EMPIRICAL COMPARISONS OF ALTERNATIVE MEASURES

OF ECONOMIC WELL-BEING

Roger H. Gordon

The distributions of lifetime income, lifetime labor income, and a measure of lifetime opportunities, are compared empirically using a model estimated from the Michigan Panel Study of Income Dynamics. It is found that most inequality in annual income is due to inequality in lifetime opportunities, and not due to temporary disturbances or differences in tastes.

The characteristics of transfer programs based on annual income are then compared to those of programs based on the above measures. It is found that the current income tax approximates a lifetime opportunity tax as well as a lifetime income tax, but significantly less well than a lifetime consumption tax. Finally, it is shown that under an annual negative income tax, almost half the transfers go to those whose income is only temporarily low.

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I.   Introduction

The empirical nature of the distribution of economic well-being is of prime
interest in describing the state of an economy and in designing economic
policy. In principle, the distribution ought to be of the utilities of in-
dividuals in the economy. Since an individual's utility is not directly obser-
vable, economists have had to construct measures of the quality of an indivi-
dual's position using more limited but observable information. Annual income
has been the most commonly used such constructed measure.   Lifetime income
and consumption are frequently suggested as preferable alternatives. In
Gordon (1977), I proposed as an additional alternative a measure of the quality
of an individual's opportunity set. The purpose of this paper is to study
empirically the degree of correspondence among these different measures on a
representative population of white males produced from a stochastic simulation
of a model estimated on data from the Michigan Panel Study of Income Dynamics.
In the next section, the theoretical motivation for the different measures will
be explored. Then section III contains a description of the principle char-
acteristics and assumptions underlying the empirical model. The following
section then describes how the welfare measures were calculated, given the
information provided by the model. Comparisons of the alternative measures
produced by a simulation of the model are presented in section V. Applications
of the model to tax and transfer programs and a summary conclude the paper.

II. Alternative Measures of Well-Being

A measure of well-being ought in principle to be consistent with each individual's ordinal ranking and with the normative rule providing for interpersonal comparisons. It also must by necessity be a function only of observable information, depending at most on the arguments of the direct and indirect utility functions (the lifetime stream of prices, wages, outside income, and quantities of goods consumed) and demographic information.

Since at least rought estimates can be made of individual preference orderings through observation of individual behavior, the critical task in constructing a welfare measure is in formulating the normative assumptions necessary to allow interpersonal comparisons of utility. Since observable information provides only ordinal information about utility, points of corresponding utility across individuals must be established at all utility levels. One possible normative rule is that all individuals facing the same opportunity set receive the same utility. Alternatively, an income measure implicitly assumes that all those with the same monetary receipts receive the same utility, and similarly for a consumption measure, with regard to consumption of commodities acquired through the marketplace. In effect these latter measures assert that those who choose relatively more leisure or nonmonetary compensation have tastes which produce fewer utils given the same opportunity sets.

However, there may well be inconsistencies between the ordering of circumstances implied by an individual's behavior and that assumed by normative rules such as these. For example, when the budget lines of two opportunity sets intersect, an individual may not order the sets in the same way as the mechanism used by the normative rule. Similarly, in circumstances providing an individual higher utility, he need not necessarily have higher monetary income or consumption of marketed goods.

Gordon (1977) provides an exploration of what assumptions are needed for

individuals to agree on an ordering of opportunity sets, enabling the first normative rule to be consistent with individual preference orderings. These assumptions prove to be quite restrictive. Under one of the subjectively least restrictive set of assumptions,[1] the measure $w^* \cdot H + y$ would satisfy both criteria, where w^* is the time path of the discounted present value of wage rates (standardized for the choice of nonmonetary compensation), H is the time path of hours worked (assumed to be the same for everyone unless constraints prevent it), and y is the discounted present value of lump-sum receipts. Were y negligibly small, then the measure $w^* \cdot H$ would satisfy both criteria, even if all individuals chose a time path of hours worked merely proportional to H. Time spent at work would in principle include time spent in productive nonmarket activity, with the wage rate interpreted to include the market value of the associated output, plus the value of the nonmonetary benefits of non-market employment. Similar restrictions, undoubtedly as severe, could be produced under which either the income or the consumption measure would be consistent with individual orderings.

In spite of these problems, I assume that each of the above proposed measures has sufficient normative appeal to be worth studying. Specifically, the measures compared will be: 1) annual income, 2) lifetime income, 3) life-time earnings, as an approximation to lifetime consumption,[2] and 4) an approximate measure of lifetime opportunities. Most of the results will refer to a population born in the same year though some results will be reported for a population of representative age distribution.

III.   Structure of the Empirical Model

The prime requirement in specifying the empirical model is that it be capable of simulating each of the proposed welfare measures for a representative

group of individuals over their lifetimes. To measure the quality of opportunity sets, information must be available about the time stream of wage rates, standardized where possible for nonmonetary characteristics of the job, and about any constraints on choice of hours of work due to unemployment or health problems. (No information was available concerning inheritances or gifts, so this dimension had to be excluded from the study.) To measure labor income, hours worked must also be available, and to measure income, income from savings must be known. Finally, in applying the results to tax and transfer programs, information about marital status and number of dependents is needed.

A forty-four equation model, capable of simulating all these variables was estimated using the first six years of data from the Michigan Panel Study of Income Dynamics. The overall sample population was restricted to white males from the cross-section part of the study who were at least twenty years old and who were the head of a household for all six years. This sample population of 1521 men probably possessed slightly more favorable characteristics than those of a representative white male sample, since those not found or successfully surveyed for six consecutive years, and those who were not heads of households, were excluded. The resulting model, estimated entirely with ordinary least squares, separately for each of three educational groups (those with less than twelve years of schooling, those with between twelve and fifteen years, and those with at least sixteen years), is described in detail in Gordon (1976), with the principle equations summarized in the appendix.

The most important characteristic of this model is the procedure used for capturing individual differences. In each of the earnings equations (those determining wage rates, hours worked, and nonlabor income), time invariant factors, such as family background, education, natural ability, etc., leading to persistent individual differences were captured by an individual constant

term -- these factors were assumed to result in a vertical translation of the expected lifetime pattern, without changing its shape. The effect of any time invariant factor that would have been entered linearly in the equation is completely captured in the coefficient of the individual constant; more complex effects of constant characteristics will only be approximated.

