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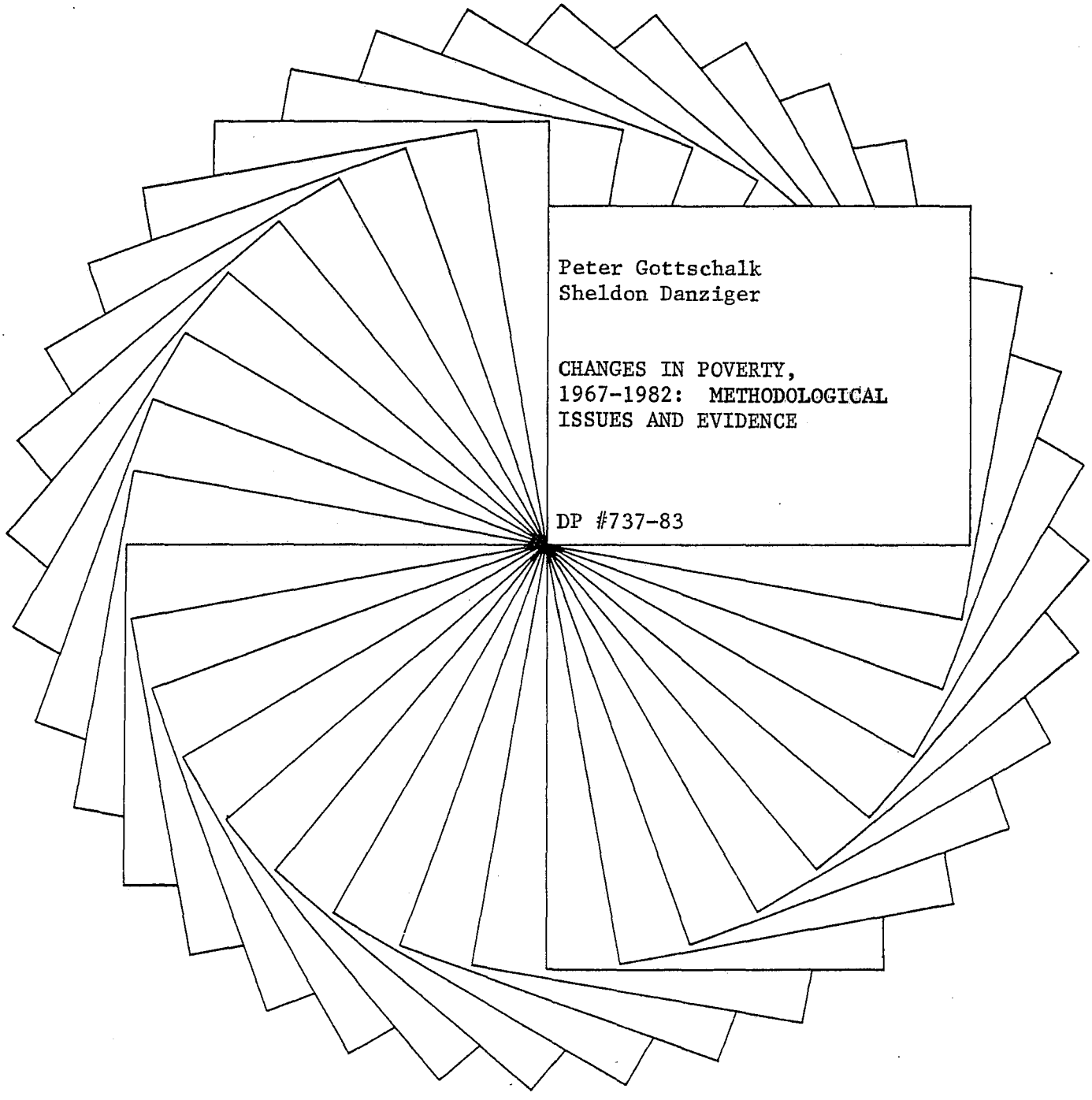

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CHANGES IN POVERTY, 1967-1982: METHODOLOGICAL ISSUES AND EVIDENCE

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ABSTRACT

In this paper we develop a methodology to estimate the interrelationships of economic growth, increases in income transfers, and reduction of poverty over the past fifteen years. The basic question we wish to address is the importance of increases in market incomes relative to income transfers in reducing poverty.

Models previously used to project poverty rates have not been specified in such a way as to separate the effects of increased market incomes from the effects of increased transfers. We develop a conceptual framework that links cyclical and secular changes in macroeconomic activity to moments in the income distribution, and thus to changes in poverty. Using data from the Current Population Surveys for 1967 through 1982, we find that increases in both market incomes and transfers reduce poverty, and that the relative importance of these effects differ widely by demographic group. Among the elderly, transfers account for almost all the decline in poverty. For persons in households headed by men of working age, change in transfer income is relatively less important, accounting for about a third of the poverty reduction.

Our simulations indicate that poverty rates will remain above the 1979 rates through the mid-1980s, even if economic conditions improve. We also find that over the period 1967 to 1981, transfers were largely responsible for the small decline in official poverty. Within that period, from 1967 to 1974, market incomes and cash transfers were of almost equal importance in lowering poverty, and the rise in poverty from 1978 to 1981 resulted primarly from cyclical economic changes.

Changes in Poverty, 1967-1982: Methodological Issues and Evidence

Debate about the relative effectiveness of economic growth or targeted antipoverty policies has been a recurring theme in the policy arena and in the academic literature (see Aaron, 1978, for a review). The War on Poverty adopted the premise that economic growth was not sufficient for alleviating poverty. The 1964 Economic Report of the President stated:

> Rising productivity and earnings, improved education, and the structure of social security have permitted many families or their children to escape; but they have left behind many families who have one or more special handicaps. These facts suggest that in the future economic growth alone will provide relatively few escapes from poverty. Policy will have to be more sharply focused on the handicaps that deny the poor fair access to the expanding incomes of a growing economy (U.S. Council of Economic Advisers, 1964, p. 72).

Indeed, Kershaw and Courant (1970) cite the perceived declining antipoverty effectiveness of economic growth as the "analytical justification" of the War on Poverty.

The Reagan administration emphasizes the dual nature of economic growth. According to the U.S. Office of Management and Budget (1983):

> History teaches us that economic growth is a critical determinant of individual and family well-being. In the decade of the 1970s, the economy failed to perform as well as in the 1960s. . . . As a result, it was in the 1960s rather than in the 1970s that the greater inroads against poverty were made. Clearly, economic growth is vital to promoting the well-being of working families. But it also benefits those who cannot work, because as the wealth of the nation grows, more money is available to help those in need (pp. 30-31).

This view implies that economic growth helps the poor by raising their own market income and by raising the income of the nonpoor sufficiently

to accommodate redistribution. The Reagan program reflects this dual approach. The "safety net" is to remain intact for those who cannot work. Yet, transfers to those who do work have been reduced, as they are expected to benefit from the expanded employment opportunities associated with growth.

How sensitive is poverty to increased economic activity, holding transfers constant? One would think that the experience of the last twenty years might offer an almost ideal social experiment to determine the relative importance of growth in market incomes and income transfers. Rapid economic growth in the late 1960s was followed by periods of slower growth and stagnation. The scope of income transfer programs, especially those targeted at low-income people, also underwent dramatic change. Variation in both of these key independent variables should have allowed researchers to accurately estimate how much poverty reduction was due to growth in market incomes and how much was due to increases in government income transfers.

We show that this public policy debate has not been resolved because previous researchers have not provided a conceptual framework to link macroeconomic conditions and income transfers with poverty reduction. We begin by reviewing the descriptive data on economic growth, transfers, and poverty. Then we reestimate some of the standard single-equation models that have appeared in the literature. We then show that although these models can be used to project poverty, they are not specified in a manner that can be used to disentangle the effects of growing market incomes from the effects of increased transfers.

Finally, we develop a conceptual framework that links secular and cyclical changes in macroeconomic activity to the moments of the income distribution, and hence, to changes in poverty. This framework is applied to data derived from the Current Population Surveys for 1967 through 1982. We find that growth in both market incomes and income transfers reduces poverty and that the relative importance of these effects differs widely by demographic group.

TIME-SERIES EVIDENCE

Table 1 presents the basic trends for macroeconomic performance, income transfers, and poverty. The rapid economic growth during the early 1960s and the slowdown during the late 1970s and early 1980s is readily apparent in the level of real GNP per household (column 1).[1] This slowdown was a result of worsening cyclical conditions coupled with slower growth, net of cycle. However, in spite of the rise in unemployment rates (column 2), the economy did experience modest net economic growth during the 1970s. Nonetheless, real GNP per household in 1982 was below the 1971 level. Thus, if economic growth tended to reduce poverty, some decline in poverty might have been expected for the 1970s, though at a slower rate than in the earlier years.

The growth in real cash and in-kind transfers per household (columns 3 and 4), commonly referred to as the "social welfare explosion," is well-known. Possibly less well-known is the fact that real cash transfers per household declined almost 7 percent from 1976 to 1980. The growth rate of in-kind transfers has slowed in recent years, but their absolute levels have continued to increase. Thus, if increased transfers

Table 1

Time Series on Macroeconomic Conditions, Income Transfers and Poverty, Selected Years 1950-1981

Year	Real GNP per Household (1972 dollars) (1)	Unemployment Rate (2)	Real Cash Transfers per Household[a] (1972 dollars) (3)	Real In-Kind Transfers per Household[a] (1972 dollars) (4)	Official Incidence of Poverty (5)	Incidence of Poverty Adjusted for In-Kind Transfers[b] (6)
1950	$10,880	5.3%	$ 365	$ 29	n.a.	n.a.
1955	12,490	4.4	460	31	n.a.	n.a.
1960	13,060	5.5	664	40	20.2%	n.a.
1961	13,170	6.7	730	43	21.9	n.a.
1962	13,810	5.5	770	49	21.0	n.a.
1963	14,200	5.7	791	54	19.5	n.a.
1964	14,630	5.2	801	58	19.0	n.a.
1965	15,350	4.5	816	63	17.3	12.1%
1966	16,010	3.8	878	71	15.7	n.a.
1967	16,020	3.8	891	150	14.3	n.a.
1968	16,390	3.6	911	204	12.8	9.9
1969	16,470	3.5	958	231	12.1	n.a.
1970	16,080	4.9	1,010	242	12.6	9.3
1971	16,170	5.9	1,150	273	12.5	n.a.
1972	16,710	5.6	1,225	304	11.9	6.2
1973	17,170	4.9	1,272	320	11.1	n.a.
1974	16,720	5.6	1,263	327	11.2	7.2
1975	16,130	8.5	1,395	386	12.3	n.a.

