110-72

INSTITUTE FOR RESEARCH ON POVERTY DISCUSSION PAPERS

THE EFFECTS OF MACROECONOMIC FLUCTUATIONS
ON THE DISTRIBUTION OF INCOME

Thad W. Mirer

UNIVERSITY OF WISCONSIN ~ MADISON

The Effects of Macroeconomic Fluctuations On the Distribution of Income

Thad W. Mirer

This paper is based on the author's doctoral dissertation which benefited from the generous advice of J. Tobin, W. Nordhaus, and G. Orcutt. The preparation of this report was supported by funds granted to the Institute for Research on Poverty at the University of Wisconsin by the Office of Economic Opportunity pursuant to the provisions of the Economic Opportunity Act of 1964. The author, a research associate at the Institute, thanks R. Haveman and C. Metcalf for helpful comments on earlier drafts, and retains responsibility for all views expressed herein.

January 1972

ABSTRACT

This study develops a microanalytic simulation model to examine the effects of macroeconomic fluctuations on the distribution of income. A representational sample of the population of the United States is linked with equations determining the variability of various types of factor income. Each family's income experience is simulated under alternative aggregate conditions, and the income distributions arising under these conditions are compared.

The main results are similar for alternative specifications of the model. The incidence of a downturn in economic activity, whether accompanied by changes in the rate of inflation or not, and measured in terms of the loss of factor income, leaves an upper middle class (families in the top quintile of the distribution, except for those in the top one-half percent) relatively better off then before and leaves most others relatively worse off. It is the very rich who bear the heaviest (proportional) burden.

The Effects of Macroeconomic Fluctuations on the Distribution of Income

I. Introduction

Studies of macroeconomic fluctuations have traditionally been concerned with changes in aggregate income and, sometimes, with changes in its distribution to various factors of production. The current concern about the size distribution of income leads one to ask how it is affected by changes in aggregate conditions. Such knowledge would be useful for economic authorities if they are to evaluate the distributional costs (or benefits) of setting alternative aggregate goals.

This study approaches the problem by simulating the income experience of the U. S. population under alternative macroeconomic conditions and comparing the resulting income distributions. The model focuses on the mechanisms by which factor incomes are allocated among families in a market economy. Transfer payments and other forms of non-factor income are not covered here, in order to concentrate on these income determination processes.

A number of recent studies have attempted to examine short-run variations in income distribution. Lester Thurow [11] fit a Beta distribution function to data for each of eighteen postwar years. To explain the changes over time in each of the two parameters, he used a one equation model containing a number of macroeconomic variables and concluded that growth and inflation tended to increase equality. Earlier, T. Paul Schultz [10] had examined cyclical fluctuation in inequality by relating the Gini coefficient, derived from distributional data, to another single equation model and found none of the economic variables to be statistically significant. A more elaborate procedure was followed by Charles Metcalf [6], who characterized the distribution for each of six groups in the population by a three-parameter displaced lognormal function and incorporated equations explaining these parameters in a medium-sized macroeconomic model.

A problem in all of these studies is that the various aggregate measures used to describe "the distribution" and changes in it may be inappropriate for some purposes or under some circumstances. For example, a great deal of year-to-year variation in family incomes and income rankings can lie concealed behind stable aggregate distributions. In order to highlight the micro level welfare implications of aggregate policies, this study traces changes in the incomes earned by individual family units. A similar approach has been taken by Edward Budd and David Seiders [3] in investigating the impact of inflation on the the distribution of income and wealth. They use the same micro data base as is used here, and where the results of the two studies are comparable, they are in general agreement.

In this model, alternative aggregate conditions or "states" of the economy are simulated, and the resulting family incomes are compared. The comparison is made by computing for each family the ratio between its income in some particular state, S', and its income in some benchmark state, S*. This ratio measures the extent to which the family realizes its benchmark income in the other state (S'), and is called a "realization rate." The pattern of realization rates in relation to (benchmark) income levels is interpreted as the "incidence" on family incomes of the economy's shifting from state S* to state S'.

II. The Analytical Framework

The behavior of families' total factor income is analyzed in a simple model tracing variations in numerous components of aggregate factor income to their ultimate incidence on individual income recipients. The model is posed in terms of flows, and changes of flows, of incomes, rather than in terms of the usual price-quantity variables of market analysis.

A comparative statics framework is adopted, in which time is frozen and macroeconomic fluctuations are viewed as changes in the "state" of the economy. Using this approach, the income effects of macroeconomic fluctuations are separated (both conceptually and empirically) from those changes in family incomes that may occur over time because of changes in the income earning tastes or capacities of families, or because of random-like variations.

To make the analysis relevant for policy considerations, a benchmark state (S*) will be referred to as the "normal" state and will be characterized by conditions analogous to those prevailing in a full-employment economy. The alternative states chosen for comparison will be analogous to less-than-full-employment situations, but the model could be applied to other deviations from normal or to a "normal" otherwise defined. The income of each family under normal (S*) aggregate conditions is defined to be its normal income.

At the core of the model are the assumptions that (1) the aggregate income flow to each factor of production in different states is determined on the macro level, (2) each family has an endowment of factors which remains fixed throughout any change of state, and (3) each unit of a factor earns the same income in any particular state, regardless of its owner.

On the macro level, the aggregate income earned by the j-th factor in any state S is determined as some proportion of the income it earned in the normal state,

$$(1) \quad Y_j(S) = Y_j(S^*) \cdot R_j(S);$$

this proportion measures the extent to which the factor realizes its normal aggregate income, and is called a "realization rate."

On the micro level, the conditions prevailing in the normal state allow the i-th family to earn its normal income $y_i(S^*)$, which is the sum of the incomes $y_{ij}(S^*)$ it receives from each of the factors it happens to own. From the assumptions of the model, it follows that the total income of the family in any state S is given by

$$(2) \quad y_i(S) = \sum_j [y_{ij}(S^*) \cdot R_j(S)].$$

Equation (2) is the basis for simulating each family's income experience in alternative macroeconomic states. The model is made operational by combining a representational sample of the U. S. population, which gives the various components of the families' normal income (i.e., the $y_{ij}(S^*)$), with a set of equations estimated from postwar macro data, which determines the various aggregate factor incomes' rates of realization (i.e., the $R_j(S)$) as functions of the macro state variables. Actually, two alternative sets of macro equations determining the realization rates are developed, and thus there are two versions of the simulation model.