These individual constants were assumed to be nonstochastic, unlike in Lillard (1977) where they are a component of the residual. Making the constants nonstochastic has several advantages. First it allows for correlation between unobserved time invariant factors and explicitly modelled time varying factors, thus eliminating any bias in the coefficients of these time varying factors due to this correlation.[3] Second, it allows for arbitrary interrelationships between the individual constants of different equations. Lillard (1977) in addition assumed the constants to be distributed normally, an assumption not imposed here.[4]

Using individual constants (whether nonstochastic or part of the residual) imposes the assumptions however that persistent differences observed over the sample period exist over a lifetime, and that individuals do not otherwise differ in the structure of their earnings profiles, except as modelled explicitly. The same assumption is made when time invariant characteristics are added linearly to the specification as in countless other studies. The resulting projections of lifetime characteristics should provide an interesting first approximation, but attempts to generalize this specification would be of value.

Of the factors which might change over time, some were included in the equations explicitly. The variables included explicitly in the wage rate equation were age, in a piecewise-linear fashion, dummy variables indicating recent spells of unemployment or health problems, to measure the effect of such

events on productivity, perhaps through loss of specific human capital, and dummy variables for self-employment status,[5] and Southern or rural residence, to measure the compensating effect on the wage rate of these characteristics of the job. The wage rate was defined to include the value of free food and housing earned on the job, and was measured in real terms using a local price index. In the hours worked equation, in addition, an attempt was made to capture the effect of nonlabor income and of transient changes in the wage rate.[6] Here, the health and unemployment dummies would measure the reaction of individuals to unexpected losses in earnings, and the other dummies would measure average behavioral differences associated with different regions and employment status. In modelling nonlabor income, as a proportion of expected lifetime labor income, the only time-varying variable included was age -- such income seemed to be too poorly measured to permit explicit measurement of other effects. In all cases, the coefficients of these variables were assumed to differ among educational groups, and were normally allowed to be a piecewise linear function of age. Finally, those time-varying characteristics not captured explicitly were assumed to possess first order autocorrelation.

Since this model was simulated stochastically, the nature of the variance and autocorrelation of the residual was important. As a result, the variance of each of these residuals was allowed to depend on the age of the individual, and on his choice on whether or not to be self-employed. Also, the degree of autocorrelation was allowed to be age dependent. However, the assumption was imposed that the residuals were distributed normally, and were mutually independent except for the first order autocorrelation. Given the estimates of the variance and autocorrelation of the sample residuals, unbiased estimates of the underlying population variance and autocorrelation were derived. (See Gordon (1976, Appendix B) for details.)

Among the other variables modelled explicitly, basically health, unemployment, withdrawal from the labor force, and marital experience, systematic individual differences from the model predicted for the relevant peer group (that group having the same values of the included independent variables) were ignored. Except for the equation predicting labor force participation, these equations mostly include just information concerning the outcome of previous random draws, so as to capture the correlations among the outcomes. (In the equations relating to health, interaction with education was not allowed, as the data indicated no need for it.)

In modelling the discrete random events (being out of the labor force, experiencing health problems or unemployment, etc.), a linear probability model was used with sufficient interaction among the independent variables to minimize the chance of a forecast outside the interval [0,1]. The nature of the experience resulting from these random events was then estimated conditional on the outcome of the random event. The density functions for time lost from work due to unemployment or health problems were assumed to be exponential (Prob(time lost < T) = $(1/\beta) \int_0^T e^{-\beta t} dt$) , so the equations for time lost estimated the parameter β , the expected time lost, while in the simulations, the estimate of β was used to define the density function for the random draw. Estimates produced using this conditional specification of hours worked and time lost will differ from those produced using unconditional specifications which correct for the truncation problem (such as those by Heckman (1974) or Hausman and Wise (1975)), but the results, provided that they are interpreted correctly, are proper statistically if the conditional equations are otherwise specified correctly.

Finally, family size was assumed to be a Markov process. The transition probability matrices were compiled from the data, with separate matrices

permitted for different age, education, and marital status groups, as the data would allow.

IV. Definitions of Welfare Measures

Each of the desired welfare measures need to be defined explicitly, using information produced by the model. Labor income in any year was simply the product of hours worked and the wage rate, the wage rate defined to include the value of free food and housing earned on the job. Income was then defined to be labor income plus nonlabor income.[7] Both measures were defined in 1973 dollars, with or without corrections for local price differences.

Defining a measure of the quality of opportunity sets is less straight-forward. Information about inheritances was not available, so this aspect of the quality of opportunities had to be ignored.[8] The wage rate used in con-structing the measure was the real wage rate,[9] in 1973 dollars, corrected for local price differences, and normally corrected for the estimated compensating effects arising from the choice to be self-employed or to live in the South or in a rural area. Other compensating differences could not be measured so were ignored, with unknown consequence. If those with desirable jobs work longer hours, then this study will exaggerate the difference between the income and opportunity measures.[10]

The appropriate weighting of wage rates in different periods is unclear. Individuals would agree on the appropriate relative weights if they would work the same relative hours at different ages, yet the estimates from the hours equation show not insignificant individual variation. The arbitrary choice of equal weightings was used in the calculations.[11] The opportunity measure might be defended as just an improved income measure which takes into account purchases of leisure, and other nonmarketed commodities, in which context the

choice of equal weightings would be the natural one.

Several modifications were made in the assigned weights, however. When individuals were constrained to zero hours due to unemployment or health problems,[12] they were arbitrarily assigned a zero shadow wage during that period. (The acquired leisure is assumed to provide no compensating benefit, a seemingly reasonable assumption for these white male heads of households.) The results were almost totally insensitive to this assumption. Since normal debilitation due to old age did not seem to be captured in the responses to questions relating to health status, health problems were assumed to cause hours (and so the weights on the wage rate) to decline linearly from full potential to zero between the ages of sixty and seventy, again without compensating bene- fit. (Individual variation in rates of debilitation was not captured.) Time spent in education or training was taken into account only for those in college (the earliest age modelled was twenty). Here, 56% of the year was assumed to be spent in training (three-quarters of the nine month school year) with a zero shadow wage (other expenses were assumed to be for purchase of consumption benefits beyond the standardized amount, while investment benefits were captured in later wage rates), so 44% of the available wage rate characterized the opportunity set.