(table continues)

Table 1 (cont.)

Time Series on Macroeconomic Conditions, Income Transfers and Poverty, Selected Years 1950-1981

Year	Real GNP per Household (1972 dollars) (1)	Unemployment Rate (2)	Real Cash Transfers per Household[a] (1972 dollars) (3)	Real In-Kind Transfers per Household[a] (1972 dollars) (4)	Official Incidence of Poverty (5)	Incidence of Poverty Adjusted for In-Kind Transfers[b] (6)
1976	16,630	7.7	1,513	427	11.8	6.7
1977	17,070	7.1	1,508	452	11.6	n.a.
1978	17,440	6.1	1,488	464	11.4	n.a.
1979	17,580	5.8	1,419	472	11.7	6.1
1980	16,850	7.1	1,414	482	13.0	n.a.
1981	17,020	7.6	1,458	505	14.0	n.a.
1982	16,160	9.7	1,475	508	15.0	n.a.

Sources: For GNP, consumer price index, and unemployment rate, 1982 Economic Report of the President; for cash and in-kind transfers, "Social Welfare Expenditures Under Public Programs in the U.S.," Social Security Bulletin, December 1968, December 1972, January 1971, January 1977, November 1981; for official poverty incidence and number of households, Current Population Reports, Series P-60, "Consumer Income"; for adjusted poverty, Smeeding (1982a).

[a]Transfers are divided by all households, not by recipient households.

[b]This series also adjusts Census incomes for simulated values of taxes and income underreporting.

n.a. = not available.

were responsible for reducing poverty, declines in poverty through the mid-1970s and increases in the late 1970s would have been expected.

The trend in the official incidence of poverty for all persons (column 5) can be broken down roughly into three periods. Between 1960 and 1969 poverty rates plummeted from about 20 to 12 percent. This was followed, until 1979, by a leveling of poverty in the 11 to 12 percent range. The 1979 to 1982 period marked the first sharp increase in poverty over the full thirty-year period. Poverty rose from 11.6 in 1979 to 13 in 1980, 14 in 1981, and 15 percent in 1982. To put this increase into perspective, note that poverty only increased from 11.2 to 12.3 during the 1974-75 recession. Clearly, the recent rise in poverty stands in sharp contrast to previous experience.

The incomplete series on poverty that includes in-kind transfers (column 6) shows a steeper decline than the official series for the earlier years and the same leveling during the 1970s. Because no data are available after 1979, we cannot be sure that the in-kind poverty series would show as sharp an increase as the official series.

The simple story which emerges from Table 1 is that the early period of sharp poverty reductions (in both measures) was a result of strong economic growth, declining unemployment rates, and large increases in transfers. All three factors contributed to decreasing poverty. The second period, that of steady poverty rates, seems to be the result of two offsetting factors. The rise in unemployment rates was offset by increases in both cash and in-kind transfers. After 1979, all three factors contributed to increasing official poverty. By 1982 GNP per household had still not regained its 1971 value and unemployment had risen

from 5.8 percent to 9.7 percent. This was accompanied by a constant value of real cash transfers per household, despite the generally countercyclical nature of transfers.

These stylized facts suggest that the poor benefit from secular economic growth, lower unemployment rates, and increased transfers. However, simple bivariate relationships are obviously inadequate to determine the relative importance of each of these factors in explaining the changes in poverty.

Since there has been rapid change in the composition of households (families plus unrelated individuals), before we turn to multivariate models we review the possible effects of demographic change on the trend in poverty.[2] Between 1965 and 1981, the total number of households grew by about 48 percent, while population grew by only about 18 percent. A wide differential also holds for the poor--poor households increased by 27 percent, while poor persons increased by only 15 percent. Households with the lowest poverty rates proportionately declined the most. For example, the proportion of families headed by men of working age fell from almost 60 to about 45 percent of all households. On the other hand, households headed by nonaged women increased from about 13 to almost 20 percent of all households, and from about a quarter to about 40 percent of all poor households. Thus, even if poverty rates had remained constant for each demographic group, the aggregate poverty rate would have risen.

Table 2 highlights the differences in poverty levels and trends for several major demographic groups for the 1967-79 period.[3] The largest reduction in poverty and the largest impact of in-kind transfers are for

Table 2

Alternative Measures of the Incidence of Poverty: Official Measure for 1967 and 1979, and Money Income Plus the Market Value of In-Kind Transfers for 1979

Persons Living in Poverty, by Type of Household Head	Official Measure 1967 (1)	Official Measure 1979 (2)	Money Income Plus In-Kind Transfers at Market Value 1979[a] (3)
All Persons	14.2%	11.1%	6.4%
White	11.0	8.5	5.2
Black	39.3	30.4	15.1
Hispanic	n.a.	21.4	12.0
Female Householder, No Husband Present	40.6	34.8	17.6
Elderly (65 and over)	29.5	14.7	4.5

Sources: For 1979, U.S. Bureau of the Census, Alternative Methods for Valuing Selected In-Kind Transfer Benefits and Measuring Their Effects on Poverty, Technical Paper #50 (Washington, D.C.: U.S. Government Printing Office, 1982). For 1967, U.S. Bureau of the Census, Money Income and Poverty Status of Families and Persons in the United States: 1982, Series P-60, No. 140 (Washington, D.C.: U.S. Government Printing Office, 1983).

[a]In-kind transfers for food, housing and medical benefits.

n.a. = not available.

elderly persons. Adjusted poverty rates for blacks, Hispanics, and women heading households remain above the official rates that existed for whites in 1967, when in-kind transfers were few and consequently had little impact. These data suggest that a disaggregated analysis of poverty trends is in order, a point made by Aaron (1967), but not followed in some of the recent time-series literature. We now turn to the multivariate regressions estimated in that literature.

TIME-SERIES REGRESSIONS

In the tradition of Anderson (1964), Gallaway (1965, 1967) and Aaron (1967), several recent studies have estimated time-series regressions to obtain the partial effects of growth in GNP and transfers on poverty reduction. The results from these studies are conflicting. For example, Thornton et al. (1978) state

> Our findings indicate that the contribution of growth has been overstated, . . . much of the past successes are illusory (p. 385).

On the other hand, Murray (1982) claims that

> The effects of economic growth did indeed trickle down to the lowest economic levels of society. . . . The fortunes of the economy explain recent trends in poverty. But the flip side of this finding is that social welfare expenditures did not have an effect on poverty. Once the effects of GNP are taken into account, increases in social welfare spending do not account for reduction in poverty in the last three decades (p. 11).

If Thornton et al. are correct, then the working poor will not be greatly aided by economic expansion. But if Murray is correct, then poverty rates should fall back to their 1979 levels after the economic recovery gets underway.

Why do studies obtain such different results? To answer this question, we estimated a large number of time-series regressions similar to those found in the literature. The natural log of the official poverty rate was regressed against the natural log of measures of economic growth, cyclical conditions, and transfers.[4] Like previous authors, we interpret the coefficient on the growth variable as the partial impact of growth in raising the market incomes of the poor. Since transfers are also an independent variable, any changes in transfers that result from growth are already taken into account. In this sense, the coefficient on the secular variable measures the extent to which the working poor benefit from growth through higher market incomes.

Without an explicit theoretical foundation for these regressions, there is little to guide us (or the previous authors) in the choice of variables or functional form. Therefore, several alternative measures of the independent variables, time periods, and corrections for autocorrelation were used. We evaluate these equations on the basis of their ability to provide stable estimates of the impact of growth and transfers on poverty and to provide projections of poverty. Each is considered in turn.

Stability of Coefficients. Tables 3 and 4 show a sample of the many regressions we ran. Three alternative measures are used to capture the impact of secular growth. Two different time periods are used--1966 to 1982 in Table 3 and 1949 to 1982 in Table 4.[5] Following previous studies, we also show the impact of estimation with first differences rather than levels (i.e., changes in the log of poverty rather than the level of the log of poverty).[6] We also estimated regressions adjusting

Table 3

Log Poverty Rate Regressions Using Alternative Measures of Secular Growth, 1966-1982

	Percentage of All Persons with Incomes below Poverty Line			
	(1)	(2)	(3)	(4)
Secular Variable:				
Year	-.57			
	(25.0)			
$Year^2$	.004			
	(26.3)			
Log Real Median Family Income		-1.7		
		(6.0)		
Log Real GNP per Household			-.09	-.14
			(.1)	(.2)
Log of Unemployment	.30	.04	.31	.30
	(21.5)	(.6)	(1.9)	(1.9)
Log Real Cash Transfers per Household	-.25	.06	-.51	-.54
	(5.5)	(.5)	(1.6)	(1.7)
Adjusted R^2	.99	.99	.97	
Level or First Difference	level	level	level	difference
Rho (if level equation)	-.84	.68	.91	n.a.
Standard Error of Rho	(.19)	(.18)	(.08)	n.a.
Predictions Based on Estimation Through 1979				
1980	13.0	12.8	12.5	12.5
1981	13.7	13.4	12.4	12.4
1982	15.5	14.5	13.3	13.2
Predictions Based on Estimation Through 1982				
1983	16.9	15.0	14.6	14.7
1984	16.9	14.2	14.6	14.8
1985	18.8	13.7	14.4	14.8

Note: t-statistics appear in parentheses.