Clearly, this model draws a very simple picture of the short-run determination of family income.[1] In considering how realistic--and

[1]And, in focusing on the short-run, it avoids the important question of what determines the factor endowments which families have. The predictions of the model are conditional upon the particular distribution of endowments which occurs at one point in the long-run.

therefore, interesting--the simulations will be, two aspects of the model should be noted:

(1) Factor Definitions.--The simulation model identifies six types of non-labor income and sixty types of labor income. The "type" of labor income is defined by the recipient's occupation and age, with ten occupations and six age categories being distinguished. Given the nature of the available data, this breakdown seems reasonable, but the correct level of disaggregation of factor income is difficult to determine a priori. The more narrowly defined are the factors (income types), the more realistic become the assumptions relating to factor homogeneity, but the less realistic becomes the assumption of fixed factor endowments.

(2) Labor Income.--The model assumes each factor to be homogeneous in the sense that all units of it earn the same income. Observed differences in labor incomes of persons selling the same type of labor factor are compatible with the model when they can be attributed to possession of different quantities of this human capital. However, these observed differences also arise because the incidence of unemployment is not uniform; at any moment only some workers of a given type are unemployed. The concept of homogeneous factors is analogous to a situation in which all workers of the same type are (un)employed to the same degree. Therefore, the labor incomes in this model might well be thought of as being expected values in different states.[2]

---

[2] As one considers the incidence of unemployment over an income-accounting period such as a year, each labor factor would be more homogeneous than it is at any instant. Unemployment is spread, there is less variance of incomes around their expected values, and the model becomes more realistic.

III. The Micro Sample

The income information for a representational sample of the U. S. population is based on the Federal Reserve's Survey of Financial Characteristics of Consumers, which covers families' activities during 1962. The survey, which contains observations on 2,557 family units representing a population of 57.927 million families, used a stratified sampling technique to oversample high income classes, thus permitting a more reliable analysis in this range.[3] The sample data are adjusted to make them compatible with the macro data used later, and to set labor incomes equal to their expected values.

The classification of survey-reported wage and salary income into the sixty labor factors is a novel feature of this study. The need to identify factor income types that are likely to be homogeneous in fluctuation and the fact that wage and salary income amounts to about 70 percent of personal income make it imperative to do some disaggregation. The two dimensions best defining labor factor types are taken to be the occupation and age of the worker; the first identifies distinct labor factors from the point of view of a production manager and the second separates the workers in each occupation into groups with different propensities to be laid off for reasons of seniority. The ten occupational classes used in defining labor factor types are professional, farm manager, manager, clerical, sales, craftsman, operative, service, farm laborer, and general laborer. Each occupation is divided into the following age classes: 18-24, 25-34, 35-44, 45-54, 55-64, and 65-up.

---

[3]In this study, the term "family" is used in reference to those units identified by the Census Bureau as "families and unrelated individuals." For further information on the survey see Projector and Weiss [9], and for a study of its reporting accuracy see Ferber [4].

For each family, selected survey-reported income components are combined into the following categories (factor types): business income, farm income, rent, dividends, interest, undistributed dividends, and sixty labor incomes. Minor adjustments of the survey data include an imputation of rent on owner-occupied houses and the allocation of unspecified "trust and estate" income between dividends and interest. A major adjustment--both in terms of magnitude and distributional importance--is the imputation of undistributed dividends to families reporting dividend income. This new factor income is computed as 1.057 times reported dividends, this being the 1962 proportion between the two aggregates in the national accounts. These retained corporate earnings are a form of savings for the stockholders, and ought to be counted as income for them. The taxed portion of corporate earnings is not counted, however, thereby embodying the view that corporations are economic entities distinct from their owners.

In conformity with the analytical framework of this study, the reported labor incomes in the survey are adjusted to be estimates of their expected values. Within each occupation-age class, workers' incomes are reallocated so that each receives that amount he hypothetically would have received if all the workers in his class had been unemployed to the same extent in the survey period. The adjustments are made on the basis of the number of months each person reported working.

After all these adjustments, the micro sample represents the distribution of factor incomes under the aggregate conditions actually prevailing in 1962. The first phase of each simulation adjusts all of the incomes to their hypothetical normal levels for 1962.

IV. The Aggregate Realization Rates

Two alternative approaches are developed to determine the realization rate functions (i.e., the $R_j(S)$) for the aggregate factor incomes, thereby introducing two versions of the basic simulation model. Because of data limitations it is possible to directly determine the functions only for the six non-labor factor incomes and the ten occupational categories of income; an indirect procedure will determine the six age-specific functions within each occupational class. For ease of exposition in this section, six non-labor incomes and the ten occupational categories of income will temporarily be called the "factor incomes."

The functions relating the realization rates to the variables chosen to characterize the state of the economy must be determined by an indirect procedure, because these rates are non-observable variables. For both sets of macro equations, postwar regressions are used to determine the behavior of the shares of the factor incomes in GNP as functions of the state variables, and the realization rate functions then are determined through identities. The central role assigned to factor shares serves to link traditional economic concern for those income ratios with the present concern for distribution on the micro level.

Equation (1) above serves to define $R_j(S)$ as the ratio $Y_j(S)/Y_j(S^*)$. Letting H_j be the share of the j-th factor in the Gross National Product, the realization rate is then determined as

$$(3) \quad R_j(S) = \frac{Y_j(S)}{Y_j(S^*)} = \frac{GNP(S)}{GNP(S^*)} \cdot \frac{H_j(S)}{H_j(S^*)} \quad .$$

In using the right-hand side of equation (3) to calculate the rate for any specific values of the state variables, $H_j(S)$ and $H_j(S^*)$ are predicted from the historical regression equations, and the ratio of GNP values will itself be one of the state variables.

In each of the two simple models which are developed, there are as many equations as there are factor shares to be determined (sixteen).[4] The first model characterizes the economy (at a given moment) by the degree of utilization of productive resources, and the second adds the rate of inflation as a characterizing variable. The regression equations are more like reduced forms than structural specifications in that they attempt to capture the effects of the exogenous state variables working through the complex structure of interrelated factor markets.