Each of these yearly measures was calculated between the ages of twenty and seventy, and the corresponding welfare measures were defined to be the sum of the present discounted values of the yearly measures, using a three per cent real discount rate. Implicitly then, the measures are designed to capture the normal level of welfare a person experiences in his adult years.

In contrast, quality of childhood welfare would relate to the

parents' decisions. It is assumed implicitly in most of the results that differences in childhood experiences per se are irrelevant in the desired welfare measure. Also, differences in age at death are ignored, the results describing welfare obtainable while alive, assuming age of death to be totally random and unexpected.

The redistributive effect of government activity (tax, transfer, and expenditure programs), while relevant, was ignored in each of these measures, for it would have been a major study in itself to calculate this effect. Pechman and Okner (1974) among others have attempted such a calculation in regard to annual income, finding little redistribution on net except at the two extremes. In this light, including the effect of only a few government activities (e.g. the income tax) was felt to be potentially quite misleading, for the ignored activities may well counter-balance any redistributive effects of those included. Further work would be needed to test this, however.

V.   Simulation Results

A.   General Results

The sample population for the model simulation was limited to the 825 white male heads of households in the survey who were between thirty and fifty-five in 1968. For other age groups the estimated individual constants were felt to be less accurate in describing normal economic position during the prime earning years. Relative to the population as a whole, this group is quite homogeneous in behavior, so if the welfare measures differ significantly on this population, they certainly will on a broader sample. In particular, since the income and opportunity measures differ substantially in their treatment of those out of the labor force (mostly housewives), these measures would differ much more if women had been included in the sample.

Each of these individuals was characterized by his education, his indivi-
dual constants in the three earnings equations, his number of dependents in
the last year of the sample (indicating desired family size), and his normal
choice on the self-employment, rural, and South dummies.[13] For most of the
results, systematic cohort effects were removed from the individual constants,[14]
so that each individual would effectively be a member of the cohort aged forty
in 1968. The distribution of these individual constants will be relatively too
disperse due to estimation error and any persistent measurement error in the
original data. Yet they will also be insufficiently disperse since attrition
in the sample population was undoubtedly concentrated among those with extreme
characteristics. All comparisons of measures take as given this description of
the population. Other initial conditions were determined stochastically from
the estimated equations. These together provide sufficient input to simulate
the model.

The model was simulated stochastically, using the unbiased estimates of
the variances and autocorrelations to define the distribution of the assumed
normal residuals, between the ages of twenty and seventy for each individual.
Each of the proposed welfare measures were calculted from the output of the
simulation.

The first means of summarizing the results will be to study how an
overall description of the degree of inequality varies with the choice of a
welfare measure. The decile breakdown in the distribution of each of the mea-
sures is found in Table 1. As a basis for comparison, the first row describes
the distribution of annual income in 1968 that arose when this population was
simulated without removing systematic cohort effects. The next two rows
describe the distribution of annual income when the cohort effects are removed,
as observed when the cohort is thirty, and when it is fifty. The first row

does not differ drastically from the other two since the advantage of belonging to a younger (and ultimately richer) cohort is closely matched by the disadvantage of being observed at an earlier point in the life cycle. Income at fifty is less disperse in large part since the variance of each of the earnings equations is smaller, and unemployment is less important.

The next row shows that the distribution of lifetime income is less disperse than that of any of the annual measures, but only slightly so. Transitory aspects of income do not explain much of the observed inequaltiy, if this model is reliable. However, inspection of the first column indicates that transitory income does seem to be important in descriptions of the degree of poverty. (Were the very young or very old population included in the annual figures, this result would have been much more dramatic.)

In the following rows, differences in individual choices were controlled for. In lifetime labor income, the effects of differences in savings behavior (as well as differences in inheritances and in rates of return on savings) are netted out. The resulting change in the overall distribution is minor except in the highest decile, where there are some individuals with substantial nonlabor income. Most income inequality is seen to result from differences in labor income alone.

Finally, the opportunity measures control in addition for differences in labor-leisure choices, and (in the last row) for some of the differences in choice of nonmonetary compensation on the job. Neither effect is large. Compared with lifetime income, the last row shows moderately less dispersion, particularly in the highest decile, but the bulk of the observed dispersion appears to arise from differences in opportunity sets and not from differences in actual choices. An only slightly less strong statement can be made when comparing annual income of one cohort with their lifetime opportunities, with the main exception being in regard to the degree of poverty.

These results say nothing however about how well one measure approximates another measure for an individual. As a simple summary analysis, correlations among these measures across this population are provided in Table 2. The first thing to notice from the table is that income at age 50 is a much better predictor of lifetime characteristics than income at age 30.[15] (Results for age 40 were very similar to those for age 50.) Income at age 50 has a .87 correlation with lifetime income, a figure very close to the correlation forecasted by Friedman (1957), though the correlation is only .79 with lifetime opportunities. Though seemingly large, this correlation implies that the forecast of lifetime opportunities, given income at age 50, has a standard error equal to 61% of the overall standard deviation of opportunities, and that even the forecast of lifetime income has a standard error of 49% of the standard deviation of lifetime income. This figure indicates the limited degree of success that a short term transfer program, based on annual income, will have in redistributing lifetime opportunities.

Ongoing programs, based each year on annual figures, might be better approximated by a program based on lifetime figures (exactly so if the benefits of the program are proportional to the annual figures). However even lifetime income has a correlation of only .83 with lifetime opportunities, only slightly higher than the figure for income at age 50. The correlation of lifetime labor income with lifetime opportunities is .89, however, suggesting that ignoring differences in savings behavior in welfare measure would allow a moderately better approximation of lifetime opportunities.

In the next two sections, two government programs will be investigated briefly to indicate what redistribution based on annual income implies about redistribution of lifetime opportunities. Individual behavior is assumed to be totally insensitive to the effects of these programs, a strong assumption but

probably a good one for white males.