Table 4

Log Person Poverty Rate Regressions Using Alternative Measures of Secular Growth, 1949-1982

	Percentage of All Persons with Incomes below Poverty Line			
	(1)	(2)	(3)	(4)
Secular Variable:				
Year	-.16			
	(3.1)			
$Year^2$	.001			
	(2.9)			
Log Real Median Family Income		-1.8		
		(6.5)		
Log Real GNP per Household			-1.27	-.52
			(2.3)	(1.9)
Log of Unemployment	.17	-.03	.04	.12
	(4.2)	(.6)	(.5)	(1.9)
Log Real Cash Transfers per Household	-.17	.14	-.18	-.15
	(1.0)	(1.0)	(.9)	(.8)
Adjusted R^2	.97	.99	.96	
Level or First Difference	level	level	level	difference
Rho (if level equation)	.90	.61	.91	n.a.
Standard Error of Rho	(.07)	(.15)	(.06)	n.a.
Predictions Based on Estimation Through 1979				
1980	11.8	12.7	12.4	12.0
1981	11.7	13.3	12.1	11.7
1982	12.0	14.2	13.0	12.1
Predictions Based on Estimation Through 1982				
1983	15.1	15.0	14.8	14.8
1984	15.2	14.2	14.4	14.4
1985	15.3	13.6	14.2	14.1

Note: t-statistics appear in parentheses.

for the receipt of in-kind transfers and regressions for major demographic subgroups of the population to account for the demographic shifts discussed earlier.

Real GNP is the traditional measure of secular growth (see Thornton et al., 1978; Hirsch, 1980). However, it includes the effects of population growth as well as economic growth. Thus, we deflated real GNP by the number of households (see note 1). Real median family income is one alternative to real GNP per household. It has the advantage of being more consistent with the poverty data, since both come from the Current Population Survey. However, median family income does not average in the income of unrelated individuals, a growing proportion of the population. It also includes cash transfers, whose effect we are trying to isolate. A drawback of both of these measures is that they are collinear with the unemployment rate, the cyclical variable most commonly used. To minimize this problem, a quadratic time trend is our third measure of secular growth.

The first equation in Table 3 uses the quadratic in time.[7] The estimation period is 1966 to 1982 and a maximum likelihood estimator is used to correct for autocorrelation. The results are consistent with those of Thornton et al. Increasing transfers or reducing unemployment both have large significant impacts on poverty. For example, a 10 percent increase in real cash transfers per household reduces the poverty rate by 2.8 percent. The secular variable shows the "petering out" effect of economic growth. Taken together, the time coefficients show that, holding cash transfers and unemployment rates constant, poverty declined before 1975, but increased after 1975.

Columns 2, 3, and 4 show the sensitivity of the coefficient to the choice of secular measures. In column 2 the log of real median family income is the secular variable. Neither unemployment nor transfers has a significant impact, and the magnitudes of the coefficients are much reduced. Murray's conclusion, that only growth matters, is borne out. The equation in column 3 is identical to that in column 2 except for the choice of secular variable. When growth is measured in terms of real GNP per household, growth has no impact; only transfers and unemployment matter. This seemingly unimportant change reverses the conclusion.

The instability of coefficients may be due to multicollinearity. To lessen this problem some studies have estimated equations stated in terms of first differences rather than levels (e.g., Thornton et al., and Murray). This procedure is appropriate only if the autocorrelation coefficient is equal to one. Examining the value of this coefficient (rho) shows that using first differences would have been inappropriate for columns 1 and 2 but may be appropriate for column 3. Changing the column 3 estimation to first differences, shown in column 4, does not alter by much the size or significance of the coefficients. The secular variable is still insignificant and the other two variables are weakly significant.

Table 4 presents the same four specifications as Table 3, but extends the estimation period back to 1949. The results differ substantially. Unemployment and transfers now have an insignificant impact in most of the regressions. However, when the estimation period is 1949 to 1965 (results not shown), transfers have a larger negative coefficient than in the 1966 to 1982 period, further showing the instability of the coefficients.

While we only show the results of using the unemployment rate and the log of real cash transfers per household as cyclical and transfer variables, we experimented with several other variants for the independent variables (e.g., employment rate, cash public assistance per household or per capita) and the poverty incidence for households instead of for persons as the dependent variable. Our conclusion, that seemingly unimportant redefinitions have large impacts on the signs, magnitudes, and significance of the coefficients, is reinforced by these regressions.[8]

In an earlier section, we discussed the role of demographic change and showed the different poverty trends by demographic groups. Table 5 presents the regression from the third column of Table 3 for eight groups. We expected that such a disaggregation might yield more meaningful results, but the major finding again is the instability of the coefficients. For example, the real GNP variable has a negative sign and is significant only for the aged and for Hispanic women, groups we expected to be among the least likely to benefit from economic growth.

We noted that the poverty measure that includes in-kind transfers is quite different from the Census measure. If a sufficiently long time series on persons with cash income plus in-kind transfers below the poverty line were available, we could have experimented with regressions like those in Table 3, using the log of the adjusted poverty rate as the dependent variable and real cash plus in-kind transfers per household as an independent variable. However, as column 6 of Table 1 shows, we only have seven observations on in-kind poverty.[9]

With this limited amount of data, we did estimate the following equation which allows increased in-kind transfers per household

Table 5

Log Poverty Rate Regressions by Demographic Groups, 1966-1982[a]

	Percentage of All Persons with Incomes below Poverty Line Who Live in Households Where Head Is							
	Aged (1)	Nonaged (2)	White Male (3)	White Female (4)	Black Male (5)	Black Female (6)	Hispanic Male (7)	Hispanic Female (8)
Log Real GNP per Household	-2.2 (1.7)	-.86 (1.2)	-.76 (0.6)	.15 (0.2)	.97 (0.4)	-.04 (0.4)	2.26 (3.5)	-1.43 (1.5)
Log of Unemployment	-.22 (1.3)	.22 (2.0)	.42 (1.8)	.33 (2.4)	.53 (1.3)	.09 (0.5)	1.22 (10.5)	-.07 (0.4)
Log of Real Cash Transfers per Household	-.44[b] (1.7)	-.03[c] (0.2)	-.77 (1.7)	-.87 (3.3)	-1.58 (2.0)	-.33 (0.9)	-2.18 (9.1)	.25 (0.7)
Adjusted R^2	.97	.96	.93	.99	.95	.99	.99	.99
Rho (Standard error of rho)	.59 (.20)	.92 (.07)	.91 (.08)	-.35 (.25)	.75 (.19)	.39 (.31)	-.67 (.23)	-.44 (.33)
Actual 1982 Poverty Rate	14.6	15.1	8.7	28.7	20.0	57.4	22.0	57.4
Predictions Based on Estimation through 1982								
1983	14.2	15.0	8.4	27.8	18.5	55.2	19.9	56.2
1984	13.9	14.5	8.3	28.5	19.8	55.4	21.7	54.7
1985	13.7	14.1	8.1	28.6	20.1	55.4	21.4	53.4

Note: t-statistics appear in parentheses.

[a]Poverty rates for Hispanics are only available from 1972 to 1982.

[b]Cash transfers primarily received by the aged.

[c]Cash transfers primarily received by the nonaged.

(INKIND) to reduce the gap between the log of in-kind poverty (IKPOV) and official poverty (LOFFPOV):

$$\log \text{IKPOV} - \log \text{OFFPOV} = -1.55 - .18 \log \text{INKIND} \quad (2.3)$$

$$\text{Adj } R^2 = .46$$

As expected, inclusion of in-kind transfers further increases the importance of increased transfers as a source of poverty reduction.

In sum, we conclude that previous estimates from time-series regressions of the relative importance of growth and transfers in reducing poverty should be viewed with a great deal of skepticism. Running such regressions with highly collinear series is basically a futile exercise if one is interested in understanding the relationship between economic growth, increases in transfers, and poverty reduction.

Projecting Poverty. While the collinearity makes it very difficult to obtain reliable estimates for individual coefficients, the regressions, taken as a whole, do provide relatively stable projections of poverty. The high R^2's in all of the specifications indicate that projections will be reliable as long as the patterns of collinearity are similar over the projection and estimation periods. If this is the case, it will not matter very much which specification is chosen.

Also, projecting within the survey period allows us to identify unusual changes in poverty which are not consistent with the estimated effects of the combined changes in transfers, cyclical conditions, and growth. For example, one might ask whether the large observed rise in poverty between 1979 and 1982 reflected anything more than the effect of

the rise in unemployment, decline in GNP, and decrease in transfers in those years.

To answer this question, we reestimated all the regressions in Tables 3 and 4 for the period through 1979. The resulting coefficients were used to generate projections, adjusted for autocorrelation, for 1980 through 1982. These are shown in the first three rows of the bottom panel of Tables 3 and 4. Looking across the columns reveals that these projections are not very sensitive to the specification.

In virtually all cases the equations badly underpredict the increase in poverty that actually occurred in 1980 and 1981. This is particularly true for the regressions for 1949-79. Only the equation in column 1 of Table 3 comes close to matching the actual 1980 and 1981 rates of 13 and 14 percent. Other factors were clearly at work driving poverty up. While we cannot identify why these years are outliers, they do point to the need to look for additional factors.

The second potential use of these time-series regressions is to make conditional forecasts of poverty. These projections are conditional not only on the projected values of the independent variables, but also on the stability of the underlying structural relationships. As we have seen, the latter assumption may not have been warranted in recent years.[10]

The bottom rows of Tables 3, 4, and 5 show projections of poverty for the years 1983 through 1985. They are based on the U.S. Office of Management and Budget's official July 1983 economic forecast of GNP, prices, and unemployment found in its "Mid-Session Review," and projections of transfers found in the fiscal year 1984 budget (1983a, 1983b).[11] Equations are estimated through 1982 and the projections are

adjusted for autocorrelation. Comparing projections across the columns shows that they are not very sensitive to the functional form chosen if one projects only two years forward.

These results indicate that there is little basis for believing that the recent increase in poverty will be reversed as the economy grows through the mid-1980s. Most equations (except for those using the quadratic time trend) show only a small drop in poverty in 1983.

We also projected poverty from the regression using the difference between in-kind and official poverty as the dependent variable. Poverty adjusted to include in-kind transfers is expected to be 8.8 percent in 1982 and 8.7 percent in 1983.[12]

While the longer-term projections are less similar, none of the equations shows a dramatic reduction in poverty. The gains from increased transfers and economic growth that led to a decline in poverty from the mid-1960s through the mid-1970s have been canceled by the decreased transfers and worsened macroeconomic conditions (except for the aged). The projections for official poverty that account for expected growth over the 1983-85 period are comparable to poverty rates from the mid- to late-1960s (early 1970s for the in-kind rate).