The two short-run macroeconomic variables:

(1) The Macro-Utilization Rate, U, is defined as the ratio of prevailing (i.e., observed) GNP to potential GNP (as defined by the Council of Economic Advisors),

$$(4) \quad U = \text{Prevailing GNP/Potential GNP}$$

and indicates the degree to which the economy is utilizing its productive resources. The Council's definition ties potential GNP to utilization of the labor force, but it is used here as proxy for GNP capacity. Changes in aggregate utilization may affect factor incomes primarily by altering producer's demands in the factor markets.

(2) The Rate of Inflation, RINF, is defined as the proportional one-year change in the GNP deflator,

$$(5) \quad RINF = (PGNP - PGNP_{-1})/PGNP_{-1} \ .$$

[4]Ideally, one would construct an econometric model determining simultaneously a large number of variables, including the factor shares. Given fixed behavior and technical relations, a particular state S' would be characterized as a certain set of values for the exogenous and lagged endogenous variables.

With real GNP fixed, changes in the rate of inflation would lead to changes in income shares if this reflected the success of certain groups in promoting their interests or if it reflected shifts in demand between various sectors of the economy.

In addition to these variables, each equation will contain a time trend, denoted by T, as proxy for the effect on factor shares of long-run changes in the structure of the economy and factor markets.

The macro data used are time series on yearly observations, 1953-1968. The data for occupational income aggregates are developed for this study from the Current Population Survey reports and the 1960 Decennial Census, and are somewhat crude. A further description of the data appears in the appendix.

For model 1, a graphical analysis of the relations between the detrended values of the shares and U indicates linear relations. Accordingly, specifications of the form

$$(6) \quad H_j = a_j + b_j \cdot T + c_j \cdot U + e_j$$

are estimated by ordinary least squares, with results as shown in Table 1.

For present purposes, the most important elements of these equations are the estimates of the c_j. A positive coefficient indicates an income share that is pro-cyclical, and a negative one indicates a share that is anti-cyclical. Examining first labor incomes, one finds the regression indicating that (1) professional, managerial, and clerical income shares are strongly anti-cyclical, (2) operative and general laborer income shares are strongly pro-cyclical, and (3) the others are in between. Patterns for non-labor incomes seem reasonable.

Table 1. Macro Model 1, Equation Estimates

j	Income Type	const	T	U	R^2	DW	SEE / Mean H_j
1	Business income	.1073 (.0101)	-1.3130 (.0712)	-.0247 * (.0106)	.968	1.26	.0013 .0602
2	Farm income	.0249 (.0171)	-1.0339 (.1204)	.0122 (.0179)	.853	1.93	.0022 .0248
3	Rent	.0530 (.0054)	-.7315 (.0382)	-.0140 * (.0057)	.970	1.98	.0007 .0310
4	Dividends	.0262 (.0063)	.1723 (.0445)	-.0015 (.0066)	.544	.82	.0008 .0268
5	Interest	.0244 (.0064)	2.0227 (.0452)	-.0004 (.0067)	.994	2.11	.0008 .0473
6	Retained dividends	-.0795 (.0304)	-.2442 (.2135)	.1177 * (.0318)	.514	1.18	.0038 .0319
7	Profes- sional	.1308 (.0162)	2.6835 (.1139)	-.0766 * (.0170)	.977	1.03	.0020 .0073
8	Farm manager	-.0000 (.0001)	-.0025 (.0004)	.0001 * (.0001)	.787	2.43	(nil) (nil)
9	Manager	.1179 (.0108)	.1418 (.0759)	-.0521 * (.0113)	.628	1.48	.0014 .0690
10	Clerical	.1213 (.0112)	.4643 (.0788)	-.0486 * (.0117)	.767	1.42	.0014 .0795
11	Sales	.0543 (.0091)	-.0891 (.0638)	-.0209 * (.0095)	.403	2.07	.0011 .0320
12	Craftsman	.1001 (.0173)	-.6576 (.1215)	.0152 (.0181)	.694	1.42	.0022 .1073
13	Operative	-.0184 (.0202)	-1.5171 (.1416)	.1545 * (.0211)	.915	1.52	.0025 .1141
14	Service	.0285 (.0079)	-.0554 (.0556)	.0078 (.0083)	.105	1.70	.0010 .8355
15	Farm labor	.0072 (.0055)	-.2676 (.0389)	.0019 (.0058)	.791	1.64	.0007 .0060
16	General labor	.0141 (.0088)	-.7270 (.0620)	.0208 * (.0092)	.914	2.36	.0011 .0260

Notes:
a. Parentheses contain standard errors.
b. T increases by .001 for each year; mean of U is .971.
c. Sample period in 1953-1968 (16 observations).
d. A coefficient on U (c_j) different from zero by a t-test with .05 significance level is indicated by an asterisk (*).

For model 2, inspection reveals that the residuals from a number of the equations estimated for model 1 appear to be linearly related to the rate of inflation. If inflation affects factor shares in this additive way, the specification

$$(7)\quad H_j = \alpha_j + \beta_j \cdot T + \gamma_j \cdot U + \delta_j \cdot RINF + \varepsilon_j$$

would be appropriate. This form is estimated, with results as shown in Table 2. The sign and significance pattern of the $\hat{\gamma}_j$ are the same as discussed above for the $\hat{c}_j$. Only four of the $\hat{\delta}_j$ are significantly different from zero.

The two models have similar estimation properties for comparable equations. In most, the constant and time trend contribute substantially toward the equation's explanatory power. In terms of goodness-of-fit, service income ranks the worst, having large residuals in 1953 and 1955. The R^2 for dividends and retained dividends are relatively low; this is disappointing because of their distributional importance. The Durbin-Watson statistics are in the ambiguous region or lead one to accept the hypothesis of no serial correlation for the disturbances--except for dividends, in which case autocorrelation is indicated at some significance levels of the tests, but not at lower ones. With regard to the coefficients on the macro variables (c, γ, δ), it should be clear that the true values of some of them may be close to (or equal to) zero. Hence, a low value for a "t-test" does not argue for excluding that variable from the equation and re-estimating the regression. The significance of the differences among the sixteen estimates for each parameter is discussed later.