B. Income Tax Results

In this section, the effect of the U.S. income tax on the distribution of the opportunity measure will be compared with that of several alternative taxes: 1) a lifetime income tax, still allowing exemptions for family size but ignoring marital status, 2) a lifetime income tax without exemptions, 3) a lifetime labor income tax, and 4) a lifetime opportunity tax. The first alternative might be approximately achieved by introduction of more liberal averaging provisions, recommended by Simons (1938), and by changing the tax treatment of the family. Under certain assumptions,[2] the third alternative would approximate a consumption tax, again with liberal averaging provisions, a tax being recommended now by Feldstein (1967) and Andrews (1974) as well as Kaldor (1955). The last alternative serves as a basis for comparison. An opportunity tax would not be feasible due at least to problems in measuring wage rates for tax purposes. This section provides a search for the alternative among those commonly proposed which best approximates an opportunity tax.

In making these comparisons, the distribution of lifetime tax payments, as they exist under the current law, as well as the total tax revenue will be held constant. As a result, under any proposed tax base, the individual with the n'th highest value of the tax base in the population was assigned the n'th highest value of lifetime tax payments. Perhaps comparing the optimal use of each tax in pursuing a stated objective would have been more interesting, but in searching for the optimal use of each, it would be critical to include other demographic groups, whose behavior would be more sensitive to changes in the tax base.

In calculating current tax obligations, the 1973 tax code was used.[16]

This code was applied to income in each year, expressed in real 1973 dollars, and discounted at a 2% rate to 1973, on the presumption that the dollar figures in the tax law would grow at the historical 2% long term real growth rate of the economy, so as to maintain a constant average tax rate.

A simple welfare measure, equal to the sum over individuals of the logarithm of their after tax opportunity welfare measure, divided by the number of individuals, is assumed so as to give some feel for the overall results. In calculating this, an individual's after tax opportunity measure equals the before tax measure times 2000 (on the presumption of fifty weeks of work at forty hours a week) minus the tax payments. The resulting comparisons have an appealing interpretation, as the change in the welfare measure when tax payments are subtracted off is approximately (for small tax payments) the average per cent change in the individuals' effective wage rate (divided by 100.), assuming normal hours of work.

The values for the welfare function before tax and under each of the proposed tax schemes is reported in Table 3. Were an opportunity tax imposed, the welfare function would fall by .1324 compared with the no tax situation (though this would be compensated for by the resulting government expenditures). With the current income tax instead, the welfare function would be .0149 further reduced. Use of a lifetime income tax, with or without exemptions, not only does not help, but even causes a further slight reduction. Under a lifetime labor income tax, however, the further reduction over an opportunity tax would be only .0084, a substantial relative improvement over the income tax.

In order to give a better sense of the order of magnitudes involved, Table 4 describes by decile (of the opportunity measure) the average per cent change in wage rates (computed directly) under the current income tax, a

lifetime labor income tax, and an opportunity tax. Here we find that when an income rather than an opportunity tax is used, the best off decile has on average, a 2.8% increase in its after tax relative to before tax wage rate, while the worst off group suffers on average a 4% decline, not insubstantial changes.

These figures hide a wide variation in the effects of the tax changes on individuals, reporting only average results. Were horizontal equity, defined as having individuals with the same after tax opportunity measure paying the same taxes, considered important, then this variation would also be disturbing. Table 5 is intended to provide evidence on the degree of horizontal inequity in the various taxes. The table reports points on the cumulative distribution function for the difference in the average tax rate on wage rates, assuming normal hours of work, under the proposed tax compared with under an opportunity tax. These results hide a long upper tail, yet still show wide variation in the effect of the shift to some form of an income tax. For example, it shows that under the current law, 80% of the individuals (.86 - .06) have a difference in average tax rates under the two taxes of no more than 8%. The corresponding figures for a lifetime income tax with or without exemptions are essentially the same. A labor income tax would imply a corresponding figure of 87%, as before a significant improvement over the income tax.

In conclusion, behavior is sufficiently heterogeneous even among white males that differences between the current income tax and an opportunity tax are not insubstantial. A tax based on lifetime income, with or without exemptions for family size, provides no better an approximation to an opportunity tax. However, a labor income tax (a consumption tax) does approximate an opportunity tax much more closely, though important differences remain.

Since the efficiency loss from a consumption tax seems to be less than from an income tax (see Feldstein, 1975), if interpersonal comparisons are based on an opportunity measure, then the shift to a consumption tax would be desirable on both efficiency and equity grounds.

C. Negative Income Tax Results

In Table 1 it was seen that the annual income distribution most differed from the lifetime distribution of either income or opportunities at the very poorest income levels. Also, though the income tax is nearly linear over small ranges, implying little difference between an annual and a lifetime tax, negative income tax proposals normally involve sharp nonlinearities in the tax schedule. For both reasons, an annual vs. a lifetime negative income tax should differ dramatically.

The appropriate welfare measure in evaluating a negative income tax is unclear, however, due to the clear focus on all members of the family. Though something like the opportunity measure might be used as a means of judging the effects on the head of the family, the welfare of other members of the family (particularly nonspouse) is also at issue. One simple but standard means of judging their welfare is to use income/needs, to measure the size of the flow of material consumption available to them. However, due to the possibility of saving, it is not annual income but the normal flow of income that matters. Here, it is assumed that lifetime income of the head divided by lifetime needs measures the welfare of other members of the family. Need in each year will be defined to equal the size of the transfer going to the family were it to receive no other income.

In the specific annual negative income tax studied, the lump sum grant included $1000 each for the head of the family and the spouse, and $500 for

each additional dependent, all in 1973 dollars. Any income would be taxed at a fifty per cent rate until that income level where total income under this rule equaled after tax income under the personal income tax. Taxable income above this breakeven level[17] would be subject to a fixed per cent surcharge in order to raise the funds to pay for the transfers. Students and those over sixty-five would not be eligible for transfers, but would still be subject to the surcharge. As with the income tax, it was assumed that the real dollar values in the law would grow at the economy's long run real 2% growth rate, with the above rates applicable to 1973. The program was introduced on its own, without replacing other programs, and individuals were assumed not to modify their behavior as a result of the program, again a reasonable assumption for white males.