POVERTY AND MACROECONOMIC CONDITIONS: A CONCEPTUAL FRAMEWORK

We have shown that estimated coefficients in the standard time-series regressions are not robust. In this section we argue that even if these coefficients were stable, they would not yield structural coefficients needed to determine the relative importance of increases in market and

transfer incomes in reducing poverty. We develop a framework which allows us to explore the structural relationships. Even after we make several simplifying assumptions, this framework is considerably more complex than the standard equations.

We begin by decomposing total income (I) into two components--market incomes (M) and transfers (T). Let μ and σ^2 be the population means and variances of each income concept (e.g., μ_M is the mean of the distribution of market income).

Start with the identity

$$(1) \qquad I \equiv M(T) + T(M),$$

where M(T) and T(M) indicate that market incomes vary with transfers due to labor supply responses and that transfers vary with market incomes if transfers are income-tested.

The mean and variance of the income distribution are given by

$$(2) \qquad \mu_I = \mu_M + \mu_T$$

$$(3) \qquad \sigma^2_I = \sigma^2_M + 2\,\sigma_{MT} + \sigma^2_T,$$

where σ_{MT} is not zero either if there are labor supply responses to transfers or if transfers are income-tested.[13]

Given these identities, changes in poverty can be decomposed into components that reflect changes in market incomes or transfers. Poverty is defined as

$$(4) \qquad PR(I < L) = \int_0^L f(I)dI,$$

where L is the poverty line and f(I) is the density of the income distribution.

Time-series regressions attempt to explain changes in this probability over time. Totally differentiating equation (4) yields

$$(5) \qquad dPr = \frac{\partial Pr}{\partial \mu_I} d\mu_I + \frac{\partial Pr}{\partial \sigma^2_I} d\sigma^2_I$$

under the restrictive assumption that the income distribution is fully specified by its mean and variance. This assumption will be relaxed shortly.

Differentiate equations (2) and (3) and substitute into (5):

$$(6) \qquad \frac{dPr}{dt} = \left[\frac{\partial Pr}{\partial \mu_I}\left[\frac{d\mu_M}{dt} + \frac{d\mu_T}{dt}\right]\right] + \left[\frac{\partial Pr}{\partial \sigma^2_I}\left[\frac{d\sigma^2_M}{dt} + 2\frac{d\sigma_{MT}}{dt} + \frac{d\sigma^2_T}{dt}\right]\right].$$

The impact of increases in transfers will affect poverty not only through the addition to mean income ($d\mu_T/dt$ in the first term) but also inasmuch as transfers are more equally provided ($d\sigma^2_T/dt$ in the second term) and if transfers become more dependent on variations in earnings ($d\sigma_{MT}/dt$ in the second term). The impacts of changes in market incomes are in corresponding terms in equation (6).

Going from equation (6) to any time-series regression is inappropriate. At best, one is using linear approximations to complicated nonlinear functions (e.g., $\partial Pr/\partial \mu_I$ would be linear only if the income distribution were rectangular, in which case $\partial Pr/\partial \sigma^2_I$ would not be linear). Structural parameters are not being estimated when one

regresses poverty on a secular, a cyclical, and a transfer variable as has been done in previous work. Gottschalk (1981) follows a structural approach, but he ignores changes in the covariance and the variance of transfers.

Before identifying how the moments of the joint distribution of market incomes and transfers were changing over time, we make two additional simplifying assumptions. Because the official poverty thresholds vary by family size, the bound of integration in equation (4) cannot be treated as a fixed number. One possible solution would be to expand the conceptual framework to take account of changes in the trivariate distribution of household needs, market incomes, and transfers. Poverty would then depend on four additional moments (the mean and variance of needs as well as the covariances of needs with market incomes and transfers). To avoid excessive complexity, we work directly with the household income-to-needs ratio (I/N) and define poverty as

$$(4') \quad \Pr(I^* < 1) = \int_0^1 \phi(I^*)dI^*$$

where I^* is the income/needs ratio, using the Orshansky poverty lines, and $\phi(I^*)$ is its density. Any household with an income-to-needs ratio below one is poor. This formulation is less general and requires that we make distributional assumptions about income-to-needs ratios, rather than income alone. However, it keeps the problem down to manageable proportions.

Next, we must make distributional assumptions. The distribution of income/needs must have positive skewness and must be limited to positive values. The log-normal distribution is the most commonly used distribution which satisfies these conditions. However, as Metcalf (1972)

showed, the skewness of the log normal does not match the skewness of the actual income distribution. It also does not match the skewness of the distribution of income/needs ratios. Therefore, we follow Metcalf in using the displaced log-normal distribution, which has three parameters, μ_I^*, σ_I^{2*}, and c (see Metcalf and Aitchison and Brown, 1957). The displacement factor c affects the skewness of the distribution.

Equation (6) must be expanded to incorporate the impact of changes in this third parameter of the distribution on poverty:

$$(6') \quad \frac{dPr}{dt} = \frac{\partial Pr}{\partial \mu_{I*}}\left[\frac{d\mu_{M*}}{dt} + \frac{d\mu_{T*}}{dt}\right] + \frac{\partial Pr}{\partial \sigma_I^2}\left[\frac{d\sigma_{M*}^2}{dt} + 2\,\frac{d\sigma_{M*T*}}{dt} + \frac{d\sigma_{T*}^2}{dt}\right] + \frac{\partial Pr}{\partial c}\,\frac{dc}{dt},$$

where the asterisks indicate income/needs ratios. By imposing structure, we can separate the impacts of variables which may be highly collinear and include moments that were neglected in previous studies.

Empirical Results. Our procedures, described more fully in the Appendix, are as follows. The 1968 and 1975 through 1982 Current Population Surveys were used to calculate sample means, variances, and covariances for M* and T* and the displacement factor in each year.[14] These are shown in columns 1-6 of Table 6. We use these data to calculate the partial derivatives in each year, shown in columns 7-9. The decline in these derivatives in all but recessionary years shows the declining antipoverty effectiveness of growth in either market or transer incomes. We substitute changes in the means, variances, covariances, and displacement factors between each set of years into equation (6') and multiply by the appropriate partial derivatives.[15]

Table 6

Moments, Displacement Factors, and Partial Derivatives

	Mean		Variance			
	Market Income ÷ Needs (1)	Transfer Income ÷ Needs (2)	Market Income ÷ Needs (3)	Transfer Income ÷ Needs (4)	Covariance of Market Income and Transfers (5)	Displacement Factor (6)
1967	2.65	.161	4.60	.148	-.190	0.551
1974	2.87	.278	5.38	.307	-.350	1.001
1975	2.78	.315	5.21	.338	-.375	1.088
1976	2.87	.312	5.49	.356	-.396	1.176
1977	2.94	.311	5.79	.360	-.408	1.230
1978	3.03	.309	5.87	.381	-.412	1.588
1979	3.01	.307	5.73	.377	-.386	1.714
1980	2.84	.315	5.17	.375	-.359	1.919
1981	2.82	.311	5.65	.377	-.352	1.443

	(7) Partial Derivatives with Respect[a] to:			(10)
	Means	Variances	Displacement	Official Poverty Rate
1967				.143
1974	-0.190	0.035	0.028	.116
1975	-0.172	0.031	0.030	.123
1976	-0.165	0.030	0.026	.118
1977	-0.157	0.028	0.025	.116
1978	-0.157	0.029	0.021	.114
1979	-0.150	0.028	0.019	.117
1980	-0.164	0.031	0.018	.130
1981	-0.154	0.027	0.021	.140

Source: Computations by authors from March Current Population Surveys.

[a]The derivative is applicable to the change in the moments between the indicated year and the previous year.

The data in Table 6, therefore, give the basic information necessary to decompose changes in poverty. For example, between 1980 and 1981 μ_M^* declined by .02 and μ_T^* declined by .004. Adding these two components of mean income and multiplying the sum by -.154 ($\frac{\partial Pr}{\partial \mu_I}$, shown in column 7), shows that changes in the mean of the income/needs distribution (the first term in equation (6')) increased poverty by .007 (i.e., .7 percentage points). The impact of changes in c and the variance of income/needs ratios on poverty are obtained by repeating the calculations for the other two terms in equation (6'). When these three terms are summed, they equal the .01 increase in poverty shown in column 10.

Table 7 shows the importance of changes in each of the underlying factors (terms in equation (6')) in changing poverty for three subperiods and for the total period 1967-81.[16] Row 1 shows that while the poverty rate for all persons declined by 0.3 percentage points between 1967 and 1981, increases in the mean of market income (standardized by needs) would have reduced poverty by 3.2 points, if all other factors had remained constant.[17] But actual increases in the variance of market income raised poverty by 3.3 points. Therefore, changes in the first two moments of the distribution of market income had a negligible impact on poverty. On the other hand, changes in the first two moments of the distribution of transfers had a large effect in reducing poverty. Increases in the mean led to a 2.8 point decrease in poverty while increases in variance offset this by only 0.7 points.[18] Thus, changes in the transfer distribution decreased poverty by 2.1 points.[19]

There are several obvious explanations for the relative importance of increased transfers. First, the terminal year, 1981, was a year of high unemployment, 7.6 percent, and depressed market incomes. Given the

Table 7

Decomposition of Changes in Poverty Rates

	Percentage Change in Poverty (1)	Percentage Change Associated with Change in: Mean Market Incomes[a] (2)	Variance of Market Incomes[a] (3)	Mean Cash Transfers[a] (4)	Variance of Cash Transfers[a] (5)	Displacement Factor (6)	Residual Factors (7)
All Persons							
1967-81	-.3%	-3.2%	3.3%	-2.8%	.7%	2.3%	-.6%
1967-74	-2.7	-4.2	2.7	-2.2	.5	1.3	-.8
1974-78	-.2	-2.4	1.4	-.5	.2	1.4	-.3
1978-81	2.6	3.4	-.8	-.0	.0	-.4	.4
Young Men[b]							
1967-81	2.2	1.3	4.9	-1.3	.2	-3.0	.1
1967-74	-2.3	-1.8	1.3	-.8	-.1	-.5	-.4
1974-78	.2	-3.0	4.0	-.3	.1	-.5	-.1
1978-81	4.3	6.1	-.5	-.2	.3	-2.1	.7
Prime-Aged[b] Men							
1967-81	.3	-5.2	3.0	-1.1	.3	3.4	-.1
1967-74	-1.5	-5.3	2.3	-.9	.2	2.1	.1
1974-78	-.5	-2.3	1.1	-.3	.1	1.1	-.2
1978-81	2.3	2.3	-.4	.0	-.0	.1	.3
Elderly[b]							
1967-81	-12.4	.5	-1.4	-13.8	.9	.3	1.1
1967-74	-11.9	1.2	-2.7	-10.8	.6	-.3	.1
1974-78	-2.0	-1.4	.5	-2.2	.2	.8	.1
1978-81	1.5	.7	.8	-.7	.0	-.2	.9

(table continues)

Table 7 (cont.)