Table 2. Macro Model 2, Equation Estimates

j	Income Type	const	T	U	RINF	R^2	DW	$\frac{\text{SEE}}{\text{Mean } H_j}$
1	Business income	.1117 (.0096)	-1.3463 (.0676)	-.0302 * (.0101)	.0621 * (.0332)	.975	2.11	.0012 .0682
2	Farm income	.0208 (.0177)	-1.0024 (.1253)	.0173 (.0188)	-.0585 (.0615)	.864	2.19	.0022 .0248
3	Rent	.0545 (.0056)	-.7428 (.0393)	-.0158 * (.0059)	.0211 (.0193)	.973	2.06	.0007 .0310
4	Dividends	.0257 (.0068)	.1760 (.0479)	-.0009 (.0072)	-.0069 (.0235)	.547	.84	.0008 .0268
5	Interest	.0233 (.0068)	2.0306 (.0480)	.0009 (.0072)	-.0148 (.0235)	.994	2.37	.0008 .0473
6	Retained dividends	-.0821 (.0325)	-.2241 (.2294)	.1210 * (.0344)	-.0374 (.1125)	.519	1.14	.0040 .0319
7	Profes- sional	.1335 (.0171)	2.6628 (.1208)	-.0800 * (.0181)	.0384 (.0592)	.978	1.07	.0021 .0873
8	Farm manager	-.0000 (.0001)	-.0026 (.0004)	.0001 * (.0001)	.0001 (.0002)	.789	2.41	(nil) (nil)
9	Manager	.1160 (.0114)	.1562 (.0804)	-.0498 * (.0121)	-.0267 (.0394)	.641	1.42	.0014 .0690
10	Clerical	.1293 (.0076)	.4042 (.0539)	-.0585 * (.0081)	.1117 * (.0264)	.906	2.45	.0009 .0795
11	Sales	.0532 (.0097)	-.0810 (.0682)	-.0196 * (.0102)	-.0151 (.0335)	.413	2.05	.0012 .0329
12	Craftsman	.1090 (.0154)	-.7246 (.1087)	.0042 (.0163)	.1244 * (.0533)	.790	1.36	.0019 .1073
13	Operative	-.0101 (.0194)	-1.5795 (.1368)	.1442 * (.0205)	.1159 (.0671)	.932	1.37	.0024 .1141
14	Service	.0266 (.0082)	-.0415 (.0580)	.0101 (.0087)	-.0260 (.0285)	.163	2.00	.0010 .0355
15	Farm labor	.0074 (.0059)	-.2689 (.0419)	.0016 (.0063)	.0025 (.0206)	.791	1.66	.0007 .0060
16	General labor	.0179 (.0084)	-.7558 (.0590)	.0161 * (.0089)	.0536 * (.0289)	.933	2.91	.0010 .0260

Notes:
a. Parentheses contain standard errors.
b. T increases by .001 for each year; mean of U is .971; mean of RINF is .021.
c. Sample period is 1953-1968 (16 observations).
d. A coefficient on U (γ_j) or on RINF (δ_j) different from zero by a t-test with .05 significance level is indicated by a *.

The implications of these regression results are drawn by examining the realization rate functions derived from them. With time fixed, the states are completely characterized by the values of the short-run macro variables. The normal state S* for model 1 is defined to be U = 1.0; for model 2, S* is characterized by U = 1.0 and RINF = 0.03. This conveniently allows equation (3) to be rewritten as

$$(8)\quad R_j(S) = U \cdot H_j(S)/H_j(S^*).$$

For model 1, the estimate of equation (6) is substituted in (8), and with T and the estimated parameters fixed, R_j is a quadratic function of U. The sixteen realization functions are graphed in figure 1. Most of the curves are very nearly straight lines, and all of the income aggregates vary pro-cyclically with GNP. The most stable income type is professionals' labor income (#7) and the most variable is retained dividends (#6). Interestingly, the four most stable incomes are those from the white-collar occupations; the next four are non-labor incomes; the next seven are from blue-collar occupations and farm proprietary income; and the most variable income is retained dividends.

For model 2, U and RINF completely characterize the state (with time fixed). With RINF held constant, each R_j is a quadratic function of U, and the set of relations between R and U is very similar to that shown for model 1. When U is fixed, R is linear in RINF with a slope of the same sign as $\hat{\delta}$ of equation (7). The effects of increases in inflation are found to be most detrimental to farm proprietary income and retained dividends, and most beneficial to general laborers' income.

