INCOME TAXES IN A LONG-TERM MACROECONOMETRIC FORECASTING MODEL.

by

Stephen H. Pollock

Dissertation submitted to the Faculty of the Graduate School
of the University of Maryland in partial fulfillment
of the requirements for the degree of
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ABSTRACT

Title of Dissertation: Income Taxes in a Long-Term Macroeconometric
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Stephen H. Pollock, Doctor of Philosophy, 1986

Dissertation directed by: Clopper Almon, Jr.
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This dissertation describes the building of an econometric model of the income distribution and income tax system and its incorporation into a large interindustry forecasting model of the U.S. economy. The model is used to help answer relevant questions about the size distribution of income, the tax burden by income size, and economic effects of different types of tax reform. The interindustry model was developed by the Interindustry Forecasting Project at the University of Maryland (Inforum).

The dissertation has four main parts. First, a detailed model of the U.S. income distribution is constructed. The model explains and forecasts cyclical and secular trends in the size distribution of adjusted gross income. An original way of describing and modeling the income distribution is introduced which not only accurately portrays and forecasts the empirical distribution but also uses linear parameters which are easily estimated and have clear economic interpretations.

Second, a forecasting model of federal income tax collection is constructed which uses the results of the income distribution model. The tax model has sufficient detail to predict and simulate changes in the tax burden of various income groups under differing scenarios of tax reform. It explicitly takes into account the major parameters of the tax system which include the rate schedule as it appears in the form

1040, the personal exemption amount, the zero-bracket or standard deduction amount, and the benefits available to certain taxpayers through itemizing deductions and taking tax credits.

Third, a bridge is constructed which converts the distribution of adjusted gross income to a distribution of personal income as defined by the National Income Accounts. This bridge distributes transfer payments and other types of income not part of adjusted gross income to the various groups of people defined by size of income.

Finally, the model is used to simulate the economic effects of, among other scenarios, the tax reform package passed by Congress in September of 1986. The simulation includes a detailed analysis of the proposal's effects on equipment investment incentives, which makes use of features and properties previously existing in the interindustry forecasting model.

This work is distinguished from other modeling exercises in its emphasis on detailed tax policy simulation capabilities and long-term forecasting properties in the context of a macroeconometric forecasting model.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF FIGURES

CHAPTER 1

INTRODUCTION.

The U.S. income tax system is one of the most influential and complex institutions in the economy. Yet most macroeconometric forecasting models give it only summary treatment. If econometric models are to imitate the structural characteristics of the economy, then the most detail and attention should be given those areas which are most important to the economy. This explains why modelers of an economy such as ours give most of their attention to the behavior of the private sector. However, they must not forget that ours is a mixed economy, and that the federal government exerts an influence nearly as large as that of the private sector.

Income tax policy in econometric models is necessarily treated as exogenous. But exogeneity must not be confused with irrelevance or invariance. In most models, the income tax section focuses only on the question of "how much?". The typical model's tax section consists merely of a scalar representing the average tax rate applied to a measure of taxable income. This approach scarcely reflects the complexity of the tax code. The questions of "how?" and "from whom?" are ignored. In addition, few models are equipped to answer the "what if?" questions of tax reform.

There have actually been two main approaches to building a forecasting or simulation model of the tax system. The first is the scalar method adopted in most macroeconometric forecasting models, briefly outlined above. Its main drawback is its inability to simulate specific changes in the tax law. The other approach is the microsimulation method. This approach works with a data base that consists of a large number of individual income tax returns for a single year. Each observation has data from every line on the tax return, and thus can be used to analyze every provision of the tax code. This cross-section analysis can be used to estimate and simulate behavioral responses to detailed changes in the law. The Joint Committee on Taxation uses such a model for its analyses of tax reform proposals. Another recent example of the applications of this approach can be found in Lindsey (1985).[1] The drawback of this approach is that it is static in the sense that there is no built-in response of macroeconomic variables to changes in the tax code. These variables, most notably aggregate income, have important feedback effects on the outcome of the tax system.

There does exist a model which helps fill the gap between the two approaches in the microsimulation context. The Transactions Model of Bennett and Bergmann[2] simulates the behavior of individual actors in the economy and sums and scales them to obtain macro aggregates. Their model, without the tax detail of the microsimulation models described above, does have the capability for many tax policy simulations in which macroeconomic feedback effects are important. It is a unique model in that it is recursive with a weekly simulation period. It is entirely different in character than any macroeconometric model.

This dissertation seeks to fill the gap in income tax modeling between the main micro and macro approaches while staying within the more traditional context of a macroeconometric model. This tax model has a much more detailed simulation capability without having to go to a huge data base of individual income tax returns. Both the income distribution and the tax system are modeled and incorporated into a large interindustry model of the U.S. economy where feedback effects from macroeconomic variables are possible. The model is used to help answer relevant questions about the the size distribution of income, the tax burden by income size, and economic effects of different types of tax reform. The interindustry model was developed by the Interindustry Forecasting Project at the University of Maryland (Inforum).

The model developed here does address the questions of how, and from whom are taxes collected, is able to address many "what if?" questions in addition to answering the all important question of "how much?". An outline of the model will follow, but first, the next few paragraphs will give very brief sketches of the tax sections of some well-known macroeconometric forecasting models. Without going deeply into the advantages and disadvantages of each method's ability to forecast, it should be clear that they leave much to be desired in terms of their abilities to simulate legislated changes in the tax code.

The DRI model calculates an average effective tax rate for federal personal taxes and nontaxes which is the ratio of revenues to the estimated tax base. That tax rate is forecast with a regression equation estimated with quarterly data using as explanatory variables the ratio of the tax base to employee hours worked, which is presumably a measure of inflation, and a list of dummy variables reflecting past changes in the tax code. Simulations are done by changing that single tax rate which is then multiplied by the estimate of the tax base[3].

The Chase Econometrics quarterly model adopts an approach only slightly different, explained in the following quote: "The effect of overall changes in tax rates cannot be directly quantified without including the whole range of tax tables. A reasonable proxy variable can be constructed by dividing total tax receipts generated at marginal tax rates by total income subject to tax at marginal rates. This procedure generates an average marginal tax rate." The Chase model then uses this constructed rate times personal income minus transfers as an explanatory variable in an equation which forecasts federal personal tax receipts. Other variables in the equation are dummy variable reflecting past code changes and witholding policy changes and separate terms for wage income and other income. Again, simulations are performed by changing the calculated average marginal rate.[4]

The Federal Reserve Board model uses the same basic approach, but at least allows for changes in the personal exemption amount. It forecasts the tax base with a regression equation as a function of personal income per capita and the personal exemption amount. Then, tax revenue is calculated in the usual way by multiplying that tax base by a calculated single overall effective tax rate.[5] The Washington University model says only: "Various categories of tax liablilities generally are calculated as the product of taxable income and an appropriately defined average tax rate."[6]

The Fairmodel handles federal income taxes in about the same way except that the average tax rate is calculated as a constant term plus a "progressivity parameter." The values of those two components of the average tax rate were determined by an equation which regressed aggregate income tax revenue per person on a set of dummy variables reflecting subperiods with a constant tax code times per capita taxable income, an intercept, and the per capita taxable income squared. The coefficient on the last term is the progressivity parameter, and the sum of the intercept and dummy terms is defined to be the constant term.

Alternate policy simulations are achieved by changing the constant term component of the average tax rate. This approach allows an estimate of progressivity to affect the income elasticity of revenue, but like the others, offers limited capability for simulation of changes in the tax code.[7]

The models listed above are all shorter-term quarterly models. As stated before, a tax model which accurately reflects the way in which taxes are actually collected is even more important for a long-term simulation model. Perhaps this is why the only model surveyed which has much detail in its tax section is the Wharton long-term annual model. The Wharton model distributes "taxable income" over 342 brackets ranging from $100 to over $500,000. Taxable income is derived from personal income after adjustments are made for Social Security contributions, transfer payments to persons, the number and value of exemptions, and deductions. The distribution is done according to a gamma probability function with taxable income and number of returns as inputs. Tax rates are computed using only the 1980 IRS schedule "Y" for married taxpayers. The Wharton long-term model is capable of simulating across-the-board tax changes and tax bracket indexation for inflation. Those are the only two capabilities mentioned in the description.[8]

The Structure of the Model.

The goal of the model described in this dissertation can be explained in terms of its desired inputs and outputs. There was a need to construct a model that uses as its exogenous inputs the major provisions of the tax code: the complete tax rate schedules, the standard deductions, the personal exemption amount, the earned income credit and a way to account for less universal provisions like itemized deductions, and tax credits. The desired output of this model is a forecast of federal tax revenue, a distribution of disposable personal income, and a relatively detailed simulation capability. In order to meet these needs, a method for modeling the income distribution had to be developed.

The method developed in this dissertation for the income distribution model has been applied here to a unique and specialized way of describing that distribution. The method itself is fairly general. It can be applied to the distribution of anything for which a quantified Lorenz curve can be constructed. A Lorenz curve of income distribution plots the cumulative percentage of the population against the cumulative percentage of income which they receive. The method used here will work either for individual or grouped data, and is applied here to the grouped data on the distribution of adjusted gross income (AGI) as it is appears in the <u>Statistics of Income,</u> (SOI) published annually by the Internal Revenue Service.

The objective of the income distribution model is to convert the model's forecasts of aggregate personal income into a detailed distribution of AGI. The detail is necessary so that the tax rate schedule can be appropriately applied. In other words, the number of households which fall into each marginal tax bracket and their average incomes must be forecast. The model of income distribution is entirely empirical.

The first step in modeling the tax system is to obtain a forecast of the size distribution of income. Certain economic variables have been found to affect the income distribution and the model explains and forecasts cyclical and secular trends in the distribution. The method, which is described in more detail in Chapter 2, and with more precision in the mathematical appendix, was developed by first transforming the axes of the Lorenz curve[9]. That simple transformation makes possible the modeling of the income distribution with an elegant and smooth functional form. The advantages of this are that the function fits the data better than the usual statistical functions, and that the income distribution is allowed to vary cyclically and secularly, but is stable enough over time so that long-term simulations give plausible and well-defined results.

The shape of each Lorenz curve is described by two parameters. Roughly, the first of these parameters represents the amount which each curve protrudes or "bows" out from the diagonal line of equally distributed income relative to the base year's (1981) curve. The second parameter represents the amount which each curve "leans" or is skewed toward either the upper or lower end of the distribution, relative again to the base year's curve. The two parameters are estimated from the cross-section grouped data for each Lorenz curve. Lorenz curves are estimated for each year and each size household. The estimated Lorenz curve parameters are arranged in time-series, and are regressed on cyclical economic variables and a time trend. These equations are then used in conjunction with forecasts of the cyclical variables which come out of the macro model in order to forecast the shape of the Lorenz curves. The resulting Lorenz curves are then applied to the aggregate amount of AGI which is forecast as a function of personal income and the items such as transfer payments which make up the difference between personal and adjusted gross income, in order to forecast the number of people in each income tax bracket, and their average incomes.

The information on the distribution of AGI is then used to forecast income tax revenue. The average income from each income group obtained from the Lorenz curves is applied to the tax rate schedules exactly as they appear in the form 1040. There are a total of 120 groups for which these calculation are done, twenty groups defined by size of income for each of six household sizes. The incomes of single-person households are applied to the single tax rate schedule, while the incomes of all other household sizes are applied to the rate schedule for married taxpayers. The appropriate amount for each personal exemption is subtracted first, and the earned income credit is applied where appropriate. The application of these major parameters of the tax system results in a construct refered to as "standard tax rates," which are an estimate of the tax rate paid by the average members of each group assuming they take the standard deduction but do not take any other tax credits or tax preference items.

The standard tax rates are also calculated for each of the 120 groups for the years 1966 through 1982. It was possible to obtain, with some interpolations of the SOI data, estimates of the actual tax rates paid by comparable groups in the history. A relationship between standard tax rates and actual or effective tax rates by income group was then established by regression analysis over the historical period. The difference between standard and effective taxes represents the amount saved by each group from itemized deductions, tax credits and other tax-reducing provisions in the tax law. It is these regression equations which model this type of legal tax avoidance.

This analysis shows that the gap between standard and effective tax rates grows not only according to the relative position of each income group in the overall distribution, but the gap also has grown over time for some groups. The projected relation of standard and effective tax rates in combination with the forecast of the income distribution allows a forecast of the tax revenue from each income group and in the aggregate. By making assumptions based on cross-section analysis of recent income tax returns about the relationship between standard and effective taxes under different tax reform proposals, it is possible to simulate the aggregate and distributional effects of tax reform with this model. Thus, by modeling the tax system in the way taxes are actually collected, the model can forecast not only how much revenue the income tax generates, but from what income groups it comes, and what changes would occur under different tax laws.

The tax system can have an overwhelming effect on the size distribution of disposable income. This is important not only in itself, but also because the mix of consumption goods depend on it. A detailed model of the tax system is necessary in order to give the consumption section an accurate estimate of the size distribution of disposable income.

Actually, the distribution of two types of income are necessary. The size and distribution of the tax burden depends on the size and distribution of AGI. It is the distribution of personal income, however, which helps determine the goods mix of consumption. There are many items which affect this latter distribution besides taxes and AGI, most importantly transfer payments. The model includes a section which distributes the items which represent the difference between AGI and personal income among the appropriate income groups.

The income distribution and tax models are further modified to accommodate a unique and special way of describing the income distribution. A good deal of computational effort has gone in to making the more general method apply to the specific requirements of the Inforum model. Consumption in the Inforum model depends on per capita income. Family size and other demographic variables are considered separately.[10] Also, the consumption part of the model requires a distribution of personal disposable income which groups the population into "ventiles." Each ventile contains 5% or one twentieth of the population. The ventiles contain people with similar per capita incomes arranged in ascending order. The income distribution is defined by indexes which represent the income of the highest person in each ventile relative to the overall mean per capita income. For example, an index value of 50 for the fifth ventile means that the person right at the cutoff between the fifth and sixth ventile, that is the person exactly at the 25th percentile of the income distribution, has an income of one-half the average per capita income.

A fair portion of the following chapters concerns making the output of income distribution and tax models conform to the form and definitions just described. For example, an algorithm had to be developed which combines the separate distributions from the six different household sizes into the ventiles just described, which contain people from all household sizes. These and similar procedures show that the method is flexible in conforming to different modeling regimes.

In long-term forecasting exercises such as the ones described here, the structure of the tax code becomes very important. The drawbacks of say, a simple scalar applied to taxable income are very apparent. The tax code is structured, so that when income increases, tax increase more than proportionally. This is because marginal rates are higher than average rates, and because the marginal rate structure is progressive. This effect is not captured by a scalar model, or even by a model which uses average tax rates by income group. Such models will tend to underestimate the revenue elasticity of income. This can become a serious problem in long-term forecasting because the changes in income over the long-term can be quite substantial. This is a significant factor even in a tax system which is indexed to inflation, because real income growth is taxed progressively at the margin also. The model described here taxes income at the margin, and fully accounts for bracket creep. It can also adjust for indexation to inflation of the brackets and personal exemption amounts. These are important properties for a long-term forecasting model.

What follows is an explanation, illustration, and demonstration of some of the model's capabilities. The output of the model under a base case forecasting scenario will be shown, along with brief explantions of how different tax law scenarios are simulated and the results of two such alternate scenario simulations.

Capabilities of the Model Illustrated: The Base Forecast.

The income distribution model, as shown before, distributes AGI among twenty equally populated groups. But an important consideration for a tax model is household size, because of the personal exemption amount. Unlike most models, which employ a measure of overall average household size of somewhere between three and four, this model explicitly calculates the number of families of each of six sizes for each of the twenty income groups. Standard taxes are calculated for 120 groups. Table 1.1 shows the household size breakdown afforded by the model. Eventually, the household sizes are aggregated so that there are just twenty groups. The distribution of AGI for the base forecast is shown in figure 1.1 and table 1.2. The base forecast assumes the tax code that was in place just prior to August, 1986.