Notes: Column (2) $\sum_t \left(\frac{\partial Pr}{\partial \mu_{I*}}\right)_t \left(\Delta \mu_{M*}\right)_t$ where t is summed over the subperiod.

(3) $\sum_t \left(\frac{\partial Pr}{\partial \sigma^2_{I*}}\right)_t \left(\Delta \sigma^2_{M}\right)_t$ where t is summed over the subperiod.

(4) $\sum_t \left(\frac{\partial Pr}{\partial \mu_{I*}}\right)_t \left(\Delta \mu_{T*}\right)_t$ where t is summed over the subperiod.

(5) $\sum_t \left(\frac{\partial Pr}{\partial \sigma^2_{I*}}\right)_t \left(\Delta \sigma^2_{T*}\right)_t$ where t is summed over the subperiod.

(6) $\sum \left(\frac{\partial Pr}{\partial c}\right)_t \Delta c_t$ where t is summed over the subperiod.

(7) Residual factors include the effects of changes in the covariance of of earnings and transfers as well as the discrepancy which results from using a differential equation to explain finite changes.

[a]These moments are measured as a proportion of household needs.

[b]Prime-aged persons are heads of household between the ages of 25 and 64; young, less than 25 years; and elderly, 65 years or older.

countercyclical nature of transfers, it might be expected that transfer growth would have a large impact on reducing poverty when comparing a relatively strong year, 1967, with 1981, a year marked by economic stagnation. This hypothesis can be explored by breaking up the period into three subperiods. The first, 1967-74, is a period of growth in market incomes, relatively low unemployment rates, and rapid poverty reduction (14.3 percent to 11.6 percent). The second, 1974 to 1978, was characterized by fluctuating unemployment rates, moderate increases in market incomes, and almost no change in poverty. Finally, 1978 to 1981 was a period of poor economic conditions. Both unemployment and poverty rose substantially, and real GNP per household declined. Therefore, by contrasting the first two periods with the later period, we can get a sense of the relative importance of cyclical conditions. The comparison of subperiods is a rough way to control for cyclical conditions. In the next section, we offer an alternative method.

Rows 2 and 3 of Table 7 indicate that increases in market incomes were important in the first two subperiods. Increases in mean market income between 1967 and 1974 reduced poverty by 4.2 points, more than enough to offset the 2.7 point increase caused by increases in the variance of market incomes. Over the same period, changes in the first two moments of the distribution of transfers caused poverty to drop by 1.7 points. Thus, changes in the first two moments of the distribution of market incomes and transfers were roughly equally important between 1967 and 1974.

The importance of changes in the two moments of the distribution of transfers was, however, much less important between 1974 and 1978, when mean transfer/needs ratios for the total population rose only moderately

(see Table 6). Changes in the distribution of transfers reduced poverty only by 0.3. The net impact of changes in the mean and variance of market income/needs was to reduce poverty by an additional one point.

The increase in poverty from 11.4 to 14.0 percent between 1978 and 1981 was almost totally caused by changes in the distribution of market incomes. The decrease in the mean increased poverty by 3.4 points. This was somewhat offset by a decrease in the variance, leading to a net 2.6 point rise in poverty.

We conclude that changes in market incomes and transfers are both important determinants of poverty. The apparent unimportance of changes in market incomes between 1967 and 1981 occurs primarily because cyclical reductions in market incomes toward the end of the period offset the poverty-reducing changes of the earlier years. Note that the poverty-reducing impact of eleven years of growth in market incomes was canceled by three years of rapid economic decline. Transfers reduced poverty over the entire period, but the largest effect was in the 1967-74 period.

In addition to cyclical conditions, changes in demographic composition are also important determinants of the trend in poverty. Therefore, Table 7 also shows the decomposition of poverty for persons in households headed by men of working age, younger men, and elderly persons.[20]

From 1967 to 1981, changes in the mean and variance of market income accounted for a 2.2 point drop in the poverty rate of prime-aged men; changes in the first two moments of the transfer distribution accounted for a 0.8 point drop. The relative importance of changes in market incomes is even larger when we exclude the recessionary period 1978-81.

Between 1967 and 1978, poverty of prime-aged men decreased by 4.2 points as a result of changes in the first two moments of the distribution of market income. Changes in the distribution of transfers account for an additional 0.9 point drop. Thus, changes in market income were four times as important as changes in transfer income for prime-aged men. However, the 1.9 point increase in poverty caused by the shift in the distribution of market income between 1978 and 1981 again shows the large impact of cyclical downturns on poverty. Almost half of the effect on poverty of the previous eleven years of growth in market incomes was eliminated in three years.

Cyclical changes are even more important for persons in households headed by men less than 25 years old. From 1967 to 1978, the net impact of changes in the mean and variance of market income was to increase poverty by 0.5 points (increases in the mean were offset by increases in the variance) while shifts in the transfer distribution accounted for a 1.1 point drop in poverty. The 1978-81 shift in the distribution of their market income increased their poverty rate by 5.6 points, totally offsetting the net gains this group had made from 1967 to 1978. We conclude that for younger men both increases in transfers and improved cyclical conditions are important in reducing poverty.

The largest drop in poverty between 1967 and 1981 (12.4 points) was experienced by households headed by elderly persons (male and female). As might be expected, this drop in poverty was almost solely a result of changes in the moments of the transfer distribution.

It is clear from both the conceptual framework leading to equation (6') and from the empirical results in Table 7 that time-series

regressions that account only for the changes in means of market incomes and transfers cannot adequately account for changes in poverty. We have shown that changes in the variances of market incomes and tranfers also matter. Changes in market income seem to be the major source of cyclical changes in poverty. Increases in transfers are at least equally important in explaining noncyclical changes in poverty.

Simulations. The fact that increased unemployment increases poverty by decreasing market income has never been disputed in the literature. The key issue revolves around the relative importance of secular increases in market incomes and transfers in reducing poverty. Our initial method for controlling for cyclical changes was to examine the causes of the changes in poverty for three subperiods. This is a crude method for separating secular from cyclical change.

We now use simulations to remove the cyclical component and focus on secular change. We begin with initial-year values for the five underlying moments and the displacement factor, shown in Table 6. We then assume that each household's market income and transfer income-to-needs ratios grew at constant rates (which we specify below). As shown in the Appendix, we can then simulate future values for each moment and the displacement factor. These are used to simulate future values of poverty which are consistent with the assumed growth rates in market and transfer income.

Because we impose the constraint that the components of income grow at constant rates, we eliminate all cyclical changes. We further assume that market and transfer incomes of those at the bottom of the distribution grow as fast as those higher in the distribution. This results in

constant coefficients of variation and skewness over time. This restriction will overstate (understate) the amount of poverty reduction due to secular growth if growth would actually have been accompanied by increasing (decreasing) inequality of market or transfer incomes. In fact, Dooley and Gottschalk (1982) find increasing inequality of market incomes after holding unemployment constant.

Table 8 shows the actual poverty rates in 1967 and 1981 (columns 1 and 2) and the poverty rates which would have existed if the market and transfer incomes of all households had grown at the rates specified for columns 3-6. The trend rates are estimated by fitting linear time trends to the means of the demographic-specific market income/needs and transfer income/needs ratios, including unemployment as a control variable. Column 3 shows the poverty rate consistent with trend growth in market incomes, holding transfers constant at their 1967 levels. Comparing columns 1 and 3 shows that between 1967 and 1981 trend growth in market incomes would have reduced poverty by 2.3 points for all persons, 2.8 points for young men, 3.1 points for prime-aged men. Trend increases in market income for the elderly would have had a negligible impact. Column 4 shows the poverty rates consistent with secular growth in both market and transfer incomes. A comparison of columns 3 and 4 indicates that trend growth in transfers would have reduced poverty by an additional 2.1 points overall, 0.1 points for young men, 0.4 points for prime-aged men, and 15.4 points for the elderly. Secular growth in market incomes would, therefore, have accounted for a little less than half of the reduction in overall poverty. This is largely due to the importance of increased transfers for the elderly.

Table 8

Poverty Rates in 1967 and 1981:
Actual and Simulated Values

	Actual Poverty Rates		Simulated 1981 Poverty Rates			
	1967	1981	Market Income Grows at Actual Trend; Transfer Incomes at 1967 levels	Transfers and Market Incomes Grow at Actual Trends	Market Incomes Grow at 2 percent; Transfers at 1967 levels	Market Incomes Grow at 3 percent; Transfers at 1967 levels
	(1)	(2)	(3)	(4)	(5)	(6)
All Persons	14.3	14.0	12.0	9.9	9.8	8.2
Persons in Households Headed by:						
Young Men	14.6	16.8	11.8	11.7	9.4	7.7
Prime-Aged Men	7.8	8.1	4.7	4.3	3.7	2.5
Elderly Persons	27.8	15.4	27.8	12.4	25.0	24.0

Notes: Column 3: Market incomes are assumed to grow at the same proportional rate for all people within the demographic group (0.9, 0.9, 1.3, and 0.1 percent for all persons, young men, prime men, and elderly, respectively). These rates are obtained from regressions using the observed log mean market income/needs ratio as the dependent variable and time and unemployment as the independent variables.