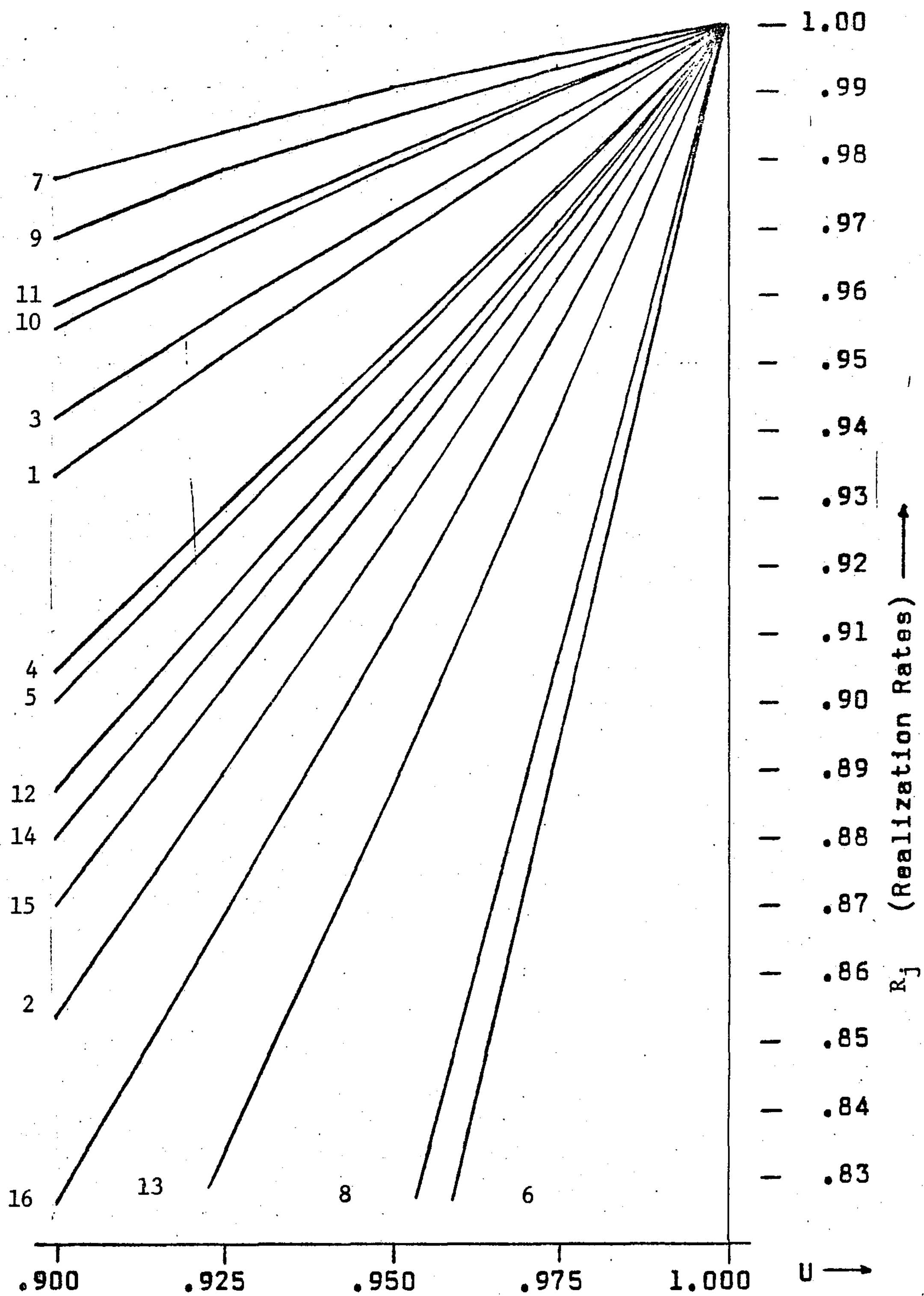

Figure 1
Model 1: The Factor Income Realization Functions
(Note: Factor incomes are identified by number as in Table 1)

The significance of any pattern of simulated distributional effects in this model rests crucially on the statistical significance of the differences between the various factor income realization rates, for the simulated values of the state variables. If the appropriate normality requirements are met, then the coefficient estimates in (6) and (7) are normally distributed, and R is equal to the ratio of two normally distributed random variables, by (8). If nearly all the probable values of the denominator are of the same sign, then R is approximately normally distributed. This condition is met, and some analysis for model 1 indicates that factor incomes at one extreme (e.g., professionals') are realized at a rate significantly higher than those at the other (e.g., retained dividends), with less able to be said about incomes in the middle.[5]

Finally, it is necessary to determine the realization rates for the six age classes within each occupation. Temporarily adopting a two-subscript notation, using j for the occupation and k for the age class, it is assumed that

$$(9)\quad R_{jk}(S) = a_{jk} + b_{jk} \cdot R_j(S).$$

In this linear structure, the coefficient b_{jk} measures the responsiveness of the realization rate for an age-specific factor income to changes in the realization rate for income of the entire occupation. By definition, all realization rates must equal unity in the normal state, so $a_{jk} + b_{jk} = 1$. Hence, only one coefficient need be determined for each factor type.

---

[5]This analysis is incomplete because not enough information is available to determine the joint distribution of the calculated realization rates.

Since age was chosen as a dimension to define labor factor types because it is associated with a worker's propensity to be unemployed, employment data is a natural source for estimating the response coefficients. Letting E_o denote the overall civilian employment rate (i.e., one minus the unemployment rate) a set of six regressions of the form

$$(10) \quad E_k = \alpha_k + \beta_k \cdot E_o + \varepsilon_k$$

are estimated to determine the responsiveness (β_k) of the employment rate (E_k) in each of the six age classes to changes in the employment rate of all the classes combined. These estimates are given in Table 3. As shown there, the responsiveness of age-specific employment rates to changes in the overall employment rate decreases as age increases.

The six estimated β_k are used as proxies for the corresponding b_{jk} in equation (9) to determine the sixty labor factor income realization rate functions.[6] A slight proportional adjustment of the values of the β_k is made, separately for each occupation, in order to make the six realization rates within each occupation category consistent simultaneously with the occupation's aggregate income realization rate and the data of the micro sample.

In sum, two alternative macro models provide the foundation for simulating the aggregate factor income realization rates. Each is based on a set of time series regressions explaining aggregate factor shares and on a study of employment variability by age class. These empirical

---

[6] If data were available to estimate the age structure of employment rates separately for each occupation, it would be preferable to use the resulting sixty estimates of the response coefficients directly as proxies for the b_{jk}. The present method constrains the relation between age-specific realization rates to be nearly identical for all occupations.

Table 3. Employment Rate Regressions

k	Age Class	const	E_o	R^2	DW	$\frac{SEE}{Mean\ E_k}$
1	18-24	-.8922 (.1011)	1.8879 (.1056)	.952	.53	.0054 .9157
2	25-34	-.0633 (.0250)	1.0680 (.0262)	.991	1.62	.0013 .9594
3	35-44	.1492 (.0222)	.8536 (.0232)	.988	.72	.0012 .9667
4	45-54	.2040 (.0446)	.7975 (.0465)	.948	.25	.0024 .9676
5	55-64	.2242 (.0632)	.7736 (.0660)	.896	.69	.0034 .9650
6	65-up	.3568 (.0454)	.6352 (.0475)	.918	1.75	.0024 .9650

Notes: a. Parentheses contain standard errors.
b. Sample period 1951-1968 (18 observations).
c. Mean E_o is .958.

results are combined and transformed to yield a set of relations from which the realization rates are determined as functions of the variables describing the state of the economy, with time fixed.

V. Simulation Results

Each simulation experiment involves choosing a set of values to characterize the state of the economy, then determining the income which would be earned by each family in this state according to equation (2), and finally calculating for each family the ratio of this income to its normal income (i.e., $r_i(S) = y_i(S)/y_i(S^*)$). For any family, the value of this ratio in a particular simulated state depends on the composition (by factor type), but not on the absolute amount, of its normal income. Thus, in this model, any differences in the extent to which various families realize their normal incomes (as measured by $r_i(S)$) is caused by the differences in their normal incomes' composition.