Figure 1.2 and table 1.3 illustrate the tax rates both standard and effective for each income group. Note that effective rates are never higher than standard rates. That is because the difference represents the amount of legal tax avoidance afforded by the tax code in the form of deductions other than the standard deduction, tax credits, and other preferential tax items. Items in the tax code which are additional taxes and would tend to raise effective tax rates above standard tax rates, such as the minimum tax, are accounted for, but are not sufficient to offset the preferential items. Note that the top group under the base tax law is able to reduce its average tax rate by about 30% relative to the standard tax rate. The effective tax rates in table 1.3 are multiplied by the tax base in table 1.2 to get the federal income tax revenue by income group.

Table 1.4 shows the highest per capita AGI in each ventile. These incomes are arrived at by interpolations described in the mathematical appendix and in Chapter 2. It is actually the distribution of personal income, not AGI which determines consumption in the model. The distribution of personal income also determines the incidence of other taxes besides income taxes at both the federal and state and local levels. The transformation of the distribution of AGI to personal

FIGURE 1.1

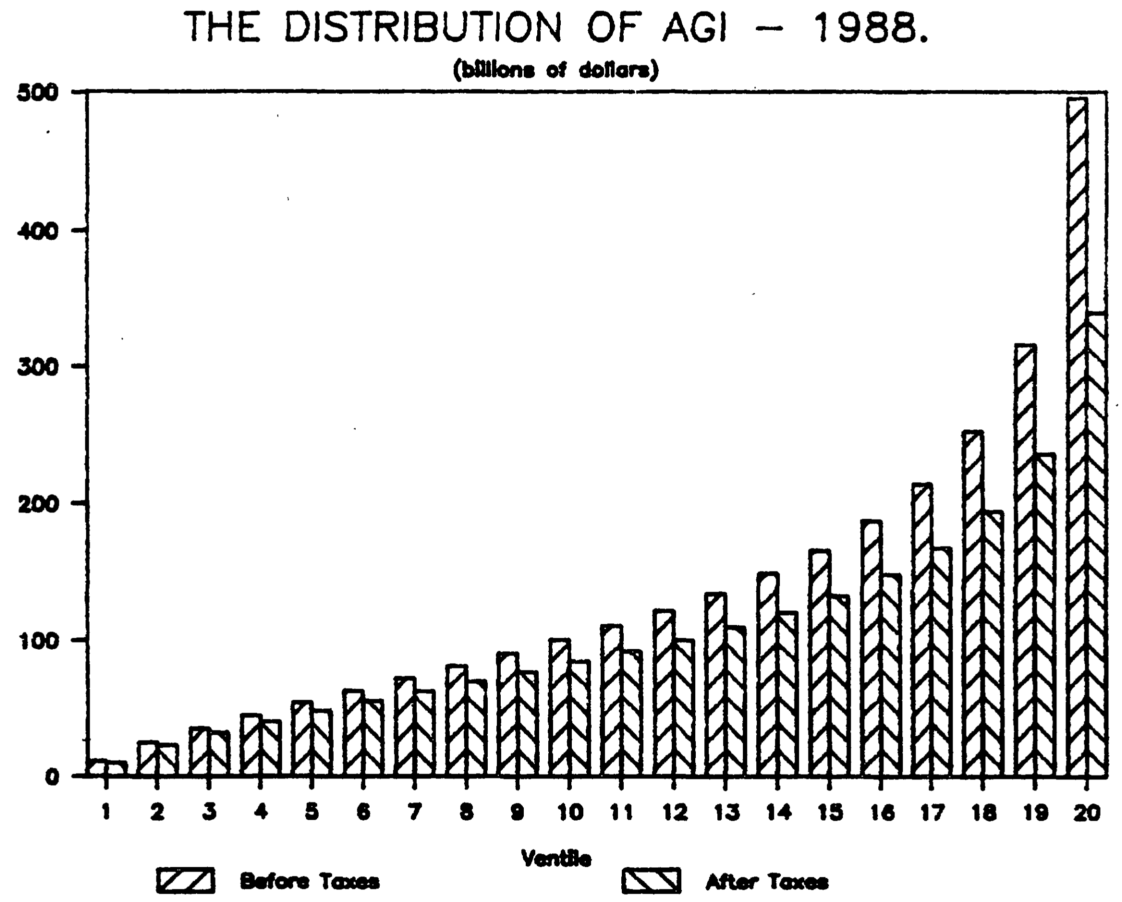
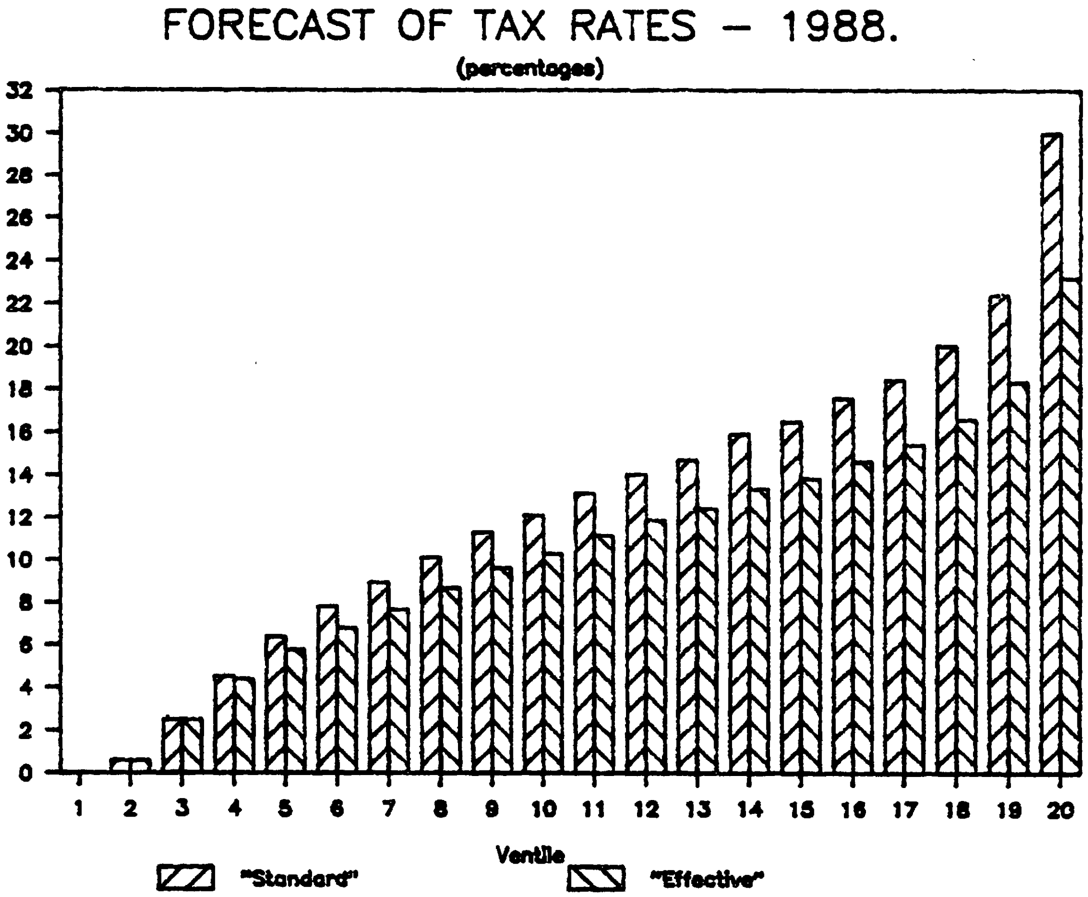

THE DISTRIBUTION OF AGI – 1988.
(billions of dollars)
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Ventile
Before Taxes
After Taxes

FIGURE 1.2



FORECAST OF TAX RATES - 1988.

income is accomplished through a bridge which distributes the items not part of AGI among the ventiles. These items include transfer payments, fringe benefits, imputations and other types of income.

Total taxes per ventile are subtracted from the distribution of AGI and personal income to get the distribution of both disposable AGI and disposable personal income, and at both the aggregate and cutoff definitions. It is the distribution of disposable personal income which determines the goods mix of consumption. That distribution, in index form is shown in table 1.5. The index is constructed by dividing the cutoff income by the overall mean. The number for the top income ventile represents not the income of the economy's single highest income, but the share of total income accruing to the top 5% of the population. The table shows the index both before and after all personal taxes. The progressivity of the personal tax system is evident by comparing values. Table 1.6 makes such a comparison by calculating the ratios of the indexes before and after taxes. The numbers in that table indicate that the lower ventiles, whose post-tax to pre-tax ratios are greater than one, are made better off in relative terms by the tax system. The upper ventiles whose ratios are less than one are made worse off. For many people in the middle portion of the income distribution, personal taxes make no difference in their relative positions.

More Capabilities of the Model: Tax Reform.

The model was used to estimate the major effects of the tax reform proposal passed by Congress in September, 1986. The details of this simulation are provided in Chapter 5. This section will provide just the briefest description of the method and results. A description of the rest of the interindustry forecasting model can be found in Monaco (1984).[11] Because the section of the model which forecasts corporate income tax revenue is inadequate to simulate the detailed changes in this tax reform plan, overall static revenue neutrality was imposed. That is, it was assumed that corporate tax revenue would increase by the amount that personal taxes would be cut under a constant level of income.

The model predicts that the plan will give the economy a very slight boost in the long run. Although the plan will depress Gross National Product adjusted for inflation (real GNP) by 0.2% in 1987, real GNP will be 0.3% higher than it otherwise would have been in 1988 when the plan is phased in. By 1995, the economy will also be 0.3% stronger. The impacts of tax reform on the major macroeconomic variables generated by the model are shown in table 1.7

Personal income tax revenue will fall by about 5% once the plan is phased in. The largest relative tax cuts will go to the income groups at the bottom 30% and top 10% of the income distribution. This can be seen in table 1.10 which shows the estimated effects of tax reform on the distribution of federal personal income tax liability by income ventile. The groups which enjoy larger percentage tax reductions than the overall average are at the extremes of the distribution, meaning that the tax system becomes somewhat less progressive at the upper end, but more progressive at the lower end.

Except for the very lowest income recipients, who pay no taxes in either case, the low income groups are better off both absolutely and relatively because of the substantial increases in the personal exemption amount and standard deduction. The middle and upper middle income groups benefit in absolute terms, but enjoy a relatively smaller tax cut than the other groups mainly because of the reduced deductions and credits. The highest income groups are made better off because of the lower marginal tax rates.

There will be individual winners and losers throughout, but the tax burden of any income group as a whole will not be drastically altered. The bill does go a long way, however, in correcting major problems with the current system. Besides its complexity and high marginal rates, the current system is "horizontally inequitable," which means a family's tax bill depends not so much on the amount of income received but on the type of income and the items on which it is spent.

The increase in corporate taxes, most notably the repeal of the investment tax credit, will depress equipment investment. The after-tax cost of using capital equipment will rise by a little over 5%, which will cause investment to fall by 2.6% in the short run and 4.4% by 1995. This cost of capital, which is explicitly modeled, depends on the corporate profits tax rate, the depreciation schedules, the investment tax credit, and interest rates. Interest rates will rise only slightly under the new plan. The model's ability to simulate the effects of changes in the cost of capital was an existing property. Only slight modification of the model was necessary to accommodate a simulation of the effects of this tax reform plan on capital costs, and hence, investment behavior.

The stimulus to the economy comes from the increase in consumption. Although the decline in investment tempers the stimulus, it is not large enough to overcome the increase in consumer spending. Corporate tax revenue is assumed to rise by enough to make the plan revenue neutral overall, therefore leaving the federal deficit unchanged. In other words, the tax bill is assumed to transfer taxes dollar-for-dollar from persons to corporations. This transfer results in a small net increase in aggregate spending because personal consumption is more responsive to changes in disposable personal income than is business spending to after-tax revenue. Profits and retained earnings absorb a substantial portion of the corporate tax increase. Also, the increase in consumption tempers the fall in investment. The overall outcome is a modest increase in aggregate spending and redistribution of resources from investment to consumption industries.

Other moderating forces are at work in the model. One is the savings rate, which rises in the simulation. Among other factors, the savings rate is a negative function of the unemployment rate and a positive function of lagged changes in disposable income. Both these variables act to increase the savings rate, thus dampening the stimulus to the economy. Therefore, aggregate consumption increases, in 1988, but not by the full amount of the increase in disposable income. The rise in consumption income will be further tempered by a decline in dividends paid to individuals because of the higher corporate taxes, thus lowering disposable personal income. Inflation was not affected by the proposal.

The effect on equipment investment by industry group is shown in table 1.8. Investment is affected because the tax bill will alter the after-tax cost of using capital equipment. The capital cost is the return on investment necessary to recover the cost of financing the machine, its depreciation and taxes. This cost would rise by about 12%

due to the elimination of the investment tax credit; but because the bill also lowers the corporate tax rate from 46% to 34% and changes the depreciation schedules, the overall rise in capital costs will be about 5% under tax reform. The estimates shown reflect economy-wide averages with respect to depreciation schedules and equipment costs. The bill's effects on capital costs for individual firms and types of equipment will vary significantly. This is discussed in more detail in Chapter 5.

Table 1.9 shows the tax bill's effect on outputs by industry group. It illustrates the redistribution of resources from investment-oriented industries to consumption oriented industry groups. Again, much more industry detail is available from the model than is presented here. These estimates were generated with a fully dynamic model of the U.S. economy. The interrelated macroeconomic and industry structure of the Inforum model makes it particularly well-suited to detailed policy analysis such as this one on tax reform.

The Effects on the Goods Mix of Consumption: A Flat Tax.

The objective of this simulation is to illustrate how tax policy can affect the after-tax income distribution, and thus the goods mix of personal consumption expenditures in the model. The scenario was designed so that the aggregate amount of both taxes and consumption was the same for the base and alternate cases. A flat tax was imposed on AGI by eliminating the personal exemption amount, the earned income credit, all deductions and credits and preference items, and by making all income brackets pay the same marginal tax rate, which in this case is also the average tax rate. The rate which under this structure yielded the same revenue as the base case for 1988 was 14.85%.

Table 1.11 shows the results of the tax variables in 1988 under both scenarios. The only curiosity on this table might be that the pre-tax and post-tax index of ventile cutoff personal incomes differ. While income taxes at both the federal and state level are applied to AGI at a flat rate, the other taxes are applied at flat rates to personal income, which because of transfers and other income items in the AGI-PI bridge, is distributed more equally. Therefore the difference occurs because the income tax burden is distributed like AGI, while the other taxes are distributed like personal income.

The goods mix of consumption is shown by each class of goods in table 1.12. The model forecasts consumption by 78 different types of goods. Each category of goods is forecast with, among other things, its own "piece-wise linear" Engel curve. An Engel curve plots the consumption of a good against the income of consumers. "Piece-wise linear" means that the curve is composed of a number of linear segments, in this case five. The curve was estimated in the cross-section with data from the Survey of Consumer Expenditures of the Census Bureau. The slope of each segment represents the portion of an increase of income in that piece's income range that is spent on the good. That is referred to as the specific propensity to consume (SPC). Each slope is specific to the good and the income range. The five income ranges to which the SPC's for each good correspond each contain the per capita incomes of one fifth of the population.

Goods with high SPCs in the top income range and low SPCs in the low ranges generally tend to be "luxury" goods, which claim an increasing share of consumer budgets as incomes become high. Think of "necessity" goods as those with low SPCs in the top income range and higher SPCs in the lower ranges. The flat tax proposal makes the disposable income distribution less equal, taking income away from the lower end and adding it to the upper end. This should tend to redistribute consumption towards those "luxury" goods and away from the "necessity" goods. This is because as low incomes get lower, the normal goods with higher SPCs in that range are hurt most, and when high incomes get higher, the luxury goods with high SPCs in that range are helped the most. That this is indeed the case can be verified by examining the last two columns of table 1.12 which show the SPCs for the lowest and highest income ranges for each category of goods. Any shifts not obviously attributable to these factors may be due to the other three SPCs for the middle income ranges not shown here.[12]

This simulation should serve to illustrate the importance to the Inforum model of having a detailed income distribution and tax model. The work described here does more than just forecast revenue. It forecasts revenue by income group. It also has an important impact on industry detail at the consumption level. Its estimation led to some significant revelations about the determinants of the size distribution of income. But perhaps most importantly from a modeling standpoint is its ability to simulate in a long-term, time-series framework, the impact of a whole array of changes in the tax code. This is an important property for a forecasting model to have, particularly now, when future tax law changes are likely to occur.