Column 4: Market incomes are assumed to grow at the rates indicated above and transfer incomes are assumed to grow at 3.2, 1.9, 3.4, and 3.0 percent for the four groups. These rates are obtained from similar regressions using log transfer income/needs as dependent variables.

Columns 5 and 6: Market incomes are assumed to grow at 2 percent (column 5) and 3 percent (column 6) for each demographic group.

Columns 5 and 6 show the poverty rates which are consistent with steady market income growth, holding real transfers constant at their 1967 levels. In this sense, they give an upper bound to the poverty reduction which could have been achieved solely through growth in market incomes. If market incomes of all households had grown by 2 percent per year (column 5), then poverty for all persons would have declined from 14.3 to 9.8 percent over this thirteen-year period. Poverty rates for young men would have declined to 9.4 percent, slightly below the overall rate. Poverty rates for prime-aged men would have been cut nearly in half, leaving only 3.7 percent poor by 1981. As might be expected, the elderly would have been considerably worse off if there had been rapid growth in market incomes but no growth in transfers than they were under the actual expanded transfer system and lower market income growth. Under this scenario, their poverty rates would have decreased only from 27.8 to 25.0 percent.

A comparison of columns 5 and 6 shows the incremental effect of an additional one-percentage-point increase in the growth rate of market incomes. For example, if market incomes grew at 3 percent per year, poverty for all persons would have been 8.2 rather than 9.8 percent.

We also simulated the effects of secular growth in in-kind transfers on poverty. Since a consistent time series on poverty after in-kind transfers is not available, we could not replicate the decompositions of Table 7 that require microeconomic data to calculate the moments for multiple years. However, with one year of microeconomic data (an adjusted March 1975 Current Population Survey provided by Timothy Smeeding) and assumed secular growth rates in market incomes and cash plus in-kind transfers, we simulated changes in poverty as in Table 8.[21]

We assume that Smeeding's adjustment for underreporting, which affects the 1974 moments and poverty level, would not affect the growth rates of market and cash transfer incomes as adjusted. We increased the growth rates for transfers in the simulations, which include cash and in-kind transfers, to reflect the fact that in-kind transfers grew faster than cash transfers.[22]

Table 9 shows the actual 1974 and the simulated 1981 poverty rates based on the official cash income and the adjusted data. By comparing columns 1-3 with columns 4-6 we show the importance of secular growth in in-kind transfers and changes in underreporting in reducing poverty. The relative importance of growth in market incomes is increased, but not by much, when in-kind transfers are included. Based on the official definition, poverty would have decreased by 2.1 percentage points over the seven-year period (11.6 percent in column 1 and 9.5 percent in column 3). Increased transfers would have been responsible for a 1.3 point reduction, or 62 percent of the total.[23] Using the adjusted data, poverty declines by 2.9 points (7.1 percent in column 4 to 4.2 percent in column 6). Growth in cash and in-kind transfers is responsible for a reduction of 2.2 points (6.4 percent in column 5 to 4.2 percent in column 6), or 76 percent of the total. The inclusion of in-kind transfers and the adjustment for underreporting significantly reduce the level of poverty in any year and increase slightly the relative importance of growth in transfer incomes in reducing poverty.

The importance of the growth in in-kind transfers is considerably greater for young men. This reflects the fact that in-kind transfers are a greater proportion of total transfers for this demographic group

Table 9

Official and Adjusted Poverty Rates in 1974 and 1981:
Actual and Simulated Values

	Official Poverty Rate			Adjusted Poverty Rates		
	Actual 1974 Rate	Simulations of 1981 Rates		Actual 1974 Rate	Simulations of 1981 Rates	
		Market Incomes Grow at Trend; Cash Transfers at 1974 levels	Cash Transfers and Market Incomes Grow at Trend		Market Incomes Grow at Trend; Cash & In-Kind Transfers at 1974 levels	Cash & In-Kind Transfers and Market Incomes Grow at Trends
	(1)	(2)	(3)	(4)	(5)	(6)
All Persons	11.6	10.8	9.5	7.1	6.4	4.2
Persons in Households Headed by:						
Young Men	12.3	10.8	10.7	9.7	8.4	7.9
Prime-Aged Men	6.3	5.3	4.8	4.6	3.7	3.2
Elderly Persons	15.9	15.8	8.8	4.9	4.9	0.1

Notes: Columns 2 and 3: Market incomes are assumed to grow at 0.9, 0.9, 1.3, and 0.1 percent for the four groups. Cash transfers are assumed to grow at 3.2, 1.9, 3.4, and 3.0 percent. These are the same growth rates as in Table 8.

Columns 5 and 6: Market incomes are assumed to grow at the rates shown for columns (1) and (2). Cash and in-kind transfers are assumed to grow at 4.6, 3.3, 4.8, and 4.4 percent.

than for all persons. Row 2 of Table 9 shows that increases in cash transfers were responsible for only 7 percent of the drop in official poverty for young men, while cash plus in-kind transfers were responsible for 28 percent of the decline in adjusted poverty.

Simulations with Labor Supply Responses

We have assumed no behavioral responses either to growth in transfers or to market income growth in our simulations. There are two reasons why this may be inappropriate. First, many transfer programs are income-tested, so that observed transfer growth will be lower if the growth in market income of recipients is increased. Second, the empirical literature on labor supply suggests a feedback from transfer growth to market income growth. As transfers grow more quickly, labor supply is reduced and market incomes grow less quickly.

To see whether inclusion of these behavioral responses would alter our basic findings from Table 9, we assumed that transfers are reduced by 33 cents for each dollar earned and that transfer recipients reduce their market incomes by 50 cents for each dollar of transfers they receive. Values for the labor supply response and benefit reduction rate were chosen, to get an upper bound on the relative importance of increased earnings in reducing poverty. A small value for the benefit reduction rate was chosen, since an extra dollar of earnings will have a large impact on poverty if it is not offset by a large decrease in transfers. A large value for the labor supply response was chosen to reduce the relative importance of growth in transfers--increased transfers are offset by large reductions in market incomes.

Since the market income and transfers that workers and recipients gain after responding are influenced by the values of the benefit reduction rate and labor supply response, we cannot set those income and transfer growth rates directly without potentially violating the assumptions of the model. We can, however, set the growth rates of pre-response transfers and market incomes. These reflect the growth rates of entitlements (i.e., guarantees) and wage rates, which we assume do not change when people vary the number of hours they work in response to changes in transfers. We choose growth rates for the unobserved income sources which are consistent with the observed growth rates in the means of market and transfer incomes.[24]

Table 10 shows poverty rates, mean market incomes, and mean transfers (including in-kind transfers) for all persons and for persons in households headed by a prime-aged man. Column 1 shows the actual 1974 values. Column 2 shows the simulated 1981 values allowing market incomes to grow, but holding entitlements constant. If entitlements had not grown, mean market income would have increased from 3.12 to 3.43 between 1974 and 1981. Simultaneously, mean transfers would have declined from .38 to .28 as a result of higher market incomes. When changes in these two moments (as well as the variances, covariances, and displacement factors) are taken into account, poverty of all persons drops from 7.1 percent to 6.1 percent. For persons in households with a prime-aged male head, poverty drops from 4.6 percent to 3.7 percent.

The differences between columns 2 and 3 show the impact of increased entitlements. This includes both the direct impact of higher transfers and the indirect impact of induced reductions in market incomes, as a result of labor supply responses to the higher transfers. Mean market

Table 10

Adjusted Poverty Rates in 1974 and 1981: Simulations Including Labor Supply Response and Benefit Reduction Rate

	Actual 1974 Values (1)	Simulated 1981 Values[a]: Market Incomes Grow at Trend Rate, Transfer Incomes at 1974 Value (2)	Simulated 1981 Values[a]: Market and Transfer Incomes Grow at Trend Rates (3)
All Persons			
Poverty Rate	7.1	6.1	5.4
Mean Market Income/Needs	3.12	3.43	3.31
Mean Transfer Income/Needs	.38	.28	.52
Persons in Households with Prime-Aged Male Head			
Poverty Rate	4.6	3.7	3.3
Mean Market Income/Needs	3.58	4.04	3.93
Mean Transfer Income/Needs	.19	.04	.26

[a]Labor supply response assumed to be -.5. Benefit reduction rate assumed to be -.33. Growth rates for market and transfer incomes before behavioral responses chosen to yield growth rates after behavioral response of mean market income of .9 percent (1.3 percent) and of mean transfer income of 4.6 percent (4.8 percent) for all persons (persons in households headed by a prime-aged man).

incomes in 1981 are reduced from 3.43 to 3.31. However, since a -.5 labor supply response implies that market incomes go down by less than a dollar for every dollar of transfer income, the increase in mean transfers (from .28 to .52) is sufficient to offset the decline in market income. As a result of the growth in transfers, poverty is decreased from 6.1 to 5.4 percent.

These simulations show that secular growth in transfers is an important source of poverty reduction, even when labor supply responses are taken into account. For all persons, increased earnings (before labor supply responses) reduced overall poverty by one point. Increased transfers (and their induced labor supply responses) had a net impact of reducing poverty by an additional 0.7 points. For prime-aged men, the corresponding figures are 0.9 and 0.4. This again indicates that when in-kind transfers are included, the poverty rates even among persons in households headed by prime-aged men are significantly reduced by secular increases in transfers.

SUMMARY

At the outset of the War on Poverty, analysts thought that poverty could be eliminated by 1980 if the economy could be kept on a stable growth path and if additional opportunities could be made available to the poor (see Lampman, 1971). Poverty obviously has not been eliminated. Income transfers to the poor have grown more rapidly than expected, but the economy has not followed a stable growth path.

Our goal in this paper was to determine the relative importance of secular growth, cyclical conditions, and income transfers in reducing poverty. We began by questioning the reliability of the regressions that

are common in much of the previous literature because they neglect the role of anything other than changes in the mean of the income distribution. We concluded that these regressions could be used for projecting poverty. We then developed a framework based on the assumption that the distribution of income-to-needs ratios can be described by the displaced log-normal distribution. This allowed us to determine the relative impacts on poverty of changes in the means and variances of market and transfer incomes. We then provided some simulations that used this framework to control for cyclical changes.

Our major findings are as follows.