The analysis of the simulation results centers on the relation between the families' realization rates and the level of their normal incomes. For there to be some systematic pattern of realization rates, there must be some systematic relation between the composition and the level of family incomes. Analysis of the micro sample indicates that such a relation does exist, but that there is considerable variation of composition among families with similar income levels.

To present the results of the simulations, the families are classified into fifty income groups, defined by \$500-width intervals up to \$12,500 and progressively larger ones above that, and the weighted mean realization rate for each group is plotted. This form of presentation neglects the high variation around the more systematic pattern of class means. Therefore, for the first simulation some indication of the variability within each group is presented in addition to the group means.

Information about this grouping is given in Table 4 for the sample adjusted to the normal state with model 1. For each group, with families properly weighted to make the whole sample represent the U. S. population, there is given: (1) the proportion of all families in this and all poorer groups; (2) the mean normal income; and (3) the proportion of total factor income received by families in this and all poorer groups. The population here looks "poorer" than that given in published size distributions for 1962, even though these incomes are grossed up to normal conditions, because of the exclusion of transfer income and the retention in the population of those families with no factor income (about 5 percent of the total).

The results of three simulation experiments are presented here.[7] The qualitative patterns which arise confirm that the distributional effect of a macroeconomic fluctuation is a complex phenomenon.

<u>Model 1.</u> This experiment is performed with U = .975 and comparisons are made to the normal state characterized by U = 1. The simulated recession results in a redistribution of income yielding the pattern in Figure 2. In this figure, the mean realization rate in each class

---

[7] In general, to analyze the implications of a simulation model, one would want to perform a set of experiments over a wide range of values of the state variables. In this model, however, the approximate results for a wide range of values can be inferred from just a few simulations, because the aggregate factor income realization rates turn out to be nearly linear in the state variables. In all the reported simulations, "time" is set at 1962, the year of the family survey.

Table 4. Aspects of the Distribution of Normal Income, Model 1

CLS	Lower Income Bound	Cumulative Proportion of Population	Normal Income Class Mean	Normal Income Cumulative Share
1	0	.126	121	.002
2	500	.164	745	.007
3	1,000	.209	1,212	.015
4	1,500	.240	1,793	.023
5	2,000	.274	2,268	.035
6	2,500	.302	2,774	.047
7	3,000	.347	3,251	.069
8	3,500	.377	3,743	.086
9	4,000	.411	4,247	.108
10	4,500	.457	4,769	.141
11	5,000	.506	5,270	.180
12	5,500	.551	5,746	.220
13	6,000	.594	6,254	.260
14	6,500	.626	6,790	.293
15	7,000	.670	7,260	.341
16	7,500	.709	7,748	.388
17	8,000	.743	8,237	.430
18	8,500	.772	8,724	.469
19	9,000	.800	9,241	.507
20	9,500	.827	9,751	.547
21	10,000	.844	10,248	.574
22	10,500	.860	10,737	.600
23	11,000	.872	11,233	.620
24	11,500	.883	11,696	.640
25	12,000	.900	12,292	.671
26	12,500	.927	13,008	.716
27	13,500	.938	13,968	.748
28	14,500	.950	15,027	.775
29	15,500	.962	16,251	.805
30	17,000	.971	17,871	.828
31	18,500	.977	19,300	.847
32	20,000	.982	21,209	.862
33	22,500	.984	23,590	.872
34	25,000	.988	27,152	.887
35	30,000	.990	32,164	.897
36	35,000	.992	37,263	.908
37	40,000	.994	41,361	.921
38	45,000	.995	46,551	.926
39	50,000	.997	54,334	.945
40	60,000	.998	65,479	.951
41	70,000	.998	75,685	.956
42	80,000	.999	88,028	.967
43	100,000	1.000	150,470	.988
44	200,000	1.000	270,536	.995
45	400,000	1.000	463,928	.997
46	600,000	1.000	635,728	.998
47	800,000	1.000	832,055	.998
48	1,000,000	-	-	-
49	1,500,000	1.000	1,912,156	1.000
50	2,000,000	-	-	-

is shown by a heavy dot, and the range of one standard deviation above and below the mean is shown by the vertical bars.

Upper middle class families (income classes 20-40, with incomes from about \$10,000 to \$70,000), who number only about 15 percent of the total population, suffer less than average in the recession. The class mean realization rate decreases as the family income rises above \$20,000, with the richest families bearing the heaviest burden of all. The realization rate decreases also as one moves down the income scale below \$20,000, reaching a trough between \$3,000 and \$4,000. Below this level of normal income, the realization rates are higher. Roughly speaking, the redistribution that occurs in this recession leaves the rich and the lower middle class worse off, relative to the upper middle and (to some extent) the poor. This type of redistribution is difficult to describe in terms of changes in inequality: if there were no reordering of families' income ranks from one state to another (i.e., if there were no variability around a smoothed pattern of incidence), the Lorenz curves describing the two distributions would cross.

Some idea of the magnitudes of the relative losses of families of different income levels is obtained by comparing the average loss in each class. In a recession where total factor income is more than 2 1/2 percent below its normal level, incomes of the least affected classes are about 1 1/2 percent below their normal levels, those of the lower middle classes are about 3 1/2 percent below theirs, and the incomes of the very rich are down by more than 6 percent.

Model 2. The experiments with model 2 are designed to analyze the separate and the combined effects of changes in the rate of inflation and in aggregate utilization. Given the benchmark state (S*) characterized by U = 1 and RINF = .03, the first simulation estimates the effect of a decrease in the rate of inflation by simulating a state (S') with U = 1 and RINF = .02; the second simulates a simultaneous decrease in utilization and inflation to a state (S") characterized by U = .975 and RINF = .02. This second experiment is somewhat analogous to the economy shifting from one point to another along a Phillips curve.