The balance of the dissertation develops in detail the material which was introduced here. Chapter 2 describes the method developed for modeling the distribution of AGI. Chapter 3 explains in detail how the model applies the tax laws to the distribution of AGI to get a distribution of tax liability. Chapter 4 describes the procedure for reconciling the differences between the definitions of AGI and personal income at both the aggregate level and the level disaggregated by income ventile. Chapter 5 explains in detail how the model was used to simulate the effects of the tax reform plan discussed above, for both the personal income tax and the corporate income tax. Appendix A and B explain the Inforum investment equations and cost of capital formula, respectively. Appendix C describes a related method of modeling the income distribution that was tried before the method in Chapter 2 was developed. Finally, the mathematical appendix, while adding some detail, is mostly a summary, in equation form, of the material in Chapters 2 through 4.

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TABLE 1.1
POPULATION AND INCOME DISTRIBUTION BY VENTILE AND HOUSEHOLD SIZE-1981.

Exemptions Other than Age or Blindness in Thousands.

Household Size Ventile	1	2	3	4	5	6	Total
1	2588.8	1582.8	1584.8	1811.1	1412.4	1813.6	10793.6
2	1632.9	1358.2	1490.4	1788.4	1585.3	2938.3	10793.6
3	1614.4	1239.0	1570.1	1968.7	1767.1	2634.3	10793.6
4	1573.8	1284.0	1647.5	2160.8	1879.4	2248.2	10793.6
5	1538.6	1343.3	1730.0	2332.6	1956.7	1892.4	10793.6
6	1521.2	1411.3	1792.6	2491.2	1986.9	1590.3	10793.6
7	1514.5	1488.8	1850.9	2626.4	1973.1	1339.9	10793.6
8	1520.1	1576.6	1905.4	2737.1	1920.0	1134.5	10793.6
9	1534.2	1679.9	1956.7	2820.3	1835.3	967.2	10793.6
10	1566.5	1800.1	2009.5	2872.0	1726.5	818.9	10793.6
11	1608.2	1939.7	2056.6	2890.2	1596.8	702.0	10793.6
12	1671.5	2102.7	2106.6	2862.7	1449.6	600.5	10793.6
13	1752.9	2293.4	2144.5	2792.0	1294.2	516.7	10793.6
14	1855.4	2518.8	2179.5	2672.4	1139.2	428.3	10793.6
15	1988.1	2774.5	2193.5	2492.5	972.6	372.4	10793.6
16	2156.1	3085.6	2178.7	2258.8	820.1	294.2	10793.6
17	2383.5	3431.3	2119.8	1954.2	663.2	241.6	10793.6
18	2680.2	3827.7	1982.4	1594.8	519.8	188.7	10793.6
19	3100.8	4216.3	1727.2	1234.9	383.6	130.7	10793.6
20	3624.2	4459.2	1334.7	875.1	329.2	171.2	10793.6
Totals	39425.8	45413.0	37561.4	45236.4	27210.9	21024.1	215871.4

Adjusted Gross Income in Millions of Dollars.

Household Size Ventile	1	2	3	4	5	6	Total
1	713.9	1010.7	1000.3	1157.2	940.8	1277.4	6100.3
2	2578.5	2273.6	2459.2	2973.8	2534.1	4601.1	17420.2
3	3668.3	2875.7	3581.9	4489.5	4018.4	5938.6	24572.5
4	4484.4	3650.5	4648.6	6135.1	5308.8	6337.7	30565.2
5	5124.7	4489.9	5784.4	7785.6	6521.6	6293.8	35999.9
6	5771.8	5399.1	6859.3	9524.3	7587.4	6058.5	41200.4
7	6545.3	6399.2	7950.8	11276.9	8478.0	5745.0	46395.3
8	7243.5	7512.2	9101.6	13080.1	9169.5	5407.5	51514.4
9	8096.8	8862.1	10317.2	14854.8	9669.9	5083.0	56883.7
10	9066.7	10457.8	11633.2	16649.5	9995.0	4745.7	62547.9
11	10247.0	12341.1	13092.4	18376.0	10142.7	4456.8	68656.0
12	11658.4	14670.4	14686.0	19981.5	10108.1	4180.0	75284.3
13	13455.6	17630.1	16479.8	21438.5	9928.5	3945.2	82877.7
14	15760.6	21391.1	18495.7	22664.6	9644.0	3637.2	91593.0
15	18787.4	26258.9	20721.7	23525.1	9178.3	3482.9	101954.2
16	23020.0	32917.8	23227.5	24025.3	8704.9	3136.2	115031.7
17	29227.3	42142.5	25968.1	23900.1	8085.7	2929.8	132253.4
18	39217.3	55976.6	28882.8	23171.3	7481.1	2677.9	157406.9
19	58203.6	78911.7	31984.0	22567.6	6921.7	2207.5	200796.0
20	129084.5	166316.5	46712.4	31789.7	12361.1	5797.5	392061.7
Totals	401955.6	521487.2	303586.8	319366.4	156779.5	87939.2	1791114.

TABLE 1.2
THE AGI DISTRIBUTION FORECAST.
(Billions of Dollars)

	Adjusted Gross Income (Pre-tax)			
	1986	1988	1991	1995
Ventile				
1	11.28	11.89	14.32	17.62
2	23.53	25.60	31.14	39.68
3	32.51	35.65	43.49	55.98
4	40.98	45.28	54.95	71.02
5	49.38	54.66	66.59	86.21
6	57.31	63.58	77.43	100.51
7	65.21	72.68	88.50	115.20
8	73.43	81.82	99.64	129.94
9	81.56	90.95	110.93	144.68
10	90.13	100.86	123.02	160.74
11	99.52	111.36	135.82	177.47
12	109.12	122.13	148.95	194.98
13	120.23	134.79	164.51	215.66
14	133.26	149.44	182.25	238.60
15	147.95	166.10	202.66	265.59
16	167.22	187.96	229.17	300.05
17	191.47	214.69	261.26	342.17
18	225.49	253.32	308.42	403.46
19	282.16	316.34	384.60	501.51
20	463.36	496.18	605.97	773.84
Total	2465.09	2735.29	3333.59	4334.92
	After-tax AGI			
Ventile				
1	10.06	10.53	12.74	15.63
2	21.61	23.48	28.46	36.17
3	29.88	32.65	39.53	50.65
4	37.04	40.82	49.20	63.22
5	44.05	48.64	58.86	75.75
6	50.57	55.96	67.75	87.39
7	56.97	63.32	76.59	99.02
8	63.43	70.43	85.09	110.14
9	69.55	77.29	93.59	121.13
10	76.21	84.98	102.83	133.16
11	83.29	92.78	112.13	145.15
12	90.36	100.72	121.82	157.87
13	98.90	110.35	133.34	172.98
14	108.25	120.72	145.70	188.66
15	119.17	133.21	160.83	208.27
16	133.29	148.94	179.70	232.87
17	150.66	168.12	202.09	261.62
18	174.34	194.85	234.23	302.51
19	210.70	236.68	284.77	367.50
20	317.21	340.16	409.34	516.84
Total	1945.47	2154.55	2598.48	3346.41

TABLE 1.3
FORECAST TAX RATES.
(Percent)

	"Standard Deduction" Tax Rates.			
	1986	1988	1991	1995
Ventile				
1	0.00	0.00	0.00	0.00
2	0.65	0.63	1.05	1.28
3	2.37	2.57	3.25	3.62
4	4.43	4.58	5.15	5.63
5	6.23	6.41	6.99	7.48
6	7.69	7.87	8.39	8.92
7	8.79	9.01	9.59	10.16
8	9.94	10.20	10.88	11.50
9	11.09	11.36	11.97	12.59
10	11.90	12.17	12.83	13.55
11	12.85	13.20	13.95	14.70
12	13.75	14.07	14.74	15.54
13	14.40	14.76	15.57	16.39
14	15.54	15.97	16.79	17.65
15	16.23	16.56	17.39	18.32
16	17.18	17.63	18.45	19.24
17	18.12	18.48	19.42	20.30
18	19.70	20.09	21.06	22.02
19	22.63	22.48	23.26	24.03
20	30.19	30.05	31.11	31.91
	Effective Tax Rates			
1	0.00	0.00	0.00	0.00
2	0.65	0.63	1.05	1.28
3	2.37	2.57	3.25	3.62
4	4.29	4.44	5.00	5.46
5	5.67	5.83	6.37	6.81
6	6.68	6.83	7.29	7.75
7	7.52	7.71	8.21	8.70
8	8.51	8.74	9.32	9.85
9	9.46	9.69	10.21	10.74
10	10.14	10.37	10.94	11.55
11	10.92	11.22	11.85	12.49
12	11.65	11.92	12.49	13.17
13	12.17	12.48	13.16	13.85
14	13.04	13.41	14.10	14.82
15	13.60	13.88	14.58	15.35
16	14.32	14.69	15.38	16.04
17	15.18	15.48	16.27	17.01
18	16.34	16.65	17.46	18.26
19	18.53	18.40	19.04	19.67
20	23.37	23.25	24.08	24.69

TABLE 1.4
UPPER LIMITS FOR PER CAPITA INCOME.
(Thousands of Dollars)

	Pre-tax AGI Cutoff Incomes.			
	1986	1988	1991	1995
Ventile				
1	1.59	1.68	1.97	2.41
2	2.45	2.63	3.10	3.84
3	3.20	3.45	4.07	5.06
4	3.94	4.26	5.03	6.28
5	4.65	5.05	5.95	7.45
6	5.34	5.80	6.86	8.60
7	6.04	6.59	7.78	9.78
8	6.75	7.37	8.70	10.94
9	7.47	8.17	9.66	12.17
10	8.26	9.05	10.70	13.49
11	9.09	9.95	11.77	14.84
12	9.97	10.93	12.93	16.33
13	11.04	12.11	14.33	18.11
14	12.22	13.40	15.85	20.03
15	13.71	15.07	17.82	22.52
16	15.54	17.08	20.19	25.51
17	18.04	19.82	23.39	29.53
18	21.89	24.03	28.33	35.66
19	29.09	31.88	37.62	47.31
	Limits for Disposable AGI			
1	1.44	1.51	1.78	2.17
2	2.25	2.41	2.83	3.49
3	2.92	3.14	3.67	4.54
4	3.54	3.82	4.48	5.56
5	4.13	4.47	5.24	6.51
6	4.69	5.08	5.97	7.44
7	5.25	5.71	6.69	8.35
8	5.80	6.30	7.39	9.22
9	6.35	6.91	8.11	10.14
10	6.95	7.58	8.89	11.11
11	7.57	8.25	9.67	12.08
12	8.23	8.98	10.53	13.17
13	9.02	9.85	11.54	14.42
14	9.89	10.79	12.63	15.78
15	10.98	12.01	14.06	17.57
16	12.32	13.46	15.73	19.66
17	14.08	15.39	17.95	22.38
18	16.66	18.25	21.27	26.47
19	21.21	23.21	27.08	33.64

TABLE 1.5

INDEX OF VENTILE LIMITS FOR PERSONAL INCOME.

(Pre-Tax)

Ventile	1986	1988	1991	1995
1	17.62	17.75	17.19	16.90
2	28.63	28.85	27.94	27.45
3	46.96	47.08	45.85	45.02
4	48.19	48.25	47.31	46.62
5	50.89	50.98	50.29	49.80
6	54.89	55.00	54.50	54.21
7	59.96	60.18	59.84	59.75
8	64.70	65.00	64.80	64.87
9	70.01	70.34	70.22	70.41
10	76.00	76.44	76.46	76.80
11	82.20	82.77	82.90	83.38
12	89.62	90.26	90.47	91.10
13	97.86	98.64	98.96	99.73
14	107.82	108.68	109.03	109.91
15	120.74	121.84	122.24	123.25
16	136.67	137.95	138.40	139.55
17	157.64	159.05	159.44	160.66
18	190.13	191.67	191.92	192.88
19	261.78	265.24	265.95	267.87
20	20.08	19.52	19.66	19.40
	Limits For Disposable Personal Income.			
1	20.19	20.35	19.85	19.62
2	32.82	33.07	32.25	31.88
3	53.60	53.73	52.61	51.92
4	54.37	54.42	53.56	52.98
5	56.55	56.62	56.03	55.66
6	60.17	60.25	59.89	59.73
7	65.01	65.19	65.03	65.07
8	69.29	69.53	69.48	69.67
9	74.07	74.30	74.34	74.62
10	79.57	79.91	80.07	80.47
11	85.15	85.57	85.80	86.30
12	91.99	92.43	92.73	93.34
13	99.51	100.04	100.40	101.09
14	108.58	109.14	109.47	110.18
15	120.57	121.32	121.69	122.50
16	135.17	136.02	136.36	137.30
17	153.89	154.82	154.96	155.81
18	181.81	183.14	183.15	183.68
19	244.18	247.88	248.41	249.95
20	18.34	17.91	18.02	17.80

The numbers are indexes (mean=100) of the cutoff income between the ventile shown and the next ventile. Ventile 20 has that group's share of all income.

TABLE 1.6
RATIO OF POST-TAX TO PRE-TAX INCOME INDEXES.

Personal Income

	1986	1988	1988	1991	1991	1995	1995
	----	BASE	REFORM	BASE	REFORM	BASE	REFORM
Ventile							
1	1.1459	1.1465	1.1399	1.1498	1.1485	1.1609	1.1548
2	1.1464	1.1463	1.1401	1.1500	1.1486	1.1614	1.1554
3	1.1414	1.1412	1.1393	1.1436	1.1465	1.1533	1.1522
4	1.1282	1.1279	1.1329	1.1292	1.1379	1.1364	1.1403
5	1.1112	1.1106	1.1177	1.1120	1.1190	1.1177	1.1198
6	1.0962	1.0955	1.0972	1.0969	1.0973	1.1018	1.0983
7	1.0842	1.0833	1.0791	1.0846	1.0805	1.0890	1.0818
8	1.0709	1.0697	1.0638	1.0705	1.0651	1.0740	1.0662
9	1.0580	1.0563	1.0506	1.0571	1.0522	1.0598	1.0530
10	1.0470	1.0454	1.0403	1.0458	1.0415	1.0478	1.0417
11	1.0359	1.0338	1.0295	1.0340	1.0302	1.0350	1.0293
12	1.0264	1.0240	1.0203	1.0241	1.0204	1.0246	1.0191
13	1.0169	1.0142	1.0109	1.0137	1.0104	1.0136	1.0090
14	1.0070	1.0042	1.0012	1.0035	1.0005	1.0025	0.9992
15	0.9986	0.9957	0.9927	0.9951	0.9928	0.9939	0.9922
16	0.9890	0.9860	0.9840	0.9874	0.9841	0.9839	0.9832
17	0.9762	0.9734	0.9736	0.9722	0.9717	0.9698	0.9690
18	0.9562	0.9555	0.9579	0.9548	0.9560	0.9523	0.9535
19	0.9328	0.9345	0.9398	0.9347	0.9399	0.9331	0.9399
20	0.9133	0.9175	0.9244	0.9183	0.9247	0.9175	0.9272

TABLE 1.7
THE IMPACT OF TAX REFORM ON SELECTED ECONOMIC VARIABLES.
(Changes in percentages and billion dollars)

Economic Variable		1988		1995	
		pct. ch.	$ ch.	pct.ch.	$ ch.
Gross national product	(72$)	+ 0.3	+ 6.1	+ 0.3	+ 5.5
Personal consumption	(72$)	+ 0.8	+ 9.5	+ 0.9	+ 13.5
Equipment investment	(72$)	- 2.6	- 3.7	- 4.4	- 7.9
Structures	(72$)	+ 0.4	+ 0.6	+ 0.1	+ 0.2
Inventory change	(72$)	+ 0.2	+ 0.0	- 2.7	- 0.3
Exports	(72$)	+ 0.1	+ 0.2	+ 0.2	+ 0.4
Imports	(72$)	+ 0.3	+ 0.5	+ 0.2	+ 0.4
Government	(72$)	+ 0.0	+ 0.0	+ 0.0	+ 0.0
Unemployment rate	(pct.)	- 0.3	---	- 0.3	---
Inflation (GNP Deflator)	(pct.)	+ 0.0	---	+ 0.0	---
AAA bond yield	(basis points)	+ 2	---	+ 27	---
10 year T-bond yld.	(basis points)	+ 3	---	+ 14	---
Savings rate	(pct. of disp. inc.)	+ 0.4	---	+ 0.4	---
Labor productivity	(index)	+ 0.0	---	+ 0.0	---
Cost of capital	(avg. index)	+ 5.4	---	+ 5.2	---
Fed. personal tax revenue	(cu$)	- 5.0	-20.5	- 5.0	- 34.7
Disposable personal income	(cu$)	+ 1.0	+35.1	+ 1.4	+ 72.6
Corporate profits after tax	(cu$)	- 5.0	-12.2	- 1.0	- 3.5
Personal dividend income	(cu$)	- 5.8	- 5.2	-17.5	- 20.6