- Poverty is projected to remain above the 1979 rates through the mid-1980s, even if the economy grows according to official predictions.
- Between 1967 and 1981, increases in transfers were largely responsible for the small observed decline in official poverty for all persons. The poverty-reducing effect of increased market incomes was offset by the poverty-increasing effect of increased variance of market incomes.
- Between 1967 and 1974, market incomes and cash transfers were roughly equally important in reducing poverty. Between 1978 and 1981, the rapid rise in poverty was primarily due to cyclical changes in the distribution of market incomes.
- For persons living in households headed by young and prime-aged men, the role of changes in cash and in-kind transfer income is relatively less important, accounting for about a third of the decline in poverty. For the elderly, transfers account for almost all of the decline in poverty.

In conclusion, we are not optimistic about the prospects for rapidly reducing poverty, given the rate of growth in market and transfer income that is expected through the mid-1980s. Much of the decline in poverty since the mid-1960s resulted from increased transfers to the elderly, a pattern that has come to an end. Sustained growth in market incomes would further reduce the poverty rates of persons living in households

headed by nonaged men. This would, however, have a limited impact on poverty for all persons, since those households represent only about 45 percent of all poor persons, and already have relatively low poverty rates.

NOTES

[1]In the empirical results presented below, aggregate GNP and transfers are divided by households to separate the impacts of economic and demographic change. Dividing by population would also correct for demographic change, but would not account for increases in family needs as households split into smaller units. Since the official poverty thresholds refer to household incomes and represent a set of equivalence scales that accounts for economies of scale associated with larger household size, GNP and transfers per household are more appropriate measures. Regressions based on per capita independent variables are, however, also consistent with our findings (available from the authors).

[2]All of the data in this paragraph come from computations by the authors from the 1966 Survey of Economic Opportunity and the March 1982 Current Population Survey.

[3]The poverty rates in column 3 of Table 2, available only for 1979, are the lowest adjusted poverty rates in the Census Bureau's technical report (U.S. Bureau of the Census, 1983). They value the transfers at market cost and include medical expenditures for institutional care. The poverty rate for all persons in column 3 differs from that shown for 1979 in column 6 of Table 1. That time series includes in-kind transfers at their cash equivalent values to recipients and simulates additional adjustments for underreporting of incomes and the payment of federal income and payroll taxes. Danziger and Gottschalk (1983) discuss the Census Bureau report and its implications for the measurement of poverty.

[4]Aaron (1967) argued that the double-log specification was appropriate if the income distribution was approximately log normal. Gallaway (1967) agreed that this was superior to the semilog specification he had used in his 1965 article on both "goodness of fit" and "ability to predict" criteria.

[5]The Census Bureau annually publishes official poverty data gathered as part of the annual March Current Population Survey. These data provide consistent time series from 1959 to the present. Detailed data on various subgroups--e.g., blacks, the aged--are available only from 1966 onward. This dictates our starting year in Table 3 and in Table 5, below. However, the 1969 Economic Report of the President published a chart from which one can derive estimates for the 1949-59 period. Since poverty rates based on microdata were not available in these earlier years, the quality of these data is less precise. We analyze them in Table 4 because Murray (1982) used them.

In our empirical work in the second half of this paper, we are restricted to the 1967-81 period because the March 1968 Current Population Survey is the earliest one for which a public use data tape is available.

[6]Some authors (e.g., Thornton et al., Murray) use the absolute change in poverty as the dependent variable. This implies constant poverty reduction rates. Yet Anderson, Aaron, and Hirsch have all made the case for diminishing marginal poverty reduction with growth when the poverty line is fixed.

[7]A constant term was included in each regression, but is not reported. Poverty rates, the number of households, and median family income are periodically revised by the Census Bureau. To ensure a consistent time series, we proportionately scaled earlier years up (down) if the revised figure was greater (less) than the unrevised figure for the same year.

[8]For example, consider the case where we decomposed the real cash transfer variable into public assistance and social insurance transfers per household and used the specification of regression (3) in Table 3. GNP then has a perverse positive and significant sign and both transfer variables are also significant. The regressions referred to in this paragraph are available on request.

[9]Paglin (1980) derived a longer time series. Smeeding (1982b) suggests that Paglin's study overstates the decline in poverty over time. He questions the technical merit and accuracy of Paglin's series on the following grounds. First, because Paglin did not use microeconomic data, he cannot account for differences in in-kind transfers by, for example, family size or age of head, and he must rely on exogenous estimates of the percentage of transfers actually received by the poor. Second, his estimates of multiple benefit recipiency were from a non-national study. We were surprised to find that the Paglin series shows a continuous decline in poverty for 1959-75. For example, during the 1974-75 recession, official poverty increased from 11.2 to 12.3, but the Paglin series declined from 3.8 to 3.6 percent.

Our doubts about the accuracy of the Paglin series were reinforced after we estimated equations like those in Table 3 using his poverty series as the dependent variable. For example, the sign on real GNP per household implies that increases in real GNP significantly increase poverty.

[10]Chiswick and McCarthy (1977) make the point that the official poverty measure for a given year is not available from the Census until the middle of the following year. Thus, even if the projections are subject to the problems mentioned, they are timely.

[11]Median family income and the number of households are not included in any official forecasts and thus must be estimated for use in our 1983-85 projections. The log of the number of households was projected using a quadratic in time. The log of real median family income was projected using the projected log of the number of households and the official projections of real GNP.

[12]Projections from the regressions that used the Paglin series as the dependent variable show a continuous decline from 1975 through the present, further increasing our skepticism about the series.

[13]The relationship between labor supply responses to transfers, target efficiency of transfers, and the covariance can be explored by considering a simplified example, which suggests the interrelationships which would emerge from a more complex model. Let

$$M_t = \varepsilon_1 - aT_t$$

$$T_t = \varepsilon_2 - bM_t$$

where ε_1 and ε_2 are independent. Each person receives initial market income (ε_1) and an income guarantee (ε_2). Each adjusts his/her market income to transfers, which are themselves a function of his/her market income. These response rates are denoted by a and b.

After the adjustments have taken place the resulting covariance between M and T is

$$\sigma_{MT} = -\left[\frac{1 - ab}{1 - a^2b^2}\right] \left[b\,\sigma^2(M) + a\,\sigma^2(T)\right]$$

The covariance will be a larger negative number the more sensitive market incomes are to transfers (i.e., a is large), the more quickly transfers are reduced as market incomes increase (i.e., b is large), and the larger are the variances of market incomes and transfers.

[14]Extracts with person weights for March 1969 to March 1974 were not ready in time for us to use them for this paper.

[15]The derivatives are obtained by differentiating equation (4') with respect to μ_{I*}, σ^2_{I*}, and c, the parameters of $\phi(I*)$. These derivatives change over time since they are functions of μ_{I*}, σ^2_{I*}, and c. The derivatives of the parameters are evaluated at the average values between each pair of years.

[16]Year-to-year changes are added over the periods 1974 to 1978 and 1978 to 1981. Since we did not have micro data on the distribution of persons for 1968 to 1973, we could not calculate year-to-year changes in poverty caused by changes in each moment and sum across these years. Instead we multiplied the seven-year change (1967 to 1974) by the appropriate partial derivative. Since we do have micro data on the

distribution of households for all years, we were able to compare the results of using these two alternative procedures on household poverty rates. The results are very similar, indicating that the methodology is not very sensitive to the size of the changes which are being analyzed.

[17]We use the terms market income and transfer income interchangeably with the more cumbersome terms market income-to-needs ratio and transfer income-to-needs ratio.

[18]Persons in households headed by women and elderly persons have increased as a proportion of all persons. Since these two groups receive above-average transfers, changes in the composition of the total population increased the growth in transfers for the total population faster than the growth for each subgroup. Changes in the distribution of transfers may, therefore, have been relatively unimportant for prime-aged and young men.

[19]The poverty-reducing impacts of changes in the mean and variance of market and transfer incomes are largely offset by changes in the displacement factor, indicating changes in higher-level moments of the income/needs distribution.

Changes in the displacement factor increased poverty for prime-aged men, but decreased poverty for young men in all periods. It had no consistent impact on poverty for the aged. Changes in the covariance, included in column (7), did not have a large impact for any group.

[20]Similar decompositions for young and prime-aged women could not be carried out because their poverty rates are inconsistent with all values of the displacement factor. Since the displacement factor must be known to calculate the partial derivatives, analysis of these demographic groups could not be carried out.

[21]Smeeding adjusted for income underreporting and the payment of personal income and payroll taxes, as well as for in-kind transfers. About half of the difference between the official and the adjusted poverty rates reflects adjustments for underreporting. The decrease in poverty from underreporting is probably an upper bound, since measurement error would cause some overreporting, a factor not taken into account by Smeeding.

[22]Data on the log of cash and cash plus in-kind transfers per household, shown in Table 1, were regressed against time and unemployment. The different growth rates in transfers for each group (see column 3 note, in Table 8) were adjusted by the ratio of the two coefficients on the time trends. Since these regressions were not differentiated by demographic group, the same scaling factor was applied to all groups.

[23]The poverty reduction due to transfer growth is higher in columns 1-3 of Table 9 than in the same columns in Table 8 because 1974, not 1967, is the base year. Between 1967 and 1974, transfers grew faster than market incomes. Thus, the data in Table 9 start with a higher base level of transfers. Letting this base grow at the same rate as in Table 8 increases the relative importance of transfer growth.

[24]Tables 9 and 10 are not directly comparable, even though they assume the same growth rates in the means of post-response market incomes and transfer income. Table 9 assumes that wage rates and transfer entitlements (or other sources of pre-response income) grew at the given rates. Table 10 assumes that wage rates and entitlements grew more quickly, but that they were reduced by the behavioral response, yielding the same post-response growth rates in <u>mean</u> market income and <u>mean</u>

transfers. This difference in assumption yields different variances, covariances, and displacement factors (see Appendix for details). In turn, this yields different poverty rates.

APPENDIX

The analytical results and computational steps necessary to decompose changes in poverty are presented in this Appendix. We first derive the analytical derivatives which are substituted into equations (5), (6), and (7) in the text. We then present the assumptions and computations used to generate the projections.