The lifetime negative income tax was computed in a similar fashion. The potential lifetime transfer was just the sum of the present value of the annual transfers, as calculated above. This lifetime transfer and lifetime income were then converted into the equivalent annual flow growing exponentially at two per cent per year, and taxes were assessed in each year, using the above rules, based on these flows. In order to focus on the effect of this program only, however, it was assumed that the personal income tax payments remained unchanged, even though applying the negative income tax involved calculating a lifetime income tax.

The same sample of white males, now with individual constants standardized to the values for the cohort aged thirty in 1973, was simulated under these two programs. In applying these programs, the annual program required a 5.26% surcharge to break even on this population, whereas the lifetime program required only a 2.85% surcharge, indicating the size of transient poverty relative to permanent poverty in this population. The basic results are reported in Table 6. The first line reports the average lifetime after personal

tax income/needs ratio by decile, one of the presumed welfare measures. The
average transfer/needs and the average tax/needs for the members of each
decile under both the annual and the lifetime program are reported on the next
four lines. In comparing the annual with lifetime transfers, one sees that
transient poverty occurs for some members of all deciles, though most of the
annual poverty in the lowest decile is permanent. Whereas under the lifetime
program, 91% of the dollar expenditures went to members of the lowest decile,
only 43% did so under the annual program. However, once the tax is taken into
account, the average net gain under the annual program is still concentrated
almost entirely in at least the lowest two deciles -- most of the transient
poor, if not permanently poor, are at least not permanently very well off.

Were the objective function to involve the opportunity measure, as it
might in regard to effects on the head of the family, the results would be as
reported in the bottom half of the table. Under this objective, the transfers
are much less focused on the poorest individuals, with those in the lowest
decile receiving only 28% of the payments under the annual program, and only
56% under the lifetime program. The lifetime program remains much more
tightly focused on the poorest individuals, however, and either program pro-
vides most of the net benefits to those in the poorest two deciles.

There is no presumption here that the above two welfare measures accurately
portray the objectives of a poverty program. Concern for illiquidity due to
short term capital market constraints, and insurance for precipitous income
changes, surely play a role. It is also dubious whether changes in income/
needs is adequate in measuring the effect of a tax program on the immediate
utility and potential earnings of children in the family. Also, the issue of
horizontal equity has not been addressed. It still remains clear, however,
that under an annual negative income tax program, almost half the payments

involving white male heads of households are for transient and not permanent spells of poverty, though most of those experiencing transient poverty are not normally all that well off.

VI. Conclusions

Attempts in welfare economics to assess the degree of inequality and to study the effect on inequality of various tax and transfer programs are hampered by the fundamental difficulty of making interpersonal utility comparisons. Some rule for such comparisons must be adopted if anything is to be said. This paper explores the implications in empirical studies of the above questions of using the quality of an individual's lifetime opportunity set in making interpersonal comparisons.

The principle conclusions in reference to a representative population of white male heads of households were:

1) The greater part of the observed dispersion in annual income arises from dispersion in quality of lifetime opportunity sets, and not from transient income or from differences in tastes. The principle exception would be in assessments of the degree of poverty.

2) However, annual income would be an unreliable forecaster of either lifetime income or opportunities, implying difficulties with short term transfer programs.

3) The current income tax differs moderately from a tax on lifetime opportunities with the same distribution of tax payments. A lifetime income tax would provide no better approximation. A lifetime consumption tax, however, would approximate a lifetime opportunity tax much more closely.

4) A negative income tax program based on annual income and needs differs substantially from one based on lifetime income and needs, with almost half the

transfer payments in the annual program going to the transiently poor. Since

most of the transiently poor are not normally very well off, however, net

payments under the annual program remain concentrated among the poorest indi-

viduals.

These conclusions were arrived at using a model of lifetime individual

mobility estimated from the first six years of data from the Michigan Panel

Study of Income Dynamics. The results must therefore be tentative, relying

on the accuracy of the projections of lifetime patterns. In this model, the

projections relied on the use of nonstochastic individual constants in the

principle equations of the model. Attempts to weaken this assumption would

be of value in testing the sensitivity of the above conclusions to modelling

assumptions.

FOOTNOTES

1. The list of assumptions rationalizing this measure, described in detail in Gordon (1977), includes identical market prices of goods across individuals, identical choices on time paths of hours of work, identical prices in terms of change in wage rate for any given set of nonmonetary compensation, unrestricted borrowing and lending at a common market interest rate, and no uncertainty.

2. Lifetime labor income and lifetime consumption would be identical if inheritances received are zero (or included in labor income), bequests given are zero (or included in consumption), and earnings on savings are at a common nonstochastic interest rate.

3. At least in the equation determining the wage rate, this bias would have been substantial. See Hausman (1976) for specific results.

4. With nine sets of individual constants estimated (three earnings equations for three educational groups), in six cases, a normal population distribution could be rejected at the one per cent level, and at the five per cent level for one additional case, by a Komolgorov-Smirnov test.

5. The Michigan tape uses an arbitrary procedure for separating labor from nonlabor income for the self-employed. This affects estimates of labor income for this group. However, the opportunity set measure ought not to be systematically affected, since the wage rate is measured net of the effects of the self-employment dummy and neither should the income measure, since effects on the estimates of labor and nonlabor income will be offsetting.

6. The wage rate-hours interaction in the model is kept simple. No effect of hours worked on wage rates, present (through overtime pay) or future (through effects on experience), are allowed for. Effects of the normal level and time profile of wage rates on hours are assumed to be captured in the individual constants and in the age pattern of the hours equation. Transient changes in the wage rate (the residual from the estimated equation) are included in the hours equation in an attempt to capture the effect of deviations from the normal pattern. However, since the wage rate is calculated by dividing labor income by hours worked, the transient wage rate includes the effect of any measurement error in hours worked. The estimated coefficients seem to show mainly the effect of this measurement error, so inclusion of the wage rate serves essentially to capture correlations in the residuals of the two equations, so as to better forecast labor income.

7. Nonlabor income, as defined in the Panel Study, omits transfer payments, inheritances, and capital gains.

8. The limited empirical information (e.g. Blinder (1974, p.91)) on the size of bequests is that they are very small relative to (potential) labor income, so this lack of information should not be too important.