TABLE 1.8
EQUIPMENT INVESTMENT BY BROAD INDUSTRY GROUP.
(billions of 1977$)

	BASE 1986	BASE 1988	REFORM 1988	BASE 1995	REFORM 1995
All industries	210.08	205.78	200.52	254.81	243.66
Ag, mining, constr	45.63	42.69	41.10	52.20	49.71
Non-durable goods	29.41	25.87	25.28	31.26	30.02
Durable goods	30.79	28.73	27.95	38.38	36.88
Transportation	12.99	13.17	12.99	15.39	14.74
Utilities	29.55	31.81	31.52	41.25	40.25
Wholesale, retail	30.12	29.13	27.99	32.41	29.95
Fin, ins, real est	11.70	11.99	11.85	14.30	14.83
Services	19.04	21.19	20.71	27.83	26.52
Miscellaneous	0.85	1.20	1.14	1.80	1.76

TABLE 1.9
THE IMPACT ON PERSONS:
DISTRIBUTION OF FEDERAL INCOME TAX LIABILITY.
(Billions of Dollars)

Ventile*	BASE 1986	BASE 1988	REFORM 1988	BASE 1995	REFORM 1995
1	0.00	0.00	0.00	0.00	0.00
2	0.15	0.16	0.00*	0.51	0.00*
3	0.77	0.92	0.19*	2.03	0.85*
4	1.76	2.01	0.99*	3.88	2.62*
5	2.80	3.19	2.30*	5.87	5.10*
6	3.83	4.35	4.00*	7.79	7.57
7	4.91	5.60	5.44	10.02	9.97
8	6.25	7.15	7.03	12.80	12.66
9	7.71	8.81	8.63	15.54	15.32
10	9.14	10.46	10.19	18.57	18.07
11	10.87	12.50	12.13	22.17	21.80
12	12.72	14.56	14.04	25.67	25.10
13	14.63	16.82	16.36	29.88	29.13
14	17.38	20.03	19.27	35.36	34.37
15	20.12	23.06	22.40	40.77	39.17
16	23.94	27.61	26.77	48.12	46.06
17	29.06	33.23	31.72	58.19	55.76
18	36.84	42.19	40.07	73.66	71.32
19	52.27	58.22	54.76*	98.65	92.80*
20	108.27	115.37	109.46*	191.09	178.22*
Total	363.41	406.24	385.75	700.57	665.88

* Denotes ventiles which enjoy tax cuts greater than average in percentage terms. Each ventile contains one twentieth of the population. They are ranked by per capita adjusted gross income.

TABLE 1.10
THE IMPACT ON BUSINESS: OUTPUT BY PRODUCING SECTOR.
(billions of 1977$)

	BASE 1986	BASE 1988	REFORM 1988	BASE 1995	REFORM 1995
Winners:					
Agriculture	166.02	168.26	168.83	191.18	191.79
Mining	93.01	97.21	97.30	113.87	113.98
Non-durables	779.74	804.52	807.90	926.12	929.48
Trade	525.52	550.33	552.53	660.87	663.41
Transportation	152.55	159.17	159.63	191.50	192.09
Utilities	240.29	256.82	257.62	322.62	323.33
Finance & insurance	181.44	189.17	190.38	222.99	224.47
Real estate	165.79	172.46	173.40	195.71	197.09
Services	640.17	670.97	674.43	808.05	811.70
Losers:					
Non electric machinery	154.01	159.08	157.27	228.74	224.35
Electrical machinerey	136.49	146.42	146.10	198.91	197.54
Transportation equip.	178.27	181.46	181.46	207.63	205.97
Instruments	37.34	38.51	38.28	49.80	49.24
Other durables	312.42	327.58	328.24	389.96	389.45

TABLE 1.11
RATES, REVENUE AND PERSONAL INCOME DISTRIBUTION INDEXES FOR 1988 UNDER BASE AND FLAT TAX.

Ventile	BASE Effective Tax Rates	FLAT Std. & Effective Tax Rates	BASE Revenue	FLAT Revenue	BASE & FLAT Pre-Tax Index	BASE Post-Tax Index	FLAT Post-Tax Index
1	0.00	14.85	0.00	1.77	17.75	20.35	19.46
2	0.63	14.85	0.16	3.80	28.85	33.07	31.62
3	2.57	14.85	0.92	5.30	47.08	53.73	50.83
4	4.44	14.85	2.01	6.73	48.25	54.42	50.93
5	5.83	14.85	3.19	8.12	50.98	56.62	52.88
6	6.83	14.85	4.35	9.45	55.00	60.25	56.35
7	7.71	14.85	5.60	10.80	60.18	65.19	61.19
8	8.74	14.85	7.15	12.16	65.00	69.53	65.59
9	19.69	14.85	8.81	13.52	70.34	74.30	70.57
10	10.37	14.85	10.46	14.99	76.44	79.91	76.39
11	11.22	14.85	12.50	16.55	82.77	85.57	82.36
12	11.92	14.85	14.56	18.15	90.26	92.43	89.60
13	12.48	14.85	16.82	20.03	98.64	100.04	97.67
14	13.41	14.85	20.03	22.21	108.68	109.14	107.39
15	13.88	14.85	23.06	24.69	121.84	121.32	120.30
16	14.69	14.85	27.61	27.94	137.95	136.02	136.05
17	15.48	14.85	33.23	31.91*	159.05	154.82	156.59
18	16.65	14.85	42.19	37.65*	191.67	183.14	188.36
19	18.40	14.85	58.22	47.02*	265.24	247.88	262.30
20	23.25	14.85	115.37	73.58*	19.52	17.91	19.51
Total			406.24	406.37			

* - Denotes those ventiles paying less federal income tax under the FLAT scenario.

TABLE 1.12
THE GOODS MIX OF CONSUMPTION UNDER BASE AND FLAT TAX 1988.

		BASE	FLAT	Percent Difference	Lowest SPC	Highest SPC
	Personal consumption expenditures	1220.80	1220.20	-0.05		
	Durable goods	221.00	220.59	-0.19		
	Motor vehicles and parts	88.07	87.23	-0.95		
1	New cars	47.68	47.18	-1.05	.042	.169
2	Used cars	8.61	8.49	-1.39	.042	.022
3	New & used trucks	15.90	15.76	-0.88	-	-
4	Tires & tubes	9.68	9.62	-0.62	.016	.006
5	Auto accessories & parts	6.20	6.18	-0.32	.016	.006
	Furniture & household equipment	92.66	92.69	0.03		
6	Furniture,mattresses,bedsprings	16.92	17.20	1.65	.013	.046
7	Kitchen, household appliances	15.11	14.95	-1.06	.016	.009
8	China,glass&tableware,utensils	6.14	6.12	-0.33	.002	.002
9	Radio,TV,records,musical instr.	35.61	35.45	-0.45	.013	.015
10	Floor coverings	6.44	6.48	0.62	.006	.028
11	Durable housefurnishings nec	8.87	8.95	0.90	.006	.028
12	Writing equipment	1.16	1.16	0.00	-	-
13	Hand tools	2.39	2.37	-0.84	-	-
	Other durables	40.28	40.67	0.94		
14	Jewelery	13.02	13.54	3.99	.005	.018
15	Ophthalmic & orthopedic goods	3.99	3.93	-1.50	.011	.006
16	Books & maps	3.89	3.86	-0.77	.012	.006
17	Wheel goods,dur sports eq&toys	12.58	12.45	-1.03	.012	.013
18	Boats, rec vech., & aircraft	6.79	6.89	1.47	.003	.032
	Non-durable goods	436.72	435.66	-0.24		
	Food and alcohol	211.34	210.61	-0.35		
19	Food, off premise	128.97	128.14	-0.64	.151	.036
20	Food on premise	50.16	49.97	-0.38	.064	.075
21	Alcohol, off premise	20.66	20.71	0.24	.005	.005
22	Alcohol, on premise	11.55	11.78	1.99	.008	.026
	Clothing	109.47	109.35	-0.11		
23	Shoes & footware	14.20	14.42	1.55	.005	.018
24	Women's clothing	65.77	65.40	-0.56	.033	.038
25	Men's clothing	27.82	27.78	-0.14	.025	.030
26	Luggage	1.68	1.75	4.17	.005	.018
	Other non-durables	54.46	54.48	0.04		
27	Gasoline & oil	31.17	31.02	-0.48	.071	.021
28	Fuel oil & coal	3.28	3.29	0.30	.005	.001
29	Tobacco	13.20	13.18	-0.15	.019	.006
31	Drug preparations &sundries	13.79	13.73	-0.44	-	-
30	Semidurable housefurnishings	6.53	6.75	3.37	.004	.020
32	Toilet articles & preparations	10.65	10.65	0.00	-	-
33	Stationery & writing supplies	3.45	3.43	-0.58	-	-
34	Nondurable toys, sport supplies	15.26	15.14	-0.79	-	-
35	Flowers, seeds, potted plants	3.08	3.06	-0.65	-	-
36	Cleaning preparations	1.03	1.02	-0.97	-	-

TABLE 1.12 (Continued)

					lowest	highest
		BASE	FLAT	Percent ch.	SPC	SPC
37	Lighting supplies	4.38	4.38	0.00	-	-
38	Household paper products	3.06	3.06	0.00	-	-
39	Magazines & newspaper	5.70	5.67	-0.53	.012	.006
40	Expenditures abroad;pers remit.	1.33	1.33	0.00	-	-
	Services	563.07	563.95	0.16		
	Housing	179.70	178.28	-0.79		
41	Owner occupied space rent	129.14	128.06	-0.84	.160	.095
42	Tenant occupied space rent	44.51	44.24	-0.61	-.006	.023
43	Hotels, motels	4.14	4.08	-1.45	.012	.008
44	Other housing	1.91	1.90	-0.52	.012	.008
	Household operation	73.58	73.26	-0.43		
45	Electricity	20.73	20.65	-0.39	.026	.007
46	Natural gas	6.69	6.66	-0.45	.005	.002
47	Water & oth sanitary services	6.29	6.23	-0.95	.008	.002
48	Telephone & telegraph	27.02	26.88	-0.52	.021	.011
49	Domestic services	3.82	3.78	-1.05	.003	.020
50	Household insurance	0.92	0.93	1.09	.010	.012
51	Oth hhld operations:repair	5.86	5.87	0.17	.010	.012
52	Postage	2.24	2.25	0.45	.010	.012
	Transportation	38.51	38.36	-0.39		
53	Auto repair	20.55	20.49	-0.29	.030	.020
54	Bridge, tolls, etc	1.00	1.00	0.00	.030	.020
55	Auto insurance	6.02	5.95	-1.16	.036	.009
56	Taxicabs	1.33	1.33	0.00	-.002	.001
57	Local public transport	1.74	1.74	0.00	-.002	.001
58	Intercity railroad	0.19	0.19	0.00	.000	.014
59	Intercity buses	0.43	0.43	0.00	.000	.014
60	Airlines	6.57	6.56	-0.15	.000	.014
61	Travel agents,oth trans service	0.67	0.67	0.00	.000	.014
	Medical services	105.05	105.57	0.50		
64	Physicians	25.41	25.67	1.02	.011	.014
65	Dentists & other prof services	22.00	21.71	-1.32	.011	.006
66	Private hospitals & sanitariums	49.65	50.26	1.23	.003	.006
67	Health insurance	7.99	7.92	-0.88	.035	.006
76	Education	16.31	16.12	-1.16	.023	.013
	Other services	149.92	152.36	1.63		
62	Laundries & shoe repair	5.62	5.63	0.18	.001	.014
63	Barbershops & beauty shops	5.51	5.47	-0.73	.017	.008
68	Brokerage,investment counseling	3.85	3.90	1.30	.002	.004
69	Bank service chrg &serv w/o,pay	31.22	31.72	1.60	.002	.004
70	Life insurance	12.71	12.76	0.39	.035	.037
71	Legal services	10.05	10.19	1.39	.002	.004
72	Funerals, oth pers business	7.17	7.28	1.53	.002	.004
73	Radio & tv repair	2.00	1.99	-0.50	.004	.001
74	Movies, theatre,spec sports	7.91	8.29	4.80	.008	.036
75	Other recreational services	30.63	31.74	3.62	.008	.036
77	Religious & welfare services	23.33	23.39	0.06	.032	.040
78	Foreign travel	9.91	10.00	0.91	-.001	.031

\- Denotes a single-sloped linear Engel curve.
SPC stands for specific propensity to consume.

CHAPTER 2.

THE INCOME DISTRIBUTION MODEL.

This chapter describes a model of the distribution of income in the United States. This model fits into and becomes part of the Inforum model, a large, interindustry forecasting model. This chapter will include a description of the specification and estimation of the income distribution model.

Why model the distribution of income? The first and most important reason is to answer questions about the distribution itself. There is much interest in information about the distribution of income, past, present, and future. Intelligent policy formation, including tax policy, requires the guidance of empirical information and analyses. The procedure developed here provides detailed information about the historical distribution of income, as well as a method for its projection into future years.

The second reason for modeling the income distribution is to facilitate a model of the income tax system. In the United States tax system, individual marginal and average tax rates are not flat, but depend on the level of family income. Therefore, tax revenues depend not only on the total amount of income, but also on how income is distributed. The next chapter will describe how taxes are calculated given the income distribution, and how taxes and disposable income and their distribution are incorporated into the large model.

The third reason for modeling the distribution of income is that except in the somewhat special case of linear Engel curves, the distribution of income affects the mix of products demanded. An Engel curve is a plot of consumption of a particular good or group of goods against the income of consumers. If that plot is a straight line, then the transfer of income from one person to another will reduce the first person's consumption of that good by exactly the amount by which it increased the second person's consumption, leaving total consumption of the good unchanged. However, in the U.S. economy, most Engel curves are non-linear.

The second and third reasons for modeling the distribution of income are irrelevant without a model sophisticated enough to take advantage of the detailed information. The model into which the present work is being incorporated is indeed sophisticated enough. Both the tax model and the consumption model depend on having a detailed model of income distribution. The consumption part of the model uses goods-specific non-linear Engel curves, so that not just the average level, but also the distribution of disposable income is important in determining the demand for various categories of consumption goods. For example, the consumption of a luxury good like jewelry is modeled with an Engel curve which get steeper in slope as income increases. Therefore, if the number of high income people increases, so will the consumption of these goods even if aggregate income does not increase. Since the large model makes full use of input-output tables, the composition of final demand is crucial throughout. Changes in the type of products which are demanded will affect demands for intermediate goods as well as the demand for factor inputs such as labor and capital.

The tax model, which is the topic of the next chapter, is also detailed enough to take advantage of information on the distribution of income. It recognizes that higher family incomes are taxed at higher marginal rates. The appropriate tax rates are applied to the various income brackets. The procedure takes household sizes and the personal exemption amount into account when calculating tax rates. Finally, it recognizes that higher income families have more opportunities for tax avoidance through deductions and credits.

The model of income distribution must be very versatile because it serves two masters: the tax model, and the consumption model. Taxes are determined from household income and household size. Consumption depends upon per capita income and household characteristics. (For per capita income, four people in a household with a $20,000 income count as four people each with an income of $5,000.) Furthermore, taxes depend on "adjusted gross income" (AGI), while consumption depends on disposable personal income. The model is flexible with respect to the definition of income. It calculates both per capita and per household income distributions of both AGI and personal income before and after taxes.

