section the procedures and assumptions used to find this median income level and to determine the poverty and affluence lines are discussed in detail.

In the *Current Population Report Series P-23* the Census Bureau publishes estimates of the mean levels of before-tax incomes, and after-tax incomes, for seven household sizes in twenty-one income categories. Subtracting the latter amounts from the former yields the average taxes paid by the households in each category. When this difference is set relative to the mid-range value of each income bracket, an estimate of the average tax rates paid by households in each bracket is obtained.¹⁵ By applying this rate to the bottom and top income levels of each bracket, the after-tax income ranges for each of the twenty-one categories for each household size is established.

Each after-tax income amount was subsequently divided by the appropriate equivalent household size. This yielded three sets of ranges of $Y/(S)^e$ for the

different sized households located in each of the twenty-one brackets. Within each set these income ranges were then aligned from lowest to highest, and the number of persons in each category was summed until the median person was located. To reach this last step in the process, it was necessary to assume that income in the brackets that contained the median person increased by equal increments.¹⁶

Once the median was found, the poverty and affluence lines were established. The number of persons in the households below and above these two lines was determined. The residual between the two tails provided the number of persons considered to be in the middle segment.

VI

Changes in the Size of the Middle Segment

A SUMMARY of the results of the computations appear in Table 2. To interpret these figures, one must recall that no economies of scale exist with Case I, some exist in Case II, and strong economies of scale are present in Case III.

TABLE 2

PROPORTION OF THE POPULATION IN EACH SEGMENT: 1980-1986

Assumption Set	Median Income	1980: % of population in		
		Lower Tail	Upper Tail	Middle Segment
I	\$5,137	16.7	25.7	57.6
II	6,212	16.6	24.3	59.1
III	10,462	16.6	22.4	61.0

Assumption Set	Median Income	1986: % of population in		
		Lower Tail	Upper Tail	Middle Segment
I	\$7,433	18.9	28.6	52.5
II	8,950	18.8	27.4	53.8
III	14,979	18.7	25.0	56.3

CHANGES FROM 1980 TO 1986

	Increase in Median Income	Change in Lower Tail	Change in Upper Tail	Change in Middle
I	6.15 %/year	+2.2	+2.9	-5.1
II	6.08 %/year	+2.1	+3.1	-5.2
III	5.97 %/year	+2.1	+2.6	-4.7

Note: The population was 224.7 million in 1980 and 238.3 million in 1986.

There are sets of four variables pertaining to 1980 and 1986 respectively. Each set contains: (1) the estimated level of median after-tax income per equivalent person, (2) the proportion of the population in the lower tail, (3) the proportion of the population in the upper tail, and (4) the size of the middle segment. The four columns in the third section of Table 2 show the changes that have occurred in each variable over the 1980 to 1986 period.

The last three columns in the third section are of key importance. They show that no matter what one assumes about the economies of scale of operating a household, the proportion of households defined to be in the middle segment has declined. In each case both tails have expanded. The lower tail has increased by about two percentage points while the upper tail has grown by about three percentage points. Thus the middle segment has declined by about five percentage points over the 1980 to 1986 period.

VII

The Role Played By Economies of Scale

THE IMPACT that economies of scale (or the value of "e"), have on the distribution of income can be gleaned from Table 2. As the degree to which the economies of scale of operating a household intensify (reading down each column), three observations can be made. First, the level of median income increases. Second, the size of the lower tail is not affected. Third, the size of the upper tail is reduced. Therefore, the greater the strength of economies of scale in operating a household, the larger is the size of the middle segment. But, over time, with each set of assumptions, the proportion of the population calculated to be in the middle segment has declined.

While the assumption about economies of scale in the operations of a household does not affect the size of the lower tail, it does influence greatly the types of households found in that segment of the income distribution. This can be seen from Table 3. To simplify matters a "small" household is defined as having either one or two persons. A "medium" sized household has three or four members. "Large" households have five or more persons. When no economies of scale are assumed (Case I), the lower tail has 17% small households and 44% large households. When economies of scale are assumed to be strong, small households make up 36% of the lower tail while large households account for about 30%. Thus going from the case where economies of scale are assumed to be nonexistent to the case where they are presumed to be strong results in the composition of the lower tail changing dramatically. Small households' representation in the lower tail increased by more than seventeen percentage points while large households declined by fourteen percentage points.