9. This wage rate was used whether or not the individual was in the labor force. The tendency for individuals to withdraw from the labor force when facing an abnormally low wage rate was not captured. For adult men, any bias should be minor, however.

10. However, if those with higher available wage rates always spend a given part of the gain purchasing more nonmonetary qualities in a job, then at least

the ordering of individuals according to quality of opportunities, without any correction for nonmonetary benefits, would be correct.

11. Using a "typical" time path of hours worked (the time path for the average high school graduate) as weights yielded almost identical results.

12. This correction to the wage rate was made whether or not the individual was in the labor force, that is, whether or not the constraint was binding.

13. Those who were normally self-employed, in a rural area, or in the South in the sample years, were assumed to maintain these characteristics in every year of the simulation.

14. In doing this, the individual constants from an equation were regressed on age in 1968, education, and some background variables. The effect of age differing from forty in 1968 was then subtracted off.

15. The correlation between incomes at ages 30 and 50 is determined mainly by the relative importance of the individual constants. This figure is larger than the similar correlation the Consultant Panel on Social Security (1976) calculated directly from Social Security longitudinal data (around .45). This evidence suggests that the assumption of individual constants, invariant over the individual's lifetime, is too strong a modelling assumption.

16. In calculating the tax, fifteen per cent of income was used as a deduction even for higher levels of income on the assumption that itemized deductions would be approximately fifteen per cent of income.

17. The fifteen per cent deduction, where not dominated by the low income allowance, was still allowed before tax assessment.

Table 1

Per Cent Distribution of Earnings, by Decile

	Decile									
	1	2	3	4	5	6	7	8	9	10
Income in 1968 (30-55 year olds)	1.64	4.34	5.62	6.69	7.73	9.02	10.49	12.51	15.88	26.10
Income in 1968 (30 year olds)	1.40	4.03	5.36	6.45	7.59	8.78	10.43	12.41	15.66	27.89
Income in 1968 (50 year olds)	2.05	4.64	5.94	7.01	8.13	9.39	10.74	12.54	15.02	24.55
Lifetime Income	3.36	5.11	6.22	7.27	8.11	9.03	10.25	12.07	14.69	23.89
Lifetime Labor Income	3.62	5.25	6.40	7.52	8.51	9.25	10.49	12.07	14.48	22.43
Lifetime Opportunities (actual wage rates)	3.61	5.34	6.65	7.68	8.58	9.56	10.53	11.76	14.08	22.14
Lifetime Opportunities (standardized wage rates)	3.87	5.55	6.84	7.77	8.63	9.55	10.47	11.70	14.06	21.57

Table 2

Correlations Among Earnings Measures

	Income at 50	Lifetime Income	Lifetime Labor Income	Opportunity Actual W	Measures Standarized W
1. Income at age 30	.66	.78	.71	.65	.64
2. Income at age 50		.87	.86	.79	.79
3. Lifetime Income			.92	.83	.83
4. Lifetime Labor Income				.90	.89
5. Opportunity measure (actual wage)					.98

Table 3

Welfare Function Values Under Various Tax Schemes

	Welfare Function
1. No taxation	12.6687
2. Opportunities tax	12.5363
3. Current income tax	12.5214
4. Lifetime income tax	12.5208
5. Lifetime income tax with exemptions	12.5193
6. Lifetime labor income tax	12.5279

Table 4

Average Tax Rate on Opportunities, by Decile
(in per cent)

					Decile					
	1	2	3	4	5	6	7	8	9	10
Current Income Tax	8.1	9.3	11.4	10.3	13.1	13.3	13.7	14.1	16.1	21.8
Lifetime Labor Income Tax	6.3	8.1	10.2	10.2	12.6	12.0	13.8	15.3	16.3	22.9
Lifetime Opportunities Tax	4.0	6.8	8.2	9.7	10.8	11.8	13.1	15.1	17.6	24.6

Table 5

Cumulative Distribution of Difference in Average Tax Rate
on Opportunity Measure Under Various Tax Schemes
Compared with an Opportunities Tax

					Decile				
	-8%	-6%	-4%	-2%	0%	2%	4%	6%	8%
1. Current Income Tax	.06	.11	.22	.38	.53	.68	.79	.83	.86
2. Lifetime Income Tax with exemptions	.07	.13	.24	.38	.53	.66	.77	.83	.86
3. Lifetime Income Tax	.06	.11	.23	.36	.54	.69	.77	.84	.87
4. Lifetime Labor Income Tax	.04	.10	.18	.33	.48	.66	.79	.86	.91

Table 6

Distributional Effect of Annual and Lifetime Negative
Income Tax on Lifetime Income/Lifetime Needs and
on Lifetime Opportunities, by Decile

	Decile									
	1	2	3	4	5	6	7	8	9	10
Lifetime Income/Needs	1.41	2.16	2.63	2.98	3.32	3.70	4.17	4.77	5.76	9.03
Annual NIT										
Transfer/Needs	.42	.18	.10	.08	.07	.06	.05	.03	.02	.02
Tax/Needs	.01	.02	.03	.05	.07	.09	.11	.14	.20	.40
Lifetime NIT										
Transfer/Needs	.36	.04	.00	.00	.00	.00	.00	.00	.00	.00
Tax/Needs	.00	.00	.00	.01	.02	.03	.04	.06	.09	.20
Lifetime Opportunity Measure	4296	6038	7194	8111	8935	9836	10752	12001	14387	20176
Annual NIT										
Transfer	798	482	277	258	243	190	145	187	198	121
Tax	87	144	200	203	218	238	284	324	435	763
Lifetime NIT										
Transfer	656	274	77	68	43	19	1	4	39	0
Tax	27	46	71	70	74	86	110	130	193	372

References

Andrews, W. O., 1974, A Consumption-Type or Cash Flow Personal Income Tax, Harvard Law Review 87, 1113-1188.

Blinder, A., 1974, Toward an Economic Theory of Income Distribution (M.I.T. Press, Cambridge).

Feldstein, M.S., 1976, Taxing Consumption, The New Republic, February 28, 14-17.

Feldstein, M.S., 1975, The Welfare Cost of Capital Income Taxation, Harvard Institute of Economic Research Discussion Paper #444.

Friedman, M., 1957, A Theory of the Consumption Function (Princeton University Press, Princeton).