I. Analytical Derivatives

Define

$$\alpha = E(I^*)$$

$$\beta^2 = \text{var}(I^*)$$

$$\mu = E\ln(I^* + c)$$

$$\sigma^2 = \text{var}\ \ln(I^* + c)$$

where I^* is the income/needs ratio. Using results of Metcalf (1972), it can be shown that if I^* has a displaced log-normal distribution, then

$$\text{(A1)} \quad \mu = \ln\left\{\frac{(\alpha + c)^2}{[\beta^2 + (\alpha + c)^2]^{1/2}}\right\}$$

$$\text{(A2)} \quad \sigma^2 = \ln\left\{\frac{[\beta^2 + (\alpha + c)^2]}{(\alpha + c)^2}\right\}$$

and

$$Z = \frac{\ln(I^* + c) - \mu}{\sigma}$$

has a standardized normal distribution with density function $\phi(Z)$. Poverty, P, is defined as

$$(A3) \quad P = \int_0^h \phi(z)dz \quad \text{where } h = \frac{\ln(1 + c) - \mu}{\sigma}.$$

We are interested in the partial derivatives of P with respect to α and β^2 (the moments of I^*, rather than the moments of $\ln (I^* + c)$). Using the chain rule, we have

$$(A4) \quad \frac{\partial P}{\partial \alpha} = \frac{\partial P}{\partial h}\left[\frac{\partial h}{\partial \mu}\frac{\partial \mu}{\partial \alpha} + \frac{\partial h}{\partial \sigma^2}\frac{\partial \sigma^2}{\partial \alpha}\right]$$

$$(A5) \quad \frac{\partial P}{\partial \beta^2} = \frac{\partial P}{\partial h}\left[\frac{\partial h}{\partial \mu}\frac{\partial \mu}{\partial \beta^2} + \frac{\partial h}{\partial \sigma^2}\frac{\partial \sigma^2}{\partial \beta^2}\right].$$

Each component of equations (A4) and (A5) can be obtained from equations (A1) to (A3). Differentiating equation (A3) yields

$$\frac{\partial P}{\partial h} = \phi(h)$$

$$\frac{\partial h}{\partial \mu} = -\frac{1}{\sigma}$$

$$\frac{\partial h}{\partial \sigma^2} = -\frac{h}{2\sigma^2}.$$

Differentiating equations (A1) and (A2) yield

$$\frac{\partial \mu}{\partial \alpha} = \frac{2\beta^2 + (\alpha + c)^2}{(\alpha + c)[\beta^2 + (\alpha+c)^2]}$$

$$\frac{\partial \sigma^2}{\partial \alpha} = - \frac{2\beta^2}{(\alpha + c)[\beta^2 + (\alpha + c)^2]}$$

$$\frac{\partial \mu}{\partial \beta^2} = - \frac{1}{2[\beta^2 + (\alpha + c)^2]}$$

$$\frac{\partial \sigma^2}{\partial \beta^2} = \frac{1}{\beta^2 + (\alpha + c)^2}.$$

Substituting these expressions into equation (A4) and (A5) yields

$$\text{(A6)} \qquad \frac{\partial P}{\partial \alpha} = \frac{\phi(h)}{\sigma^2(\alpha + c)(\beta^2 + (\alpha + c)^2)} \left[h\beta^2 - \sigma(2\beta^2 + (\alpha + c)^2)\right]$$

$$\text{(A7)} \qquad \frac{\partial P}{\partial \beta^2} = \frac{\phi(h)}{2\sigma^2[\beta^2 + (\alpha + c)^2]} [\sigma - h].$$

Recognizing that

$$\frac{\partial h}{\partial c} = \frac{1}{(1+c)\sigma} + \frac{\partial h}{\partial c},$$

we have

$$\text{(A8)} \qquad \frac{\partial P}{\partial c} = \frac{\phi(h)}{(1+c)\sigma} + \frac{\partial P}{\partial \alpha}.$$

Equations (A6), (A7), and (A8), along with equation (A5), specify how changes in the underlying parameters of the income/needs distribution influence poverty.

II. Computational Steps

Estimates of α and β^2 are given by the sample moments of I^* in every year. One more piece of information must be used to estimate c, which is associated with the degree of skewness. Metcalf (p. 21) uses the

relationship between α and the 10 percent and 90 percent cutoffs to estimate c. Maximum likelihood or method of moments are possible alternative estimation procedures. We chose, however, to follow a method close to Metcalf's.

Since we are most concerned with the shape of the distribution near the poverty cutoff (where I^* equals one) we use a method which ensures that the theoretical distribution, based on α, β^2, and c, yields a cumulative probability distribution which is similar to the observed distribution around the cutoff. Let h be the standardized normal variate, defined in (A3), which is consistent with the observed poverty rate. Equations (A1), (A2), and (A3) are, therefore, three nonlinear equations in three unknowns--μ, σ, and c--which can be calculated on the basis of three observed quantities--h, α, and β. These equations are solved numerically in each year to yield a time series on c.

Changes in poverty can be decomposed by calculating the changes in the means, variances, and covariances of market incomes/needs and transfer income/needs ratios as well as changes in c between adjacent years. These changes are each multiplied by the appropriate partial derivative (evaluated at the average values of α, β^2, and c for each pair of years) to calculate the impact of changes in each of these parameters on poverty.

Simulations. The simulations assume that each household's market income/needs ratio grows at the rate γ and that each household's transfer income/needs ratio grows at the rate δ:

$$M_{i,t} = \gamma^t M_{io}$$

$$T_{i,t} = \delta^t T_{io}.$$

The subscript zero denotes the base year. This implies that

$$\text{(A9)} \quad \alpha_t = \gamma^t E(M_o) + \delta^t E(T_o)$$

$$\text{(A10)} \quad \beta_t^2 = \gamma^{2t} E(M_o - E(M_o))^2 + 2\gamma^t\delta^t E[M_o - E(M_o)(T_o - E(T_o)] + \delta^{2t} E(T_o - E(T_o))^2$$

$$\text{(A11)} \quad \lambda_t^3 = \gamma^{3t} E[M_o - E(M_o)]^3 + 3\gamma^{2t}\delta^t E[(M_o - E(M_o)^2(T_o - E(T_o)] + 3\gamma^t\delta^{2t} E[(M_o - E(M_o))(T_o - E(T_o))]^3 + \delta^{3t} E[T_o - E(T_o)]^3$$

where E indicates expected values and λ_t^3 is the third moment of the theoretical distribution in year t. Equations (A9) and (A10) are used to generate times series on α and β, based on the assumed growth rates (γ and δ) and the base year moments of M and T. Equation (A11) is used to generate a time series on c using the following relationship between λ^3 and c (see Metcalf, p. 21):

$$\text{(A12)} \quad \lambda_t^3 = \left[\frac{\beta^2}{\alpha + c}\right]^3 + \frac{3\beta^6}{(\alpha + c)}.$$

The procedure is as follows. The value for c in the initial year is calculated as stated above. It is then used to calculate λ_o^3. Equation (A11) can then be used to generate a time series on λ^3, which

can be converted back to a time series on c, using equation (A12). With time series on α_t^2, β_t, and c_t we generate the poverty rates shown in the text, using equations (A1) to (A3).

For the simulations which include behavioral responses we assume that:

(A13) $M_{it} = \tilde{M}_{it} + a\ T_{it}$

(A14) $T_{it} = \tilde{T}_{it} = b\ M_{it}$

where $\tilde{M}_{it}$ and $\tilde{T}_{it}$ are market and transfer incomes before behavioral responses. Equation (A13) assumes that, as a result of labor supply responses, market incomes are reduced by a fraction ($a \leq 0$) of the increase in transfers. Equation (A14) assumes that transfer entitlements ($\tilde{T}_{it}$) are reduced by a benefit reduction rates ($b \leq 0$), to yield observed transfers (T_{it}).

Equations (A13) and (A14) can be rewritten:

(A15) $\tilde{M}_{it} = M_{it} - a\ T_{it}$

(A16) $\tilde{T}_{it} = T_{it} - b\ M_{it}$.

The moments of $\tilde{M}_{it}$ and $\tilde{T}_{it}$ can, therefore, be written in terms of the moments of M_{it} and T_{it}, which are observed in the base year, and the two parameters, a and b. For example,

$$\sigma_{\tilde{M}\tilde{T}} = (1 + ab)\sigma_{MT} - b\sigma_M^2 - a\sigma_T^2.$$

These formulae are used to obtain the moments (and c) for the base year.

We assume that $\tilde{M}$ and $\tilde{T}$ grow at rates $\tilde{\gamma}$ and $\tilde{\delta}$. Following the logic of equations (A9) to (A11) we can, therefore, generate time series on the moments of the pre-response income distribution.

We can write the moments of M and T in each year (after the base year) in terms of the moments of $\tilde{M}$ and $\tilde{T}$ since:

$$M_{it} = \frac{1}{1-ab} [\tilde{M}_{it} + a \tilde{T}_{it}]$$

$$T_{it} = \frac{1}{1-ab} [\tilde{T}_{it} + b \tilde{M}_{it}].$$

This yields the necessary time series to calculate the poverty rates which would have existed, given $\tilde{\lambda}$, $\tilde{\delta}$, a, and b.

$\tilde{\gamma}$ and $\tilde{\delta}$ are chosen so that E(M) and E(T) grow at their observed growth rates. Recognizing that $\tilde{\gamma}$ equals $E(\tilde{M}_{t+1})/E(\tilde{M}_t)$ and substituting equations (A15) and (A16), after taking expected values, yields:

$$\tilde{\gamma} = \frac{E(M_{t+1}) - a\, E(T_{t+1})}{E(M_t) - a\, E(T_t)}$$

$$= \frac{\gamma E(M_t) - \delta\ a\, E(T_t)}{E(M_t) - a\, E(T_t)}.$$

and

$$\tilde{\delta} = \frac{\delta E(T_t) - \gamma\ b\, E(M_t)}{E(T_t) - b\, E\,(M_t)}.$$

Therefore $\tilde{\gamma}$ and $\tilde{\delta}$ are weighted averages of γ and δ. These equations are evaluated using the base year values of $E(M_t)$ and $E(T_t)$ and setting a equal to -.5 and b equal to -.33.

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