The model begins with AGI as its definition of income. AGI is appropriate because it is the income base for the income tax. There is a detailed time-series of it readily available, updated each year. The data, published in the Treasury Department's Statistics of Income, (SOI), show the size distribution of AGI by income groups. There is a table for each of six household sizes. The data availability by household size is crucial for the analysis of per capita income and also for tax calculation because of the different rate structure for single taxpayers, and because of the allowance for personal exemptions.

The income distribution model is constructed from the historical cross-section data at the household size level. A function is fit to the income distribution data for each year and each household size. The function has two parameters, and describes a cross-section relationship between the percentage of income and the percentage of people earning at least that income. The relationship is commonly referred to as a "Lorenz curve." The same function is fit to all groups of data with the parameters varying according to household size and year. For each household size, time-series of the parameters of the Lorenz curves become dependent variables in time-series regression equations. These equations are then used to forecast the parameters and thus, the income distributions. Economic variables are used as the predictors in those equations. The persons from the various household sizes are then put together into per capita income groups. So the procedure forecasts not only household income distributions for each household size, but also a per capita income distribution.

The Personal Consumption Model.

Before describing the income distribution modeling process, a brief discussion of the consumption part of the input-output model in which the tax model will be incorporated is in order. The consumption model was built and put in place in 1979, before work on the income distribution and tax sections began. The structure of the consumption section dictated the way in which the income distribution was to be modeled. In particular, it was the format of the consumption model that required the income distribution to be modeled in terms of twenty equally populated ventiles. It was the consumption model that required the modeling of cutoff incomes which represent the incomes of the people on the border of two adjacent ventiles. And it was the consumption model that required the construction of a per capita income distribution as opposed to the more commonly modeled distribution of household incomes. While some aspects of this thesis are necessarily specific to the Inforum modeling framework, it will be shown that the system is quite flexible and might be applied to other frameworks of analysis.

The consumption section of the model combines cross-section and time-series analysis to produce a system of consumption equations having many desirable properties. They can show substitutability and complementarity between goods; they incorporate demographic variables, and a time trend representing tastes. But for present purposes, the most important feature is the good-specific non-linear relation between per capita income and per capita consumption. The non-linear Engel curve allows the income distribution to affect the mix of products consumed.

Using data from an extensive consumer survey, cross-section effects from income and demographic variables were estimated. The form of the equations postulates that the amount of a good consumed depends in part, on two separate terms: the per capita income effects come about through the piece-wise linear Engel curves explained in Chapter 1, and the "size" of the household. The "size" of the household is not just the number of people. Rather it is an age-weighted size, with a varying set of weights for each good. Using only per household income as a determinant of consumption would not allow for the distinct and significant effects of a changing family age structure. For example, the model is able to simulate the change in product mix consumed as the people from a baby-boom mature. To allow the age structure (and other characteristics) of households to affect the demand for different products differently, the income distribution must be defined in per capita terms rather than per household terms. This is to allow for households of similar size but differing demographics to have different consumption patterns. Household size has little additional effect on consumption once the demographic characteristics of the individuals are taken into account. However, the income for tax determination is household income. Therefore, the income distribution model must be sufficiently versatile to be able to model both types of income. See Devine (1983) and Almon (1979) for further details about the consumption section of the model.

The consumption model uses a special form for representing the income distribution. The aggregate of disposable income must be divided up into twenty "ventiles." A ventile is a group of people containing exactly one twentieth of the population. The people in each ventile receive a per capita income between the ventile's lower and upper bounds. The ventiles are ordered according to per capita (not per household) incomes. The precise per capita incomes which lie at the border of each ventile must be determined. These cutoff incomes are then divided by the overall mean disposable income to form a series of index numbers which describe the income distribution. Each ventile's number is its highest per capita income as a per cent of the overall mean. The top ventile's number is not indexed as are the other numbers because the highest individual income in the economy is an irrelevant statistic. Rather, the top ventile's total income is expressed as a percentage of the aggregate disposable income.

Before the model of the income distribution described in this chapter was built and incorporated, the pre-existing distribution model predicted the index numbers directly with separate regression equations for each ventile.. Certain cyclical and demographic variables served as the regressors. Taxes were removed by a simple tax function with five income brackets. This approach was unsatisfactory for several reasons. First, it was unrealistic. Tax laws are complex and not well represented by a simple five-bracket schedule. Second, no household size information was taken into account in calculating taxes. The taxable income is the household income, not per capita income, which was the distribution being forecast. The old system was estimated on the basis of the 1972 tax distribution, and it could not take into account the changes in the tax law between 1972 and the present for its forecasts. Each year in the forecast, more and more people were, because of inflation and real income growth, being allocated to the top income bracket. The tax schedule was becoming mostly a single bracket schedule as the model got further out into the forecast. Finally, the old system was not built for simulation of tax law changes. Changes in the rate schedule, deductions, credits, the personal exemption amount, indexing or the taxable income base were not modeled. The model in this dissertation corrects these and other deficiencies.

The Modeling Framework.

As discussed previously, a flexible approach is appropriate for modeling the income distribution. It was first thought that trying to use some smooth functional form to describe the distribution would be too restrictive. In particular, it seemed that the well-known statistical distributions would not give a satisfactory fit to the income distribution data. Therefore, the first modeling attempt made was to forecast the twenty cutoff points individually by regression equation, using numerical methods of integration to complete the income distribution. In this way, there would be no imposition of a single functional form. However, this freedom sometimes resulted in forecasts of odd-shaped income distributions, particularly as the forecast went further into the future. At times, one ventile's upper limit might even move above that of the ventile above it. Many arbitrary fixes were required to keep the distribution in the proper increasing order. The forecasts of the income distribution were also quite sensitive and volatile, which made simulation studies difficult.

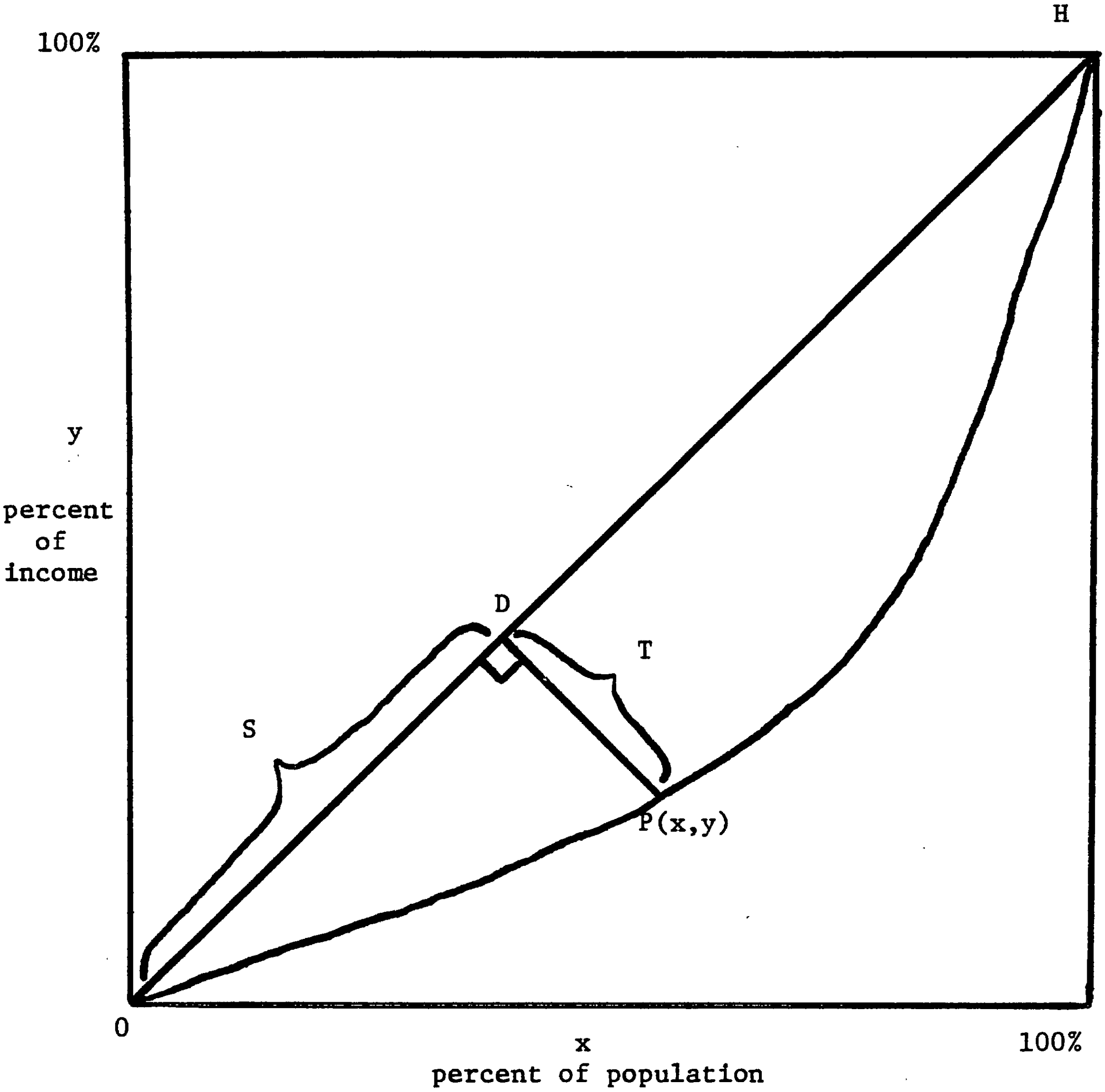
Because of the problems with the free-form distribution, it was felt that imposing a mathematical form that would guarantee sensible properties was necessary. Most previous efforts fit functions to frequency density functions. The curves used were mathematically complex such as the log-normal, F, Cauchy, or Gamma; and none fit very well. An alternative introduced by Kakwani and Podder (1976) is to fit the distribution instead to the Lorenz curve. Several functions can be devised to fit the curve in terms of alternate coordinates (S and T) shown in figure 2.1.

The procedure used is particularly well-suited to grouped distribution data, which corresponds to the reporting method actually used by the IRS. The data used are reported in Statistics of Income, (SOI), published annually by the IRS. The data come from the section of tables titled: "All Returns: Exemptions by Type, Number of Exemptions, Sources of Income, by Size of Adjusted Gross Income, returns classified by number of exemptions other than age or blindness."

Considerable effort went into finding the best way to implement the

FIGURE 2.1

THE LORENZ CURVE TRANSFORMATION.



2.1) $S = (x + y)/\sqrt{2}$ 2.2) $T = (x - y)/\sqrt{2}$

2.3) $x = (S + T)/\sqrt{2}$ 2.4) $y = (S - T)/\sqrt{2}$

smooth Lorenz curve approach. Several functions were tried, and the best one was the CES function. This method showed so much potential that is was implemented completely, and the entire tax model was built around it. However, the problem of goodness of fit with smooth functions was not adequately alleviated. Another approach was adopted which used the same basic Lorenz curve framework in "T and S" space. A complete description, including tables on goodness of fit of the CES approach is found in appendix C. The CES procedure is the same as the final chosen procedure up to the point where the form of the function T=f(S) is chosen. Rather than the smooth CES function, the function finally used is a linear combination of an actual base year distribution and a smooth function representing deviations from that base.

The first step in the procedure is to forecast the size distribution of AGI. The distribution is defined in terms of a Lorenz curve. The Lorenz curve plots the cumulative percentage of population on the horizontal axis against the cumulative percentage of income received on the vertical axis. The curve is plotted in a unit square with the population arranged in ascending order of its income. The curve is a straight line if income is distributed equally, and will bow downward and to the right as the income distribution is more skewed.

Consider figure 2.1. Let P be any point on the Lorenz curve with coordinates P(x,y), where x is the cumulative percent of the population, and y is the corresponding cumulative percent of income. The line of equal distribution is the diagonal running from 0 to H, and it is of length $\sqrt{2}$. The angle ODP is a right angle by construction. The line segment OD is labled S, and the line segment DP is labled T. The lengths of S and T can be expressed in terms of x and y, and vice versa.

The Pythagorean theorem tells us that $S^2 + T^2 = x^2 + y^2$, and alternatively that $(\sqrt{2}-S)^2 + T^2 = (1-x)^2 + (1-y)^2$. Combining these two equations and solving for S yields:

2.1) $S = (x+y)/\sqrt{2}$

This equation, combined with the above information allow the derivation:

2.2) $T = (x-y)/\sqrt{2}$

Equations 1 and 2 can then be solved for x or y and combined to derive:

2.3) $x = (S+T)/\sqrt{2}$

2.4) $y = (S-T)/\sqrt{2}$

A full derivation of these formulae is found at the end of the mathematical appendix.

By definition, x must be greater than or equal to y. The restriction that income is positive must be imposed, meaning that S must be greater than or equal to T, or alternatively, the Lorenz curve must lie completely within the box. Observations of income groups with negative AGI could not be used. The Lorenz curve and size distribution of income may be defined by expressing T as a function of S.

The function $T = f(S)$ must conform to several restrictions if it is to describe a proper Lorenz curve: 1) y must always increase as x increases. 2) The Lorenz curve must always lie on or below the line of equal distribution. 3) T must be of length 0 at the corners when S is of length 0 or $\sqrt{2}$. 4) The second derivative of y with respect to x must always be positive. Kakwani and Podder (1976) show that these restrictions are met with the CES production function. The second and third of these conditions are also met for the version of the function actually used. The first condition is probably, but not necessarily met, and the fourth condition is violated, but only at the end points of the Lorenz curve in an empirically unimportant way.

Both the individual equation and the CES function approaches seemed lacking in certain respects. The first approach, where ventile cutoff incomes were each estimated separately, had the desirable property of fitting the history perfectly, but led to ill-defined and ill-shaped income distributions which did not meet any of the three restictions listed above in forecast and simulation exercises. The smooth functional form approach had well behaved forecast and simulation properties, but was unable to yield a curve which adequately fit the actual historical income distributions, particularly at the two extreme ends. An approach had to be found that not only fits the historical data well, but gives sensible forecasts. An alternative approach was developed which maintains and combines the desirable aspects of the above two methods, while minimizing their shortcomings.

The approach taken, which is described more concisely in the mathematical appendix, begins with a curve that fits one year of the history perfectly. Again, the Lorenz curve with T as a function of S is used, but this time with a different function f(S). The function is additive in two parts. The first part uses the exact income distribution from historical observation as its base, or starting point. The historical base year could have been any year or average of years but was chosen as 1981, because of its position near the end of the sample and the fact that there were 31 income groups published in SOI for each of the six household sizes for that year compared to only 15 published observations per distribution in 1982. Also, 1982 may have had an atypical distribution due to the recession that year. So the first part of the function is just the exact 1981 income distribution denoted as T81. This part consists of the actual values of T at various points along the x axis.

The second part of the function is a smooth but skewed curve to be added to the base. This curve represents values of T, the perpendicular distance from the diagonal, as a function of S, the distance along the diagonal at which the function is evaluated. The entire formula for the income distribution for year t, household size h is:

2.5) $$T_{thi} = A_{th}T81_{hi} + B_{th}\{S_{thi}^{1.5}(\sqrt{2}-S_{thi})^{.5}\}$$

The i subscript refers to the position along the distribution at which the function is evaluated, usually at the ventile points, where S_i corresponds to values of x which are multiples of .05. However, it is necessary, as will be discussed later, to evaluate the function at other points in order to combine household sizes. In particular, it will be necessary to construct a more detailed "grid" which consists of 50 quadruplets containing corresponding values of x_i, y_{thi}, S_{thi} and T_{thi}. Here, the 50 values of x_i will range from .02 to 1, increasing by increments of .02. A_{th} and B_{th} are parameters which are determined historically by regression, and forecast in time-series.

The curve, then, starts with an exact duplication of the 1981 distribution, scales it by a factor of "A" and then adds or subtracts a fraction "B" of the skewed curve defined by the formula in the second coterm of equation 2.5.

This approach solves the problems of the first two, because first, it fits the history well, in fact perfectly for 1981 (with values of 1 for A and 0 for B) and second, it maintains a well defined, smooth and appropriately-shaped curve in forecasts and simulations, because it begins with a well-shaped curve and deviates from it by a scaled version of another smooth, well-shaped curve.