Gordon, R., 1976, Essays on the Causes and Equitable Treatment of Differences in Earnings and Ability, M.I.T. Ph.D. thesis, unpublished.

Gordon, R., 1977, A Search for Consistent Welfare Measures, mimeo.

Hausman, J., 1976, Specification Tests in Econometrics, M.I.T. Department of Economics Working Paper #185.

Hausman, J. and D. Wise, 1975, The Evaluation of Results from Truncated Samples: The New Jersey Income Maintenance Experiment, mimeo.

Heckman, J., 1974, Shadow Prices, Market Wages, and Labor Supply, Econometrica 42, 679-694.

Kaldor, N., 1955, An Expenditure Tax (Allen & Unwin, London).

Lillard, L. 1977, Inequality, Earning vs. Human Wealth, American Economic Review 67, 42-53.

A Panel Study of Income Dynamics, 1973, Survey Research Center, University of Michigan, Ann Arbor, Michigan.

Pechman, J. and B. Okner, 1974, Who Bears the Tax Burden? (The Brookings Institution, Washington, D.C.).

Report of the Consultant Panel on Social Security to the Congressional Research Service, 1976.

Simons, H., 1938, Personal Income Taxation (University of Chicago Press, Chicago).

Appendix

Description of Earnings Equations

This appendix provides a brief description of the principle equations of the empirical model, those relating to wage rates, hours worked, and nonlabor income. Further details and a description of the other equations are found in Gordon (1976).

The population from which the samples for these equations were drawn consisted of the 1521 white males in the cross-section part of the six year tape from the Michigan Panel Study of Income Dynamics who were the head of a household for all six years and were over age twenty. The equations reported below were estimated by ordinary least squares, separately for three educational groups: 1) less than twelve years of schooling, 2) twelve to fifteen years of schooling, and 3) college graduates. The results for the three groups will be reported together, with the respective coefficients stacked vertically.

Many of the coefficients were made a piecewise linear function of age, so a group of coefficients rather than one coefficient, is reported for a variable. Each would have the same interpretation as a single coefficient, except that it would refer specifically to those of a given age. For the age variable, the coefficients represent the increment from age twenty to the dependent variable by ages 35, 45, 55, 65, and 75, except in the hours equation, where age 25 is also included. (In the variance equations, the level at each age including age 20, rather than the increment from age twenty, is reported.) For the other variables the reported coefficients represent the size of the coefficient at ages 20, 45, 65, and 85, though the last is occasionally omitted. The coefficient for any other age would be calculated through a linear interpolation between the two adjacent reported coefficients. In the autocorrelation equations, the coefficients are reported for ages 20, 35, 45, 55, 65, and 75, with the hours equation including also age 25.

Definitions of the symbols used are reported in Table A-1. Presence of individual constants in an equation is denoted by "i.c." Notes on the equations are found below. Subscripts i and t represent the individual and the year, respectively.

I. Basic Equations

Wage Rate

Sample restrictions: $H_{it} > 0$

$$
\log(w) = \text{i.c.} +
\begin{bmatrix}
.755 & 1.02 & 1.39 & 1.55 & 1.47 \\
.820 & 1.17 & 1.39 & 1.57 & 1.18 \\
.674 & 1.02 & 1.36 & 1.26 & .471
\end{bmatrix} A +
\begin{bmatrix}
-.043 \\
-.011 \\
-.158
\end{bmatrix} U_{-1}
$$

$$
+
\begin{bmatrix}
-.032 \\
-.010 \\
-.107
\end{bmatrix} H1_{-1} +
\begin{bmatrix}
-.124 \\
-.212 \\
.043
\end{bmatrix} SE +
\begin{bmatrix}
-.025 \\
-.157 \\
.135
\end{bmatrix} S +
\begin{bmatrix}
-.030 \\
-.005 \\
.065
\end{bmatrix} R
$$

$$
\text{Standard Error} =
\begin{bmatrix}
.322 \\
.272 \\
.288
\end{bmatrix}
\qquad
\text{\# of Observations} =
\begin{bmatrix}
2808 \\
3991 \\
1363
\end{bmatrix}
$$

$$
R^2 =
\begin{bmatrix}
.717 \\
.768 \\
.767
\end{bmatrix}
$$

Hours worked

Sample restriction: $H_{it} > 0$ and $WL < 40$

$$\frac{H}{1000} \cdot \frac{52}{(52-WL)} = \text{i.c.} + \begin{pmatrix} .280 & .259 & .067 & \neg.303 & -1.61 & -2.63 \\ .875 & .715 & .655 & .311 & -.345 & -2.17 \\ 1.50 & 1.93 & 1.62 & 1.41 & 1.46 & -.204 \end{pmatrix} A$$

$$+ \begin{pmatrix} \neg.066 & .101 & .352 & .347 \\ .220 & -.107 & .506 & 4.67 \\ .183 & .208 & .358 & .150 \end{pmatrix} U + \begin{pmatrix} -.097 & -.038 & -.213 & .306 \\ -.224 & .134 & -.335 & .185 \\ -.924 & .200 & -.354 & -.722 \end{pmatrix} H1$$

$$+ \begin{pmatrix} 3.58 & -2.30 & -.222 & .051 \\ -.152 & -2.14 & -.139 & .244 \\ \neg1.51 & -.286 & -2.37 & 3.55 \end{pmatrix} OLF_{-1} + \begin{pmatrix} .136 & .284 & .848 & -.077 \\ -.041 & .367 & .646 & .153 \\ .255 & -.262 & -.042 & 2.54 \end{pmatrix} SE$$

$$+ \begin{pmatrix} .024 & -.216 & -.129 & -.535 \\ -.393 & -.055 & -.179 & 1.03 \\ -.072 & .147 & -.065 & 2.12 \end{pmatrix} R + \begin{pmatrix} .0 & .0 & -.160 & -.061 \\ .0 & .0 & -.155 & .024 \\ .0 & .0 & -.052 & -2.05 \end{pmatrix} Y/\hat{W}65$$

$$+ \begin{pmatrix} -.874 & -.768 & -.510 & -.055 \\ -.692 & -.861 & -.161 & -.345 \\ -.503 & -.654 & -.429 & .164 \end{pmatrix} \varepsilon_w$$

$$\text{Standard Error} = \begin{pmatrix} .423 \\ .413 \\ .375 \end{pmatrix} \qquad \text{\# of Observations} = \begin{pmatrix} 2792 \\ 3988 \\ 1361 \end{pmatrix}$$