The results of the first simulation, which estimates the effects of decreasing the rate of inflation by one percentage point, are shown in Figure 3. Families with incomes above $12,000 and those with incomes below $2,000 are made better off, relative to those with incomes in between, and the rich are made better off in absolute terms. Total personal (real) factor income decreases by one-half percent, while real GNP remains constant. The macro equations thus imply that other components of GNP--viz., capital consumption allowances, indirect business taxes, corporate income taxes, and in this model some interest income not allocated to the personal sector--must increase with a decrease in rate of inflation.

For the second experiment, the associated magnitudes of the simultaneous changes in utilization and inflation are chosen to be reasonable, on the basis of (pre-1970) historical experience. The effects of the decrease in aggregate utilization strongly dominate and differ from the effects of the decrease in inflation, leaving net results (Figure 3) which are practically the same as those of the pure recession simulated by model 1. The rich and the lower middle class are

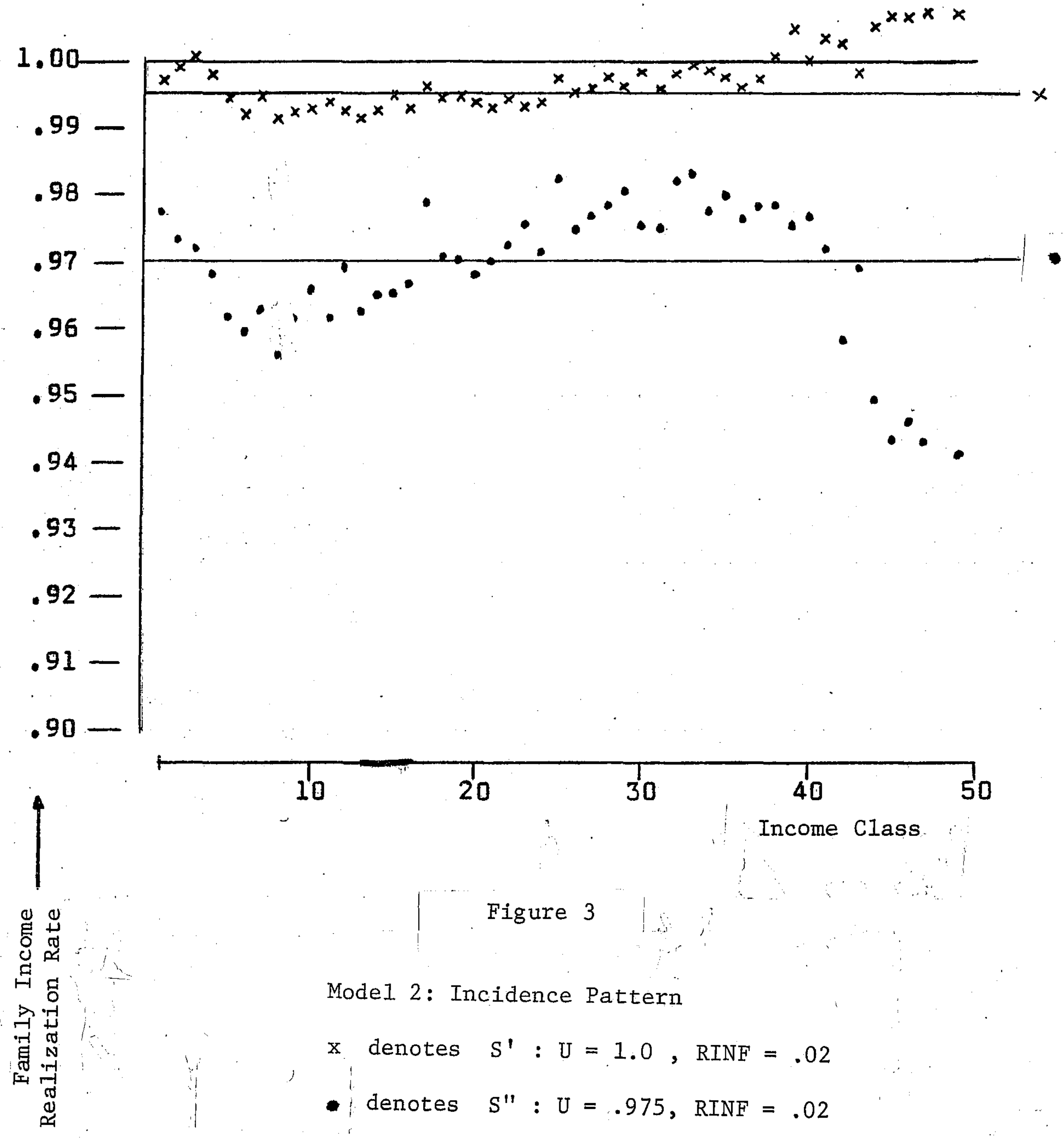

Figure 3

Model 2: Incidence Pattern

x denotes S' : U = 1.0 , RINF = .02

• denotes S" : U = .975, RINF = .02

Benchmark, S* : U = 1.0 , RINF = .03

made worse off relative to the upper middle class, while the poor are left about as well off as average or even a bit better.

In all the experiments, the considerable variability of predicted family income realization rates around the pattern of the class means must be recognized. While the pattern of class mean does summarize what might generally be accepted as an interpretation of the incidence of the change in aggregate income, this variability reduces the reliability of generalizations based on these estimates.

The results of the simplest simulation (model 1) are in accord with simple economic expectations. Families with normally low incomes derive most of their income from blue-collar employment and suffer income-losses due to unemployment in depressed times. Families with white collar incomes, which are relatively stable, have higher normal incomes. The wealthiest families, whose incomes are tied to corporate ownership, suffer when business declines.[8] The results of the simulated change in the rate of inflation are similar to those found by Budd and Seiders [3], but less confidence can be placed on the statistical properties of these estimates than on the others in the model.

VI. Conclusion

While the nation may have good reasons for slowing the growth of national income or decreasing its level, this policy results in a loss

---

[8] In other experiments, the category of "undistributed dividends" was excluded from factor income. The simulated incidence patterns were nearly identical for the first thirty income classes. In simulated recessions, the realization rates declined for richer families as they do here, but the lower limit of the class means was much higher--approxmately equal to the mean realization rate for all families.

of potential income. Who bears the burden? The simulation study reported here suggests that the incidence of a loss of aggregate income is not uniform. General recessionary conditions cause the lower middle class and the very upper class to suffer more--in the sense of foregone income, proportionally measured--than persons in the upper middle class. The very poor seem not to bear more than an average burden, but confidence in this result must be tempered by recognition of the inadequacies of the income concept used in this model.