Figures 2.2 and 2.3 show each of the two parts of equation 2.5 separately; the actual 1981 household size one distribution in figure 2.2 and the skewed deviations curve which can be scaled and added or subtracted in figure 2.3. Figure 2.4 shows the effects of scaling the actual curve, that is varying the A parameter only. Changes in the A parameter alone act to make the entire Lorenz curve more or less bowed. Figure 2.5 shows the effect of adding scaled versions of the skewed curve to an actual distribution (T81). Changes in the value of the B parameter act to skew the shape of the Lorenz curve to the left or the right.

Equation 2.5 could have had a third term which was the formula for the skewed curve with the exponents reversed. This would add another curve which was skewed to the left, or lower part of the distribution. But this extra term would be redundant in a regression determining the values of the three term's coefficients, meaning there would be near perfect multicollinearity between the second and third terms. A curve which could be represented as a linear combination of all three terms could also be represented as a linear combination of the first two, as in equation 2.5.

Figures 2.6 and 2.7 are evidence of this and of the versatility of the equation. Here, the parameters A and B are varied such that one end of the distribution is kept at its base level, while the other end becomes more or less skewed. In figure 2.6, where the lower end is unvaried, the parameters A and B move in opposite directions from their base values of 1 and 0 so that their effects cancel each other out in the lower part of the distribution. For example, the lower value of A

FIGURE 2.2

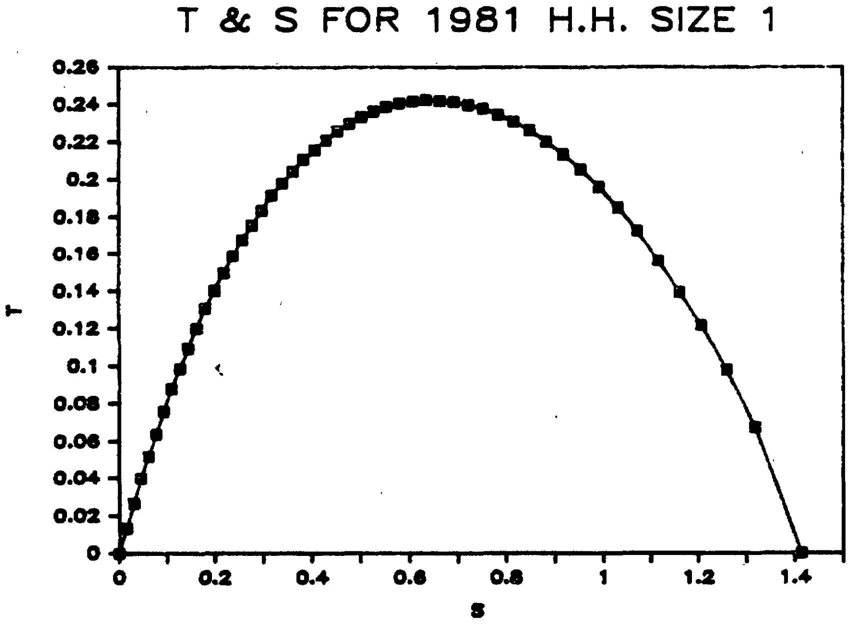


FIGURE 2.3

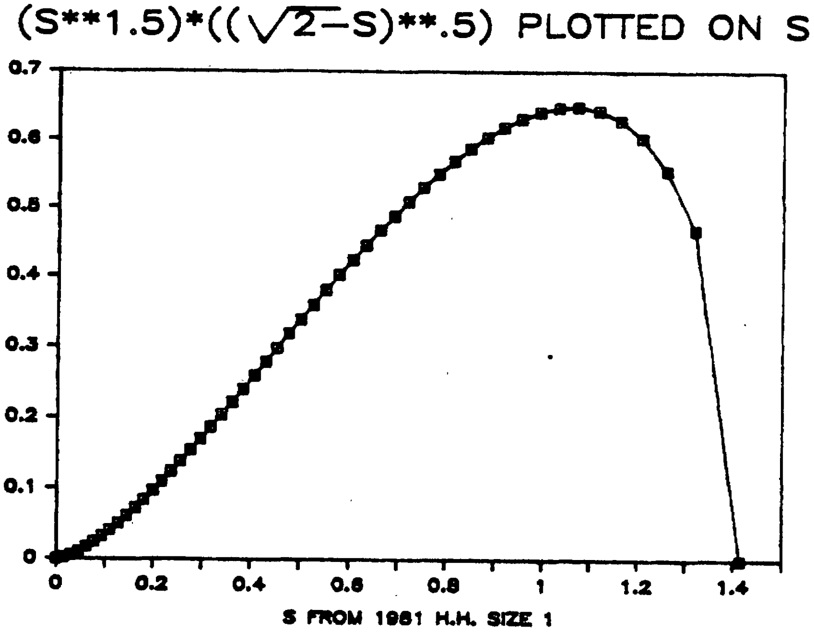


FIGURE 2.4

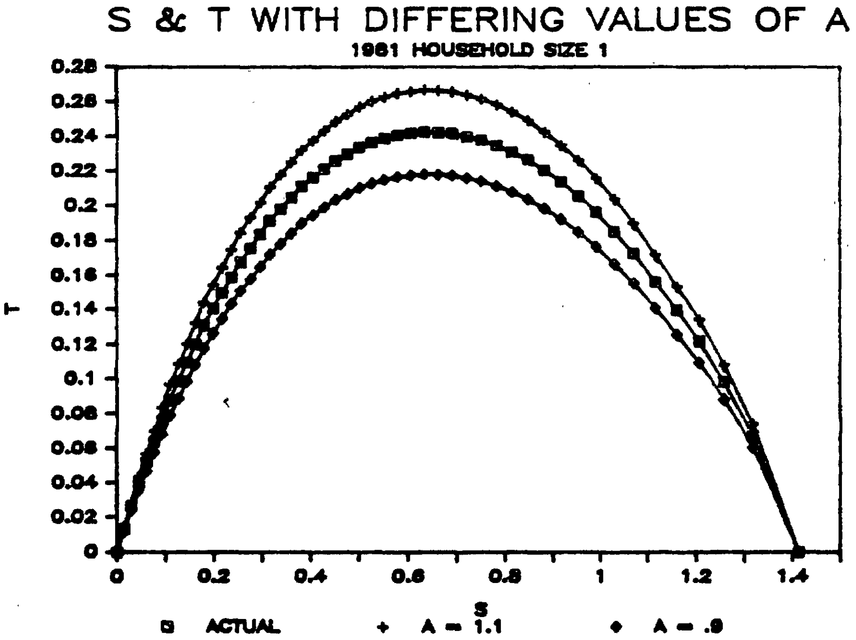


FIGURE 2.5

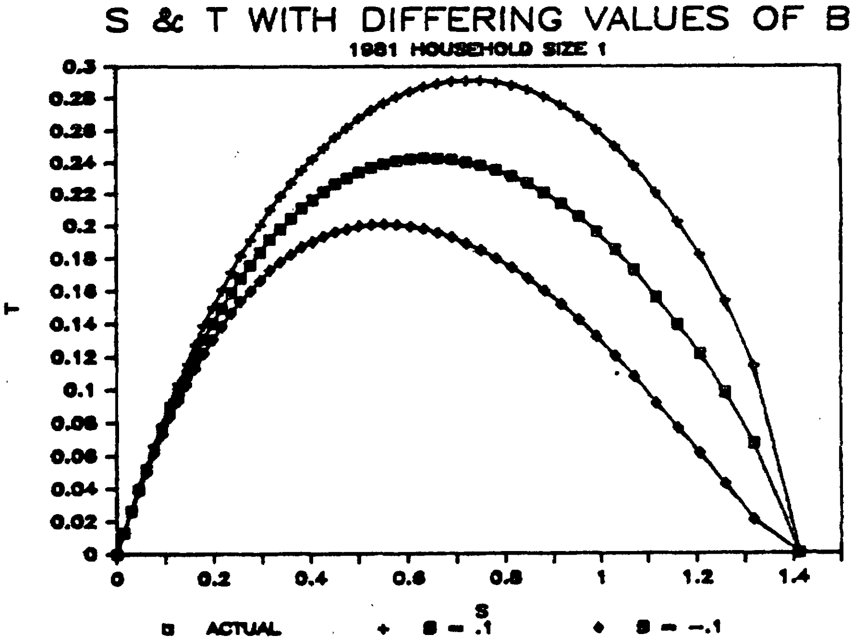


FIGURE 2.6

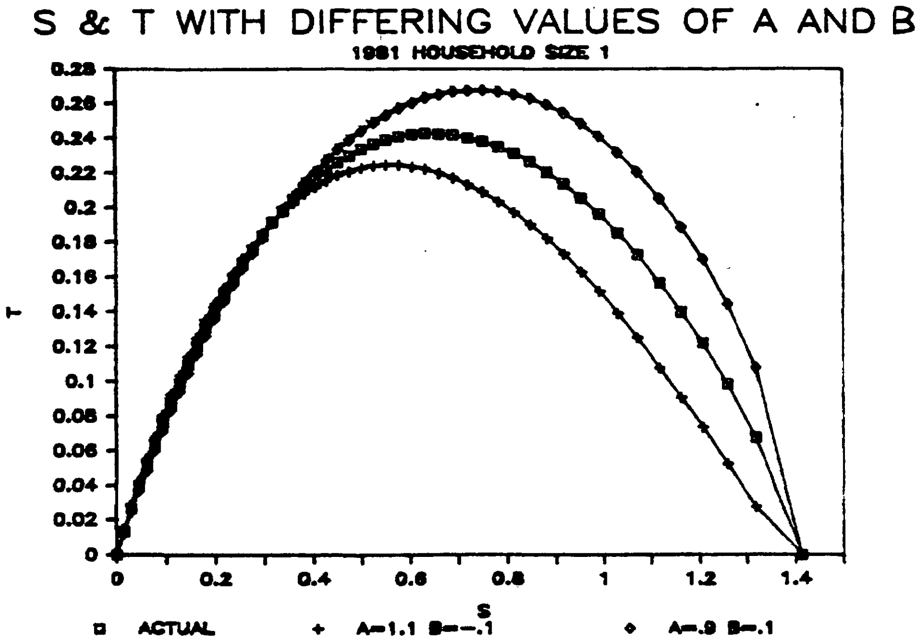
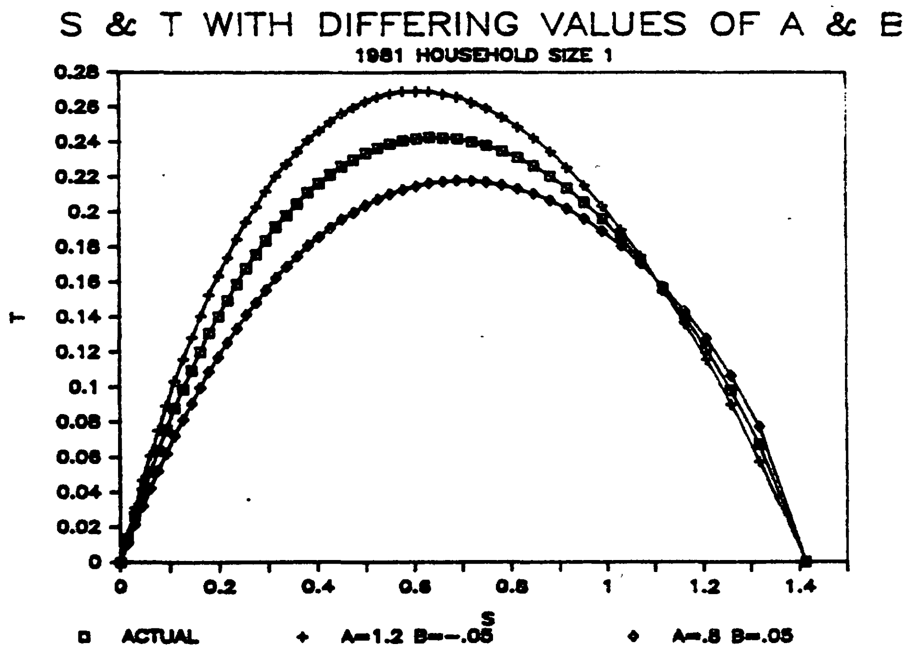


FIGURE 2.7



might be cancelled by a positive vaue value of B in the lower end, but at the upper end, the positive value of B would dominate, because the deviations curve is skewed more at the upper end. The result is an overall curve that is more skewed toward the upper end of the distribution.

Figure 2.7 shows the effects of a stronger variation in parameter A in combination with a weaker deviation in parameter B. Again, both parameters move in opposite directions. In this case, parameter B is too weak to offset the effect of parameter A in the lower part of the distribution, but is able to offset it in the upper part of the distribution. The curves here are similar to the base curve in the upper part but more skewed toward the lower part. These two graphs should make it clear that virtually any well-shaped and reasonable Lorenz curve can be represented by linear combinations of the actual 1981 distribution, T81, and the skewed curve $S^{1.5}(\sqrt{2}-S)^{.5}$. It should be clear that the A and B parameters alone can accurately describe most well-shaped Lorenz curves. So it is the historical estimation and future forecasting of those parameters which are the essential parts of the income distribution model. The next section will describe the procedure

Estimation Procedure for A and B.

The estimations are done in the cross-section. One curve is estimated for each household size and each year for which there is data. The data set includes 16 years, 1966 and 1968-1982, and six household sizes, one through five, and six and over. (1967 is left out because the data were not published by household size that year.) There are 96

(6x16) curves estimated in all. The equation is estimated in the form shown in equation 2.5. First, the variable $T81_{hi}$ must be created, that is to say, the 1981 distribution must be defined. But to do this, one must first create the observations on x_{thi} and y_{thi}. The raw data from SOI are grouped according to income brackets with each distribution having between 15 and 31 published brackets. Let r_{thj} and q_{thj} be the number of returns and the amount of income published in bracket j. Let R_{th} and Q_{th} be the total number of returns and amount of income in year t, household size h. Then x_{thj} and y_{thj} are obtained by cumulating the observations and converting them to percentage terms.

2.6) $$x_{thj} = \sum_{n=1}^{j} r_{thn}/R_{th}$$

2.7) $$y_{thj} = \sum_{n=1}^{j} r_{thn}/Q_{th}$$

Linear interpolation is then used to get 40 values of yy_{thk} which correspond to 40 values of xx_k chosen to be .025, .05, .075...1.0. (k varies from 1 to 40). The linear interpolation is performed in the following manner. If the value of xx_k falls between x_{thj} and x_{thj+1}, then the value of yy_{thk} (which corresponds to the value of xx_k) would be calculated as

2.8) $$yy_{thk} = \{(xx_k - x_{thj})/(x_{thj+1} - x_{thj})\}*(y_{thj+1} - y_{thj}) + y_{thj}$$

These 40 values of xx and yy for each year and household size are then used in equations 2.1 and 2.2 to obtain 40 corresponding values of S_{thk} and T_{thk}. The values of T_{thk} for the year 1981 are then called $T81_{hk}$. The procedure is followed for all the years in the sample. The values for T_{thk} are used on the left hand side of equation 2.5, and the values of $T81_{hk}$ and S_{thk} are used on the right. Equation 2.5 is then estimated with ordinary least squares, using 40 observations for each of the 96 equations. The estimates of parameters A_{th} and B_{th} are thus obtained. Table 2.1 shows the summary statistics for these estimations.

It should be noted here that because of the definition and structure of the data points, heteroscedasticity is necessarily present. No attempt was made to correct for this or for the possible correlation of error terms by using a generalized least-squares estimation technique. In their article, Kakwani and Podder did use four such techniques and found they made little difference in the estimated parameter values. The ordinary least-squares approach used here still generates unbiased parameter estimates. The use of 40 data points standardized by interpolation for the estimation procedure eliminated the inconsistencies in the number and location of the actual data points reported in SOI which varied significantly from year to year.

Table 2.1 shows that the parameter estimating equations fit the historical data very well. However, one must remember that these are equations relating T to S. How does this prodedure fit the Lorenz curve representation, which relates y to x? An even better question is how this method fits the data when examined in terms of the dollar amount of income in each ventile of each distribution. Table 2.2 shows just that, but before examining it we should discuss how the approach transforms values of A and B to dollars per ventile.