Nonlabor income

$$R^2 = \begin{pmatrix} .799 \\ .732 \\ .758 \end{pmatrix}$$

$$\frac{Y}{\hat{W} \cdot \hat{H}} = \begin{pmatrix} .062 & .158 & .617 & .915 & .977 \\ .158 & .297 & .439 & .729 & .888 \\ .184 & .322 & .811 & 1.30 & 1.01 \end{pmatrix} A + i.c.$$

$$\text{Standard Error} = \begin{pmatrix} .564 \\ .425 \\ .490 \end{pmatrix} \qquad \text{\# of Observations} = \begin{pmatrix} 3444 \\ 4241 \\ 1428 \end{pmatrix}$$

$$R^2 = \begin{pmatrix} .769 \\ .689 \\ .765 \end{pmatrix}$$

II. Variance of Residuals

Sample restrictions: residual available in all six years

Wage rate

$$\varepsilon_W^2 = \begin{pmatrix} .071 & .032 & .044 & .010 & .130 & .159 \\ .098 & .029 & .017 & .044 & .087 & .116 \\ .116 & .056 & .026 & .014 & .072 & .082 \end{pmatrix} A + \begin{pmatrix} .204 & .101 & .071 \\ .054 & .101 & .031 \\ -.010 & .160 & .062 \end{pmatrix} SE$$

$$\text{\# of Observations} = \begin{pmatrix} 2460 \\ 3774 \\ 1320 \end{pmatrix}$$

Hours worked

$$\varepsilon_H^2 = \begin{pmatrix} .096 & .116 & .086 & .074 & .089 & .236 & .116 \\ .427 & .151 & .099 & .061 & .085 & .174 & .223 \\ .369 & .209 & .062 & .065 & .022 & .296 & .143 \end{pmatrix} A + \begin{pmatrix} .176 & .134 & .067 & .170 \\ .141 & .115 & .104 & -1.38 \\ -.076 & .107 & -.171 & .277 \end{pmatrix} SE$$

$$
\text{\# of Observations} = \begin{pmatrix} 2412 \\ 3756 \\ 1308 \end{pmatrix}
$$

Nonlabor income

$$
\epsilon_Y^2 = \begin{pmatrix} .243 & -.143 & .321 & -.182 & .222 & .243 \\ .011 & .056 & .027 & .166 & -.011 & .693 \\ .212 & .027 & .104 & -.091 & .598 & .635 \end{pmatrix} A + \begin{pmatrix} -1.29 & 2.62 & .192 & 1.01 \\ .014 & .649 & .714 & -.657 \\ -.833 & .787 & 1.15 & -1.12 \end{pmatrix} SE
$$

$$
\text{\# of Observations} = \begin{pmatrix} 3438 \\ 4206 \\ 1428 \end{pmatrix}
$$

Note: In each of the variance equations, corrections were made in those observations where acknowledged reporting errors existed in the original data.

III. Autocorrelation of residuals

Sample restrictions: Residuals available in all six years, with first

year excluded

Wage rate

$$
\epsilon_W/\hat{\sigma}_W = \begin{pmatrix} .891 & .091 & .243 & .143 & .344 & -.035 \\ .276 & .304 & .328 & .316 & .116 & .026 \\ -.005 & 1.00 & .577 & -.041 & -.139 & -.114 \end{pmatrix} (\epsilon_W / \hat{\sigma}_W)_{-1}
$$

$$\text{\# of Observations} = \begin{pmatrix} 2050 \\ 3145 \\ 1100 \end{pmatrix}$$

Hours worked

$$\varepsilon_H / \hat{\sigma}_H = \begin{pmatrix} .056 & .336 & .193 & .266 & .363 & .455 & .233 \\ .699 & .593 & .149 & .461 & .410 & .791 & 1.00 \\ .308 & .727 & .379 & .255 & .240 & .519 & .199 \end{pmatrix} (\varepsilon_H / \hat{\sigma}_H)_{-1}$$

$$\text{\# of Observations} = \begin{pmatrix} 2010 \\ 3130 \\ 1090 \end{pmatrix}$$

Nonlabor income

$$\varepsilon_Y / \hat{\sigma}_Y = \begin{pmatrix} .835 & .529 & .882 & .101 & .230 & .548 \\ .615 & .023 & .785 & -.268 & .563 & .096 \\ 1.00 & .392 & .306 & .992 & .018 & .054 \end{pmatrix} (\varepsilon_Y / \hat{\sigma}_Y)_{-1}$$

$$\text{\# of Observations} = \begin{pmatrix} 2865 \\ 3505 \\ 1190 \end{pmatrix}$$

Note: The estimated autocorrelations were severely biased due to the short time interval of estimation. The reported set of coefficients are those true values of ρ which would in expectation produce the observed estimates of ρ.

The procedure used in doing this assumed that only individual constants were included in the original equations, and that autocorrelation estimates were made separately by age interval, and not with a piecewise linear technique. Reported values of 1.00 indicate estimates above the feasible range. Similar corrections were applied to the variable estimates. (A minimum variance of .01 and a maximum autocorrelation of .8 were assumed in the simulations.)

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Table A-1

Definitions of Symbols

Symbol	Definition
A	Age
H	Hours worked per year
$\hat{H}$	Forecast of a weighted average of hours worked using the individual constant and the age variable
H1	Dummy indicating health problems
OLF	Dummy indicating absence from labor force
R	Dummy indicating rural residence
S	Dummy indicating Southern residence
SE	Dummy indicating self-employment
U	Dummy indicating an unemployment spell
W	Real hourly wage rate
$\hat{W}$	Individual constant from wage rate equation
$\hat{W}_{65}$	Forecasted wage rate at age 65, using the individual constant and the age variable
WL	Number of weeks out of work due to unemployment or health problems
Y	Real nonlabor income
ε_i	Estimated residual for ith equation
$\hat{\sigma}_i$	Forecast of standard error in the ith equation, using the appropriate variance equation.