The size of the households found in the upper tail also changed when different assumptions about economies of scale are used. This can be seen from the Section IV in Table 3. In each year more than half of the upper tail is comprised of small households when no economies of scale are assumed (Case I). This figure drops to 36% when it is assumed that economies of scale in operating a household are strong (Case III). Again there is a change of nearly twenty percentage points. For large households, their gain in the upper tail is about ten percentage points in going from Case I to Case III.

The conclusion is that the composition of both tails is very sensitive to the assumption about economies of scale. This is understandable. When the economies of scale in operating a household are assumed to be strong, opportunities for joint consumption are assumed to be abundant. These scale effects allow the persons who live in large households to enjoy levels of well-being higher than is suggested by the per capita income of that household. The relative position of these large households in the income distribution shifts accordingly as economies of scale get stronger.

VIII

Summary

ECONOMIES OF SCALE in the operations of a household may arise from the joint consumption of some commodities. The degree to which these economies of scale do exist in a household is not known. Without specific knowledge about these scale effects, a researcher who is studying the well-being of household units must make assumptions about this matter. In this study three assumptions about economies of scale are used. (1) They do not exist. (2) They are weak. In this case each additional person adds the equivalent of three-fourths of a person to a household. (3) Economies of scale in each household are intense. In this case each additional person adds the equivalent of one-fourth of a person to a household.

Two interrelated questions are answered. Has the distribution of after-tax income changed since 1980? Do economies of scale in the operations of a household affect either the income distribution in a particular year or the changes that take place over time? To answer these questions the frequency distribution of after-tax income per equivalent person is divided into three segments. The lower demarcation point is equal to one-half the median person's income. The upper demarcation point is drawn at the income level equal to one and one-half times the median person's income. Between these two points lies the middle segment.

TABLE 3

SIZES OF THE HOUSEHOLDS IN THE THREE SEGMENTS OF THE
INCOME DISTRIBUTION: 1980 and 1986

I. Proportion of Households in each category

	1980	1986
Small Households	31.6	33.2
Medium Households	42.3	44.2
Large Households	26.1	22.6

II. Composition of the Lower Tail: 1980 and 1986

	Small	Medium	Large
Case I	16.1	36.1	47.8
Case II	20.7	36.0	43.3
Case III	36.9	32.1	31.0
Change from			
I to III	+20.8	-4.0	-16.8
Case I	18.7	39.7	41.5
Case II	21.8	39.3	38.8
Case III	35.5	35.8	28.7
Change from			
I to III	+16.8	-3.9	-12.8

III. Composition of the Middle Segment: 1980 and 1986

Case I	24.3	47.1	28.6
Case II	25.3	46.1	28.6
Case III	28.4	43.6	28.0
Change from			
I to III	+4.1	-3.5	-.6
Case I	26.6	47.7	25.7
Case II	27.8	48.1	24.2
Case III	30.8	44.9	24.2
Change from			
I to III	+4.2	-2.8	-1.5

IV. Composition of the Upper Tail: 1980 and 1986

Case I	57.8	35.5	6.7
Case II	54.3	37.4	8.3
Case III	36.2	46.7	17.1
Change from			
I to III	-21.6	+11.2	+10.4
Case I	54.7	40.4	4.9
Case II	51.5	39.7	8.7
Case III	36.5	48.7	14.8
Change from			
I to III	-18.2	+8.3	+9.9

Overall, economies of scale in the operations of a household did not affect what happened to the size of the middle segment over time. The proportion of the population in the middle segment declined during the 1980 to 1986 period. In a given year the assumption about economies of scale did affect the size of the middle segment and the sizes of the households found in each segment of the distribution. When one assumes that economies of scale in the operations of a household become more intense, three events occur: (a) the proportion of the population in the middle segment increases, (b) large sized households move up in the distribution, and (c) small sized households move down in the distribution.

Notes

1. Katherine Bradbury, "The Shrinking Middle Class," *New England Economic Review* (Sept./Oct. 1986): 42–55; Lester Thurow, "The Disappearance of the Middle Class," *The New York Times* (Feb. 5, 1984): F-3; Robert Lawrence, "Sectoral Shifts and the Size of the Middle Class," *The Brookings Review* 2 (Fall 1984): 3–11; Bennet Harrison, Chris Tilly, and Barry Bluestone, "Wage Inequality Takes a Giant U-Turn," *Challenge* 29 (Mar./Apr. 1986): 26–32; Bob Kuttner, "The Declining Middle," *The Atlantic Monthly* (July 1983): 60–72; Patrick McMahon and John Tschetter, "The Declining Middle Class: A Further Analysis," *Monthly Labor Review* 109 (Sept. 1986): 22–27; and the Industrial Union Department, AFL-CIO, *Deindustrialization and the Two Tiered Society* (Washington, DC: AFL-CIO, 1984).