Once the parameters of the CES function have been estimated, a functional relationship between T and S is defined for each curve. However, the Lorenz curve must be defined in terms of a relationship between x and y. This is done numerically. Calculated values of S_{hg}, $T81_{hg}$, x_g and y_{hg} from the 1981 distribution are used. The g subscript refers to the position in a "grid" of 50 ordered quadruplets which was constructed in the same manner as the xx's and yy's. This grid is of size 50, and the values of x_g are equally spaced at .02,.04,.06...1.0. The grid was constructed to facilitate this part of the procedure; that is, to numerically translate values of A and B to values of x and y.

The grid values of S from 1981 and T81 are inserted into equation 2.5 with the estimated values of A and B. The result is a new vector of values for T. These new T's and the S's used to generate them (the grid values of S from 1981) are inserted into equations 2.3 and 2.4 to get the "predicted" or fitted values for x and y for the history. These values for x are not equally spaced, however, so another linear interpolation must be performed. In this case, we seek to get values of y which correspond to twenty ventile values of x_i (x = .05,.1,.15,...1.0). The procedure, then, is to interpolate x_i between the grid values of x just calculated, just as the interpolation in equation 2.8 was performed. The size of fifty for the grid was chosen because it is large enough to give a very good approximation of the curvature of the Lorenz curve despite the use of linear interpolation. Experimentation with more detailed grids of size 100 and 200 did not change the results significantly.

Since the forecast values of x and y are in percentage terms, it is a simple matter to convert them to the number of people, X_{thg}, and dollar amount of income Y_{thg}, for year t, size h and grid cell g. The required pieces of data are the total population and AGI for each household size per year. The macro model determines both numbers in the aggregate, and the equations in tables 2.7 and 2.8 show how the aggregate is divided among the six household sizes. Let R_{th} be the number of people in household size h, year t, and Q_{th} be that group's adjusted gross income. X_{thi} and Y_{thi} are defined:

2. 9) $$X_{thi} = (x_{thi} - x_{thi-1}) * R_{th} * H$$

2.10) $$Y_{thi} = (y_{thi} - y_{thi-1}) * Q_{th}$$

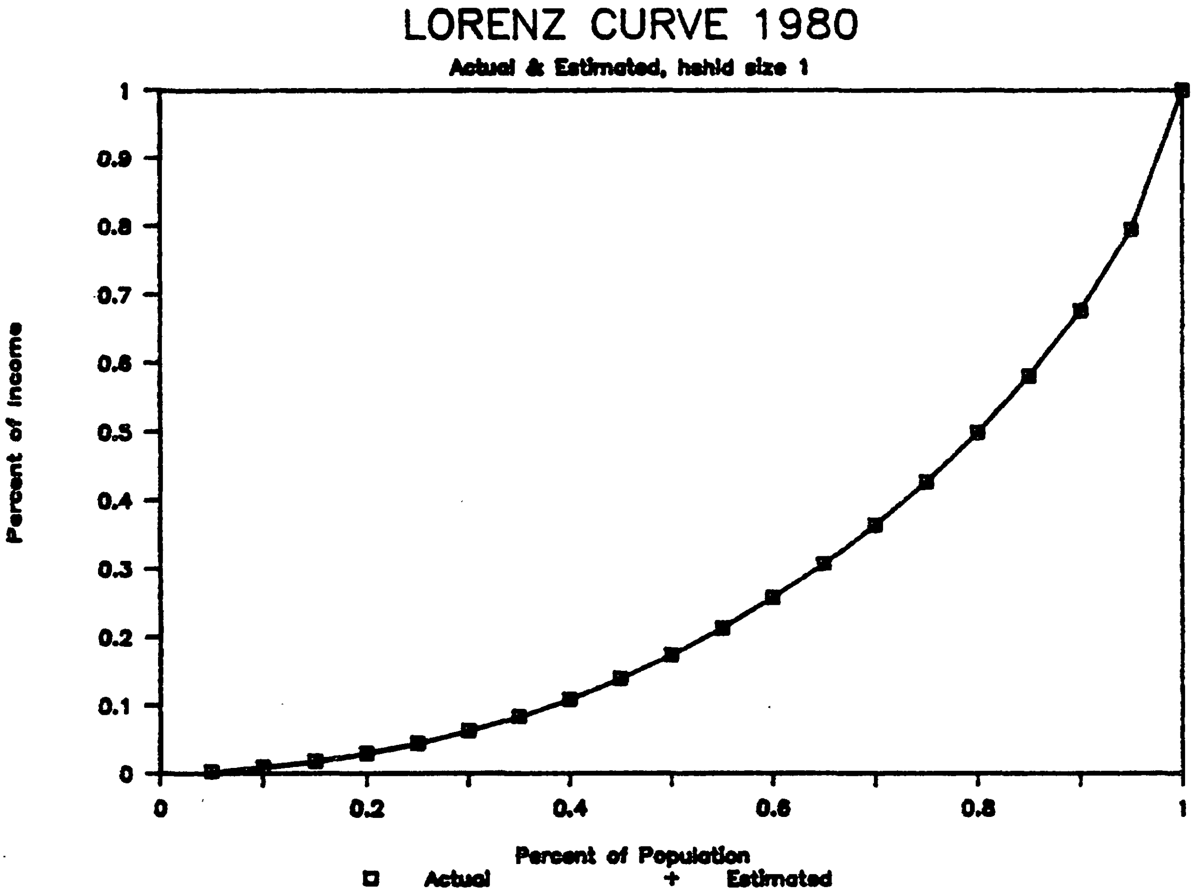
H = h, except when h = 6; then H is the overall average household size of the six and over household size group.

Table 2.2 shows the fitted data compared to the interpolated but not otherwise transformed data. Although the equations were estimated with 40 data points, in order to save space and be directly comparable to the CES method, table 2.2 condenses the distributions into 20 equally populated groups, or ventiles. The years 1966, 1970, 1975 and 1980 were chosen for display only because of their relative positions in the time-series, not because they had better or worse than average fits. The fit for 1981 is perfect by definition, because the values for A and B in 1981 are 1 and 0 for all household sizes. By comparing the percent residual columns of both table 2.2 and the CES table shown in table C.2 of appendix C, one can see that the fit improves with use of the derivations from base function over the CES function.

The first column of table 2.2 shows the horizontal coordinates, and the next two columns show the actual and estimated vertical coordinates. The fits appeared excellent when viewed this way. There is almost never a miss of over half a percent. Figure 2.8 shows a typical plot of an actual Lorenz curve against the estimated version. The two are nearly indistinguishable when viewed on this scale.

The third and fourth columns of table 2.2 show the same data, but the cumulative percentages of income are converted to number of people and dollars of income per ventile. The estimation is subtracted from the actual reported amount and shown as the residual in the last column of each table. The residuals, by construction, sum to zero in dollar

FIGURE 2.8


LORENZ CURVE 1980
Actual & Estimated, hshld size 1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Percent of Income
0
0.2
0.4
0.6
0.8
1
Percent of Population
□ Actual
+ Estimated

terms.

Interpretation and Forecast of the Parameters.

The parameters A and B have economic interpretations. As A increases, the Lorenz curve becomes more bowed overall. In other words, the distribution of income becomes more unequal. As B increases, the curve also becomes more bowed, but particularly at the upper end. That is, the high income people are getting more unequal among themselves. Values of A greater than one combined with negative values of B may mean the shape of the curve is getting more skewed or bowed toward the lower end, or that the lower income people may be getting less equal among themselves relative to 1981.

In a recently published Brookings Institution study, Pechman (1985) writes: "There was virtually no change in the distribution of income as defined in this study between 1966 and 1985. However, this income concept includes transfer payments, which rose dramatically during this period. As a result, the distribution of income from market activity (wages and salaries, interest, dividends, rents, and windfall profits) must have become more unequal." We should expect the data on income distribution here to tell a consistent story. That is, this study should provide supporting evidence of Pechman's conclusion; it should reveal that AGI, like "market income" has been getting less equally distributed. This study does provide such evidence, as will soon be discussed.

This study also offers some evidence on the cyclical determinants of the income distribution. It seems that the time-series of parameters A and B show not only a secular trend, but also have some correlation with cyclical economic variables. The time-series of those parameters are shown in figures 2.9 and 2.10.

Making general statements about the equality or lack of equality of a particular income distribution is hazardous. Only in a very few special cases can it be said without ambiguity that one distribution is "more equal" than another. A convention will be adopted here, regarding the use of the term "equality," with the realization that it may not conform to other notions of equality. From here on, the equality of an income distribution over a certain range of income will be measured by the average length of "T" on the Lorenz curve over that income range. Lower values of parameter A, then for example, tend to make the length of T shorter, and the income distribution more equal.

The parameters are assumed to be linear functions of a constant term, the unemployment rate, UN, the percentage of aggregate personal income made up of net interest and dividend income, PCTINC, the percentage change in the GNP deflator from the previous year, INFL, and a time trend, TIME. Table 2.3 shows the historical values of these variables. The equations estimated for each household size are:

2.11) $A = c + d*UN + e*PCTINC + f*INFL + g*TIME$

2.12) $B = c + d*UN + e*PCTINC + f*INFL + g*TIME$

Before discussing the results of the equation estimations, we should establish what we expect the results to be, starting with the time trend. The income distribution has been getting less equal over time, at least according to the Brookings study. Therefore, one must expect the A parameter has been increasing over time, and that the estimated coefficient on the time trend variable will be positive. Interpreting the B coefficient is not as straight forward. A value less

FIGURE 2.9

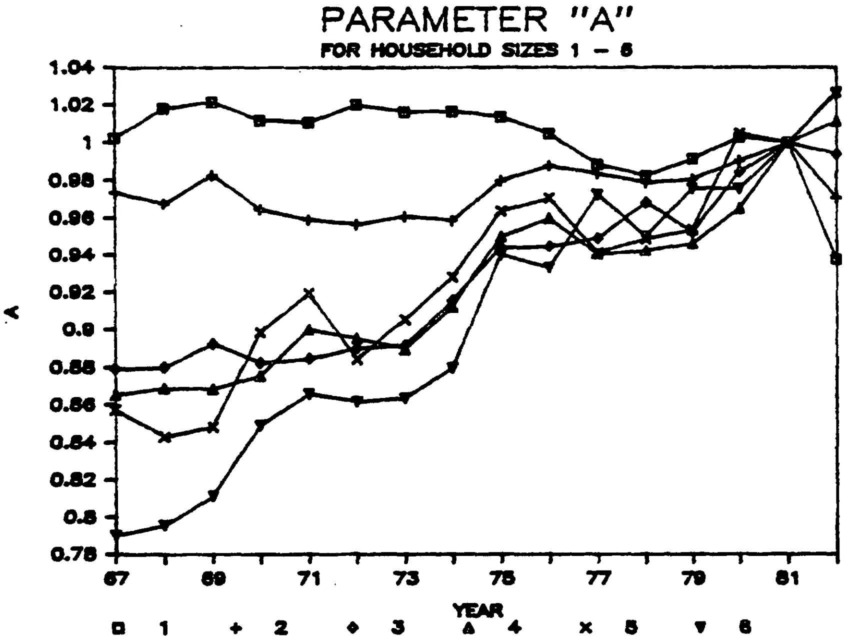
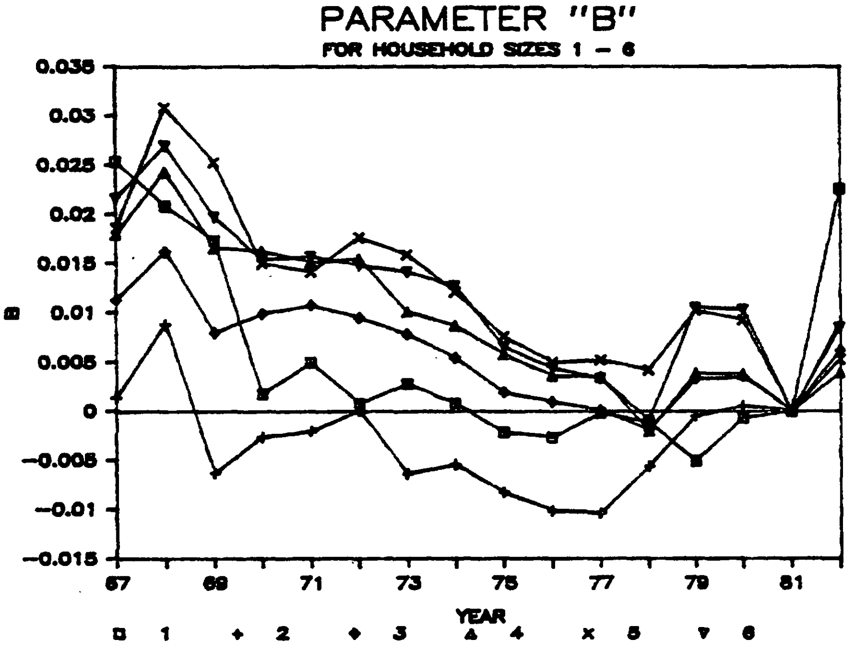


FIGURE 2.10



than 0 flattens the curve more at the top end than at the bottom, so a low value of B tends to skew the curve more towards the bottom end of the distribution. A high or positive value of B tends to skew the curve more toward the upper end. Since we believe the overall personal income distribution has been constant in the face of increasing welfare and transfer payments to poor people, we should believe that the AGI distribution has been getting more unequal - particularly at the lower end where the transfers have been accruing. Therefore, the coefficient on the time trend for parameter B should be negative in order to partially offset the increase in the upper part of the distribution due to the higher value of A, while allowing the increase in the lower part to remain. In other words, a negative value for the time trend coefficient for B would mean that the AGI distribution is getting relatively more bowed at the lower end. Indeed, as is apparent from figures 2.9 and 2.10, with few exceptions, the A parameters have been rising over time, while the B parameters have been flat or falling.

The unemployment rate should have an effect on the income distribution. Those who are laid off will have their incomes drastically reduced while the rest will not experience much change. While people at all income levels are affected by cyclical unemployment, those at the low end of the distribution are probably the most affected, because the last hired are usually the first fired, and those unfortunate ones are typically the lower paid junior employees. Therefore, we should expect the coefficient on the unemployment rate to be positive for parameter A and negative for parameter B.

The percent of personal income made up of interest and dividends has increased significantly over the sample period, while at the same time, has shown considerable cyclicality. The variable, PCTINC, is measured in the aggregate, not according to income ventile. So, while it is true that some lower income households, such as those headed by retirees, have a large share of their income from assets, in the aggregate, those at the very top of the income distribution receive a disproportionate share. Therefore, an increase in this variable means more income is accruing primarily to households in the upper ventiles. Thus, an increase in this variable will tend to exacerbate the inequality of the income distribution as a whole, and it should skew it more toward the top. That is, we should expect the estimated coefficients on PCTINC to be slightly positive for parameter A and more strongly positive for parameter B.

It is not entirely clear that inflation should have much of an effect on the income distribution. The Lorenz curve is defined to be homogeneous of degree one in income. That is, in a fully indexed economy, pure price level induced changes in income will not affect the shape of the Lorenz curve. However, there may be an effect to the extent that the economy is not indexed. While indexing has become more prevalent recently, with COLA's on social security, welfare, and many private pensions, and even changes in the minimum wage, the sample begins back in the 1960's when indexing was not as prevalent. Those who are adversely affected by inflation would be primarily those on fixed incomes, some elderly retired persons, and even a few wage earners. These people tend to be at the lower end of the income scale. Therefore, if inflation is to have an impact, it should be a weak one making the overall distribution less equal, so its coefficient should be positive for paramter A. Since the effect should be largest at the bottom end, we should expect B to be negative as well.

Table 2.4 shows the qualitative results from the regressions, including the prior expectations just discussed. Table 2.5 shows the quantitative results. Of the 48 parameters from the 12 equations, 42 have the expected signs. The ones with the unexpected signs were not statistically significant at the 5% level. Overall, 18 coefficients were statistically significant as measured by t-ratios. There might be some multicollinearity among the variables which would tend to produce estimated variances misleadingly high and therefore t-ratios misleadingly low. However, the coefficient estimates remain unbiased.