In the late 1960's much analysis of anti-inflationary policies was couched in terms of the Phillips curve tradeoff. What distributional effects might be expected from an anti-inflationary policy? The results of this study suggest that the pure effects of disinflation would benefit the rich, to the detriment of nearly everyone else. One could not realistically suppose, however, that a disinflationary policy would be unaccompanied by a decrease in the utilization of the economy's resources. For changes in aggregate conditions analogous to the economy's moving down the Phillips curve, the predicted effects are virtually the same as those described in the previous paragraph.

The simulation model developed here is based on a 1962 sample survey, and the predicted distributional effects are based on the composition of income existing at that time. It seems unlikely that this composition has changed considerably in recent years. Therefore, a fair test of the predictive powers of this model could be made by examining the actual distributive impact of the 1970 recession.

APPENDIX

A. DATA ON OCCUPATIONAL INCOMES

Time series data on income by occupation are not regularly available, and are constructed here to be compatible with the National Accounts total of Wages and Salaries plus Other Labor Income. Wage and Salary income amounts to about 70 percent of Personal Income, and the attempt to meaningfully disaggregate this total is a major feature of this study.

The occupations considered are the "major occupations" as defined by the Census Bureau, with one exception: household and nonhousehold service workers are here grouped together in one occupation, "service workers." This consolidation makes the occupational groupings conform to those of the Federal Reserve survey.

There are two major sources of data drawn upon: (a) the Current Population Survey, conducted by the Census Bureau, whose results are reported in various Census Bureau and Labor Department publications [12, 14, 15], and (b) the 1960 Decennial Census [14], which was used to make some benchmark calculations.

Basically, the calculations consist of three steps:

(1) Finding the mean Wage and Salary (W & S) income for the occupation. Time series for means by occupations were constructed by adjusting the available series on medians [12, P-60, No. 69, Table A-9] with the corresponding mean/median ratios derived from the 1960 census [14, Table 27].

(2) Finding the numbers of W & S workers, by occupation. These series are obtained by adjusting the numbers of employed persons (including self-employed) found in [12, 15] by benchmark ratios for "W & S earners/employed persons" derived from the 1960 census [14].

(3) Multiplying these two derived series to obtain income figures by occupation. These data were then proportionally inflated to make each year's total equal to the National Accounts data on total Wages and Salaries.

Where possible, the intermediate steps were carried out separately by sex. The resulting series are rather crude estimates, but their variation as investigated in the macro equations conforms fairly well to a priori expectations. A more complete description of these data manipulations is found in [7].

B. DATA ON NONLABOR INCOMES

Time series on aggregate income by type were taken from the National Income Accounts, in [18] and the latest July editions of [17]. Series for potential income were created from the Council of Economic Advisors' benchmarks and growth rates found in [16], while those for actual GNP were found in the National Accounts.

C. DATA ON EMPLOYMENT RATES

Data on the size of the civilian labor force and on the number of employed persons by age class were collected (1953-56 [12], 1957-68 [15]) and combined to form time series on employment rates by age class.

D. CHOICE OF SAMPLE PERIOD

The earliest year for which occupational income could be derived was 1950, but the years 1950-52 were deleted from this study because in a number of cases the data appeared to be inconsistent with the behavior indicated by later years. These three years witnessed the build-up and the peak of the Korean War, when controls were placed on the natural behavior of markets.

REFERENCES

[1] A. B. Atkinson. "On the Measurement of Inequality." Journal of Economic Theory 2 (September 1970).

[2] E. C. Budd. "Postwar Changes in the Size Distribution of Income in the U. S." American Economic Review 60 (May 1970).

[3] __________, and D. E. Seiders. "The Impact of Inflation on the Distribution of Income and Wealth." American Economic Review 61 (May 1971).

[4] R. Ferber, J. Forsythe, H. Guthrie, and E. Maynes. "Validation of a National Survey of Consumer Financial Characteristics: Savings Accounts." Review of Economics and Statistics 51 (November 1969).

[5] R. G. Hollister, and J. L. Palmer. "The Impact of Inflation on the Poor." (Institute for Research on Poverty Discussion Paper) Madison: University of Wisconsin, 1969.

[6] C. E. Metcalf. "The Size Distribution of Personal Income During the Business Cycle." American Economic Review 59 (September 1969).

[7] T. W. Mirer. "A Simulation Model of the Effects of Macroeconomic Fluctuations on the Distribution of Income." (unpublished dissertation) Yale University, 1971.

[8] G. H. Orcutt, M. Greenberger, J. Korbel, and A. Rivlin. Microanalysis of Socioeconomic Systems: A Simulation Study. New York: Harper & Row, 1961.

[9] D. S. Projector, and G. Weiss. Survey of Financial Characteristics of Consumers. (A Federal Reserve Technical Paper) Washington: Board of Governors of the Federal Reserve System, 1966.

[10] T. P. Schultz. "Secular Trends and Cyclical Behavior of Income Distribution in the United States: 1944-1965." In L. Soltow, ed., Six Papers on the Size Distribution of Wealth and Income (NBER Studies in Income and Wealth #33). New York: NBER, 1969.

[11] L. C. Thurow. "Analyzing the American Income Distribution." American Economic Review 60 (May 1970).

[12] U. S. Bureau of the Census. Current Population Reports. Series P-50, "Labor Force," various issues, 1947-1959. Series P-60, "Consumer Income," various issues.

[13] ________________. Income Distribution in the United States, by H. P. Miller (A 1960 Census Monograph). Washington: U. S. Government Printing Office, 1966.

[14] ________________. U. S. Census of Population: 1960. Subject Reports. Occupational Characteristics. Final Report PC(2)-7A. Washington: U. S. Government Printing Office, 1963.

[15] U. S. Bureau of Labor Statistics. Employment and Earnings. Various issues, 1959-1969.

[16] U. S. Office of Business Economics. Business Conditions Digest. Various issues.

[17] ________________. Survey of Current Business. Various issues.

[18] ________________. The National Income and Product Accounts of the United States, 1929-1965. (A supplement to the Survey of Current Business, 1965.)