2. Frank Levy, "The Middle Class: Is It Really Vanishing?" *The Brookings Review* 5 (Summer 1987): 17–21 and *Dollars and Dreams* (New York: Norton, 1988); Neal Rosenthal, "The Shrinking Middle Class: Myth or Reality?" *Monthly Labor Review* 108 (Mar. 1985): 3–10; Richard Kirkland, Jr., "Are Service Jobs Good Jobs?" *Fortune* 117 (June 10, 1985): 38–43; Marvin Kosters and Murray Ross, "A shrinking middle class?" *Public Interest* (Winter 1988): 3–27.

3. U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-20, No. 371 and No. 419.

4. U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-23, No. 126 and 157.

5. U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States* (Washington, DC: U.S. Government Printing Office, 1981) 472.

6. Kathryn A. Nantz and James Buss, "Income Distribution Across the United States: A Comparative Study," *Proceedings of the Northeast Business and Economics Association* (Nov. 1988): 75–77.

7. Statistically the Gini coefficient is one-half the relative mean difference or one-half the arithmetic average of the absolute values of the differences between all pairs of incomes. For a description of the Gini coefficient see, for example, Robert Ekelund and Robert Tollison, *Economics* (Glenview, IL: Scott, 1988) 386.

8. Brigitte Buhman, et al., "Equivalence Scales, Well-Being, Inequality, and Poverty: Sensitivity Estimates Across Ten Countries Using Luxembourg Income Study (LIS) Database," *Review of Income and Wealth* 34 (June 1988): 115–142.

9. Let the well-being and income of a single person be represented by W_1 and Y_1 respectively. In a two person household W_2 represents per capita well-being and Y_2 is that unit's total income. For $W_2 = W_1$, $Y_2 = Y_1$ (2)^c. If economies of scale in operating a household do not exist and

the value of e is one, for W_2 to equal W_1 it is necessary for Y_2 to be twice as great as Y_1 . If economies of scale are present in the operations of a household, for W_2 to equal W_1 , Y_2 need not be twice as great as Y_1 . Thus a five person household might need 4.2 times the income of a one person household for its average member to have a level of well-being equal to that of the person living alone.

10. U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-23, No. 126 and 157.

11. Levy, 17.

12. According to Isabel Sawhill, "Poverty in the U.S.: Why Is It So Persistent?" *Journal of Economic Literature* 26 (Sept. 1988): 1076, this definition of the poverty line was originally presented by Victor Fuchs, "Redefining Poverty and Redistributing Income," *The Public Interest* (Summer 1967): 88-95.

13. Kosters and Ross, 14.

14. For a discussion of the controversy as to whether poverty and affluence are absolute or relative concepts, see Sawhill, 1076-1077 and the references cited there.

15. Two implicit assumptions were made. First, the mid-range income of each category is equal to the mean income for households in that category. Second, all households in a particular category pay the same tax rate.

16. This assumption implies that within the bracket that contains the median person, households are distributed evenly. The income increment separating households in this bracket is equal to the difference between the top and bottom incomes of this bracket divided by the number of households in it.

Social Tyranny

Society can and does execute its own mandates: and if it issues wrong mandates instead of right, or any mandates at all in things with which it ought not to meddle, it practices a social tyranny more formidable than many kinds of political oppression, since, though not usually upheld by such extreme penalties, it leaves fewer means of escape, penetrating much more deeply into the details of life, and enslaving the soul itself.

JOHN STUART MILL (1806-1873)

Loyalty or Parochialism?

The president of the United States can play golf, run his speedboat and shoot quail, but the president of Harvard has no time for tennis nor to read a box score. Those immersed in Harvard might say the level of leisure is proportionate to the importance of the two jobs.

PETER ANDERSON.

["Harvard's Commoner King," *Boston Globe*, Feb. 4, 1992, p. 45 *et seq.*, at p. 48.]