The time trend coefficient estimates back up the Brookings study providing additional evidence that the overall distribution of AGI or private income has recently gotten less equal, particularly at the lower end. The hypothesized effect of unemployment seems to be supported by these regressions as well. Also as expected, the inflation rate variable had little impact on the values of A and B. The results show a similarity among the household sizes in general. Household size one had the most signs contrary to expectations, (three), and household size 6-plus had two contrary coefficient signs. The equations fit least well in terms of corrected R-squared for household size two. That is because the parameters A and B show little movement over time and business cycles, indicating a fairly stable income distribution for that household size. The coefficients on the constant terms (shown in table 2.5) were mostly significant in the statistical sense.

Preparing the Data for Income Tax Calculation.

Once the function parameters are forecast for each year, they are used to construct each household size's income distribution. As described above, the distributions are constructed by enumerating a grid of 50 corresponding quadruplets, each corresponding to equally spaced values of x_g between .02 and 1. Ultimately, the income distribution will be defined in terms of twenty equally populated ventiles (20 equally spaced values of x_i between .05 and 1) each including persons from all household sizes. At this stage of the procedure, however, the household sizes are separate.

The household sizes are combined by determining cutoff per capita incomes for the aggregate ventiles. Think of a cutoff per capita income as the per capita income which divides one income ventile from the next. Alternatively, it could be viewed as the highest income of any of the people in a given ventile. It is of course the same for each household size, since it is per capita income that is being calculated, and the ventiles contain persons from all household sizes.

The grid values of x and y are converted into number of people, X, and dollars of income Y, in the intuitive manner by equations M.11 and M.12, in the mathematical appendix. Per capita income for year t, household size h, and grid cell g is then defined as:

2.13) $$PCI_{thg} = Y_{thg}/X_{thg}$$

The cutoff per capita income between grid cell g and g+1 for year t, household size h, PCC_{thg} is obtained by:

2.14) $$PCC_{thg} = (PCI_{thg} + PCI_{thg+1})/2$$

The different household sizes are combined into a single distribution per year by an algorithm where first, a guess is made of ventile i's cuttoff per capita income PCC_{ti} (i = 1...20). Then the number of people from each household size whose income falls between that guess and the previous ventile's cutoff per capita income, PCC_{thi-1} (this value is 0 for i=1) is estimated by interpolation. If the guess PCC_{ti} falls between the grid values of PCC_{thg} and PCC_{thg+1}, then the guess at the number of people in ventile i from household size h, year t is:

$$2.15) \quad X_{thi}=(PCC_{ti}-PCC_{thg}/(PCC_{thg+1}-PCC_{thg})*X_{thg}+X_{thg-1})$$

At the same time, an estimate of each cell's contribution to dollar income, Y_{thi}, is calculated in the same way as in equation 2.15 except with Y substituted for X. Now the X_{thi}'s are summed over household sizes, h. If that sum is more than 5% of the total population for that year, the process is repeated with a lower guess at the per capita income cutoff, PCC_{ti}. If the sum over h of X_{thi} is less than 5% of the population, the process is repeated with a higher PCC_{ti}. The process is repeated until it converges, and the sum is within a specified range (100 persons) of the true ventile population. For the next ventile the previous ventile's cutoff serves as a lower limit, and the same procedure is applied. The top ventile, then falls out as a residual, given the total amount of adjusted gross income that is to be allocated. The resulting X_{thi}'s and Y_{thi}'s for 1981 are shown in table 2.10 along with their sums over household sizes.

This system has many advantages. It determines not only the income cutoffs for each ventile, which are used by the consumption part of the model, but also the total amount of income received in each ventile. Also determined are the shares of both income and population which come from the six different household sizes in each ventile and overall. While just the aggregate ventiles are used for the consumption part of the model, the detail shown in table 2.10 is retained for the calculation of income tax liabilities. This is important data to have, because taxes are levied on a per household basis, not per capita, and household size is a significant factor in tax liability.

The determination of the income distribution is now complete. However, the description began by assuming that the adjusted gross income and population for each household size was given. Those numbers must be generated by the macro model. By the time the income distribution and taxes are to be estimated by the model, only an estimate of total personal income has been generated. The income distribution model must first convert personal income to AGI, and then split it up into the six household sizes. Similarly, the population must be converted to the number of taxpayers and allocated to the household sizes.

These steps of reconciliation between personal income and AGI will be described in Chapter 4, which explains the AGI-PI bridge. In fact, the first thing done by the income distribution model is to convert aggregate personal income to aggregate AGI. Then, after the distribution of AGI is determined, taxes are calculated. (Tax estimation is the subject of the next chapter.) Then, the after-tax distribution of AGI is converted back to a distribution of personal income, using the bridge described in Chapter 4.

The population base over which the income distribution model is estimated is the population of income tax filers with postive AGIs. The equation shown in table 2.6 determines this population base. IRS data only contain information on households who file tax returns. This subgroup of the overall population is referred to as "total exemptions" (other than age or blindness), and is the group over which the model distributes adjusted gross income. While total exemptions is about ninety four percent of total population in 1982 and rising, a forecast of it must be made and is done via a regression equation with the noninstitutional population and time as the explanatory variables.

The share of income and exemptions going to each of the six household sizes must also be determined. This is explained by the inverse of the share of the population which is 65 years of age or older. As this variable increases, one would expect the share of small household sizes and their incomes to increase. Note that this variable is really little more than a time trend, especially in the forecast. Using the same set of independent variables for each equation in a system of share equations ensures that the predicted values will sum to 100 percent. The choice of this particular variable was due to its reasonable looking forecasts, and the fact that it was much easier to estimate and get the sums to be 100 percent than say, a logistic curve. The regression results are shown in tables 2.7 and 2.8. Finally, the average household size in the six and above group must be forecast. It is explained by a time trend and the results are shown in table 2.9.

TABLE 2.1

REGRESSION RESULTS.

```
YEAR  1967   HH SIZE  1  ¦ YEAR  1967    HH SIZE 2  ¦ YEAR  1967    HH SIZE 3
RSQ 0.9977 RBARSQ 0.9976 ¦ RSQ 0.9980 RBARSQ 0.9979 ¦ RSQ 0.9960 RBARSQ 0.9959
RHO 0.9191 AAPE   2.9376 ¦ RHO 0.7895 AAPE   1.3637 ¦ RHO 0.8620 AAPE   2.3768
A    1.0024 T-STAT 152.20 ¦ A   0.9737 T-STAT 175.82  A   0.8791 T-STAT 129.28
B    0.0254 T-STAT   8.24 ¦ B   0.0013 T-STAT   0.60 ¦ B   0.0113 T-STAT   4.73

YEAR  1967   HH SIZE  4  ¦ YEAR  1967    HH SIZE 5  ¦ YEAR  1967    HH SIZE 6
RSQ 0.9956 RBARSQ 0.9954 ¦ RSQ 0.9963 RBARSQ 0.9962 ¦ RSQ 0.9946 RBARSQ 0.9944
RHO 0.5675 AAPE   2.1708 ¦ RHO 0.4519 AAPE   2.0788 ¦ RHO 0.6079 AAPE   3.0645
A   0.8655 T-STAT 118.50 ¦ A   0.8573 T-STAT 124.24 ¦ A   0.7901 T-STAT  95.50
B   0.0180 T-STAT   7.75 ¦ B   0.0186 T-STAT   8.41 ¦ B   0.0216 T-STAT   7.60

YEAR  1968   HH SIZE  1  ¦ YEAR  1968    HH SIZE 2  ¦ YEAR  1968    HH SIZE 3
RSQ 0.9989 RBARSQ 0.9989 ¦ RSQ 0.9968 RBARSQ 0.9967 ¦ RSQ 0.9913 RBARSQ 0.9910
RHO 0.8881 AAPE   1.5134 ¦ RHO 0.8905 AAPE   1.6565 ¦ RHO 0.9393 AAPE   3.1845
A   1.0181 T-STAT 228.22 ¦ A   0.9676 T-STAT 138.08 ¦ A   0.8801 T-STAT  87.97
B   0.0208 T-STAT   9.96 ¦ B   0.0088 T-STAT   3.15 ¦ B   0.0162 T-STAT   4.60

YEAR  1968   HH SIZE  4  ¦ YEAR  1968    HH SIZE 5  ¦ YEAR  1968    HH SIZE 6
RSQ 0.9916 RBARSQ 0.9914 ¦ RSQ 0.9936 RBARSQ 0.9934 ¦ RSQ 0.9917 RBARSQ 0.9915
RHO 0.8964 AAPE   2.9870 ¦ RHO 0.8814 AAPE   2.5788 ¦ RHO 0.9151 AAPE   3.2916
A   0.8688 T-STAT  87.55 ¦ A   0.8430 T-STAT  92.66 ¦ A   0.7956 T-STAT  77.93
B   0.0243 T-STAT   7.73 ¦ B   0.0308 T-STAT  10.57 ¦ B   0.0269 T-STAT   7.69

YEAR  1969   HH SIZE  1  ¦ YEAR  1969    HH SIZE 2  ¦ YEAR  1969    HH SIZE 3
RSQ 0.9987 RBARSQ 0.9987 ¦ RSQ 0.9949 RBARSQ 0.9948 ¦ RSQ 0.9903 RBARSQ 0.9900
RHO 0.9054 AAPE   1.6240 ¦ RHO 0.9192 AAPE   2.0067 ¦ RHO 0.9194 AAPE   3.2512
A   1.0215 T-STAT 213.01 ¦ A   0.9828 T-STAT 114.38 ¦ A   0.8924 T-STAT  84.93
B   0.0173 T-STAT   7.71 ¦ B  -0.0063 T-STAT  -1.84 ¦ B   0.0079 T-STAT   2.14

YEAR  1969   HH SIZE  4  ¦ YEAR  1969    HH SIZE 5  ¦ YEAR  1969    HH SIZE 6
RSQ 0.9904 RBARSQ 0.9901 ¦ RSQ 0.9908 RBARSQ 0.9905 ¦ RSQ 0.9868 RBARSQ 0.9864
RHO 0.9324 AAPE   3.1548 ¦ RHO 0.8665 AAPE   3.1815 ¦ RHO 0.9132 AAPE   3.9820
A   0.8685 T-STAT  83.46 ¦ A   0.8483 T-STAT  78.81 ¦ A   0.8115 T-STAT  63.96
B   0.0166 T-STAT   5.03 ¦ B   0.0253 T-STAT   7.33 ¦ B   0.0197 T-STAT   4.54

YEAR  1970   HH SIZE  1  ¦ YEAR  1970    HH SIZE 2  ¦ YEAR  1970    HH SIZE 3
RSQ 0.9993 RBARSQ 0.9992 ¦ RSQ 0.9990 RBARSQ 0.9989 ¦ RSQ 0.9979 RBARSQ 0.9979
RHO 0.8481 AAPE   1.0799 ¦ RHO 0.7542 AAPE   1.2057 ¦ RHO 0.8058 AAPE   1.9257
A   1.0118 T-STAT 287.17 ¦ A   0.9646 T-STAT 245.98 ¦ A   0.8824 T-STAT 176.85
B   0.0017 T-STAT   1.05 ¦ B  -0.0026 T-STAT  -1.67 ¦ B   0.0099 T-STAT   5.62

YEAR  1970   HH SIZE  4  ¦ YEAR  1970    HH SIZE 5  ¦ YEAR  1970    HH SIZE 6
RSQ 0.9978 RBARSQ 0.9977 ¦ RSQ 0.9979 RBARSQ 0.9978 ¦ RSQ 0.9977 RBARSQ 0.9976
RHO 0.6584 AAPE   1.6616 ¦ RHO 0.6288 AAPE   1.3586 ¦ RHO 0.6911 AAPE   2.0974
A   0.8755 T-STAT 166.01 ¦ A   0.8985 T-STAT 165.83 ¦ A   0.8491 T-STAT 150.29
B   0.0163 T-STAT   9.69 ¦ B   0.0150 T-STAT   8.57 ¦ B   0.0154 T-STAT   7.88

YEAR  1971   HH SIZE  1  ¦ YEAR  1971    HH SIZE 2  ¦ YEAR  1971    HH SIZE 3
RSQ 0.9993 RBARSQ 0.9993 ¦ RSQ 0.9988 RBARSQ 0.9987 ¦ RSQ 0.9982 RBARSQ 0.9982
RHO 0.8351 AAPE   1.0061 ¦ RHO 0.8079 AAPE   1.4283 ¦ RHO 0.7961 AAPE   1.3183
A   1.0106 T-STAT 294.19 ¦ A   0.9590 T-STAT 223.78 ¦ A   0.8844 T-STAT 191.79
B   0.0050 T-STAT   3.10 ¦ B  -0.0020 T-STAT  -1.18 ¦ B   0.0107 T-STAT   6.60

YEAR  1971   HH SIZE  4  ¦ YEAR  1971    HH SIZE 5  ¦ YEAR  1971    HH SIZE 6
RSQ 0.9981 RBARSQ 0.9980 ¦ RSQ 0.9984 RBARSQ 0.9984 ¦ RSQ 0.9979 RBARSQ 0.9978
RHO 0.5579 AAPE   1.4739 ¦ RHO 0.4606 AAPE   1.1835 ¦ RHO 0.6807 AAPE   2.1363
A   0.9000 T-STAT 180.83 ¦ A   0.9194 T-STAT 194.81 ¦ A   0.8658 T-STAT 158.26
B   0.0151 T-STAT   9.52 ¦ B   0.0141 T-STAT   9.27 ¦ B   0.0157 T-STAT   8.31
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TABLE 2.1 (continued)

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YEAR  1972   HH SIZE  1  : YEAR  1972    HH SIZE 2  : YEAR  1972    HH SIZE 3
RSQ 0. 9995 RBARSQ 0. 9995 : RSQ 0. 9992 RBARSQ 0. 9992 : RSQ 0. 9985 RBARSQ 0. 9984
RHO 0. 8311 AAPE   1. 3489 : RHO 0. 7192 AAPE   1. 1668 : RHO 0. 8460 AAPE   1. 7184
A   1. 0200 T-STAT 345. 39 : A   0. 9566 T-STAT 276. 29 : A   0. 8900 T-STAT 206. 22
B   0. 0008 T-STAT   0. 55 : B   0. 0001 T-STAT   0. 05 : B   0. 0094 T-STAT   6. 20

YEAR  1972   HH SIZE  4  : YEAR  1972    HH SIZE 5  : YEAR  1972    HH SIZE 6
RSQ 0. 9986 RBARSQ 0. 9986 : RSQ 0. 9992 RBARSQ 0. 9992 : RSQ 0. 9979 RBARSQ 0. 9979
RHO 0. 4009 AAPE   1. 3960 : RHO 0. 3375 AAPE   1. 1064 : RHO 0. 8013 AAPE   2. 1303
A   0. 8951 T-STAT 215. 01 : A   0. 8842 T-STAT 269. 19 : A   0. 8616 T-STAT 162. 15
B   0. 0155 T-STAT  11. 66 : B   0. 0176 T-STAT  16. 68 : B   0. 0148 T-STAT   8. 05

YEAR  1973   HH SIZE  1  : YEAR  1973    HH SIZE 2  : YEAR  1973    HH SIZE 3
RSQ 0. 9995 RBARSQ 0. 9994 : RSQ 0. 9991 RBARSQ 0. 9990 : RSQ 0. 9987 RBARSQ 0. 9986
RHO 0. 8335 AAPE   1. 3485 : RHO 0. 8470 AAPE   1. 1621 : RHO 0. 7979 AAPE   1. 4881
A   1. 0163 T-STAT 333. 80 : A   0. 9609 T-STAT 259. 51 : A   0. 8916 T-STAT 221. 60
B   0. 0027 T-STAT   1. 93 : B  -0. 0063 T-STAT  -4. 29 : B   0. 0078 T-STAT   5. 46

YEAR  1973   HH SIZE  4  : YEAR  1973    HH SIZE 5  : YEAR  1973    HH SIZE 6
RSQ 0. 9981 RBARSQ 0. 9980 : RSQ 0. 9979 RBARSQ 0. 9979 : RSQ 0. 9975 RBARSQ 0. 9975
RHO 0. 6354 AAPE   1. 7425 : RHO 0. 7287 AAPE   1. 4209 : RHO 0. 8118 AAPE   1. 9108
A   0. 8894 T-STAT 184. 83 : A   0. 9054 T-STAT 168. 91 : A   0. 8635 T-STAT 148. 29
B   0. 0101 T-STAT   6. 58 : B   0. 0159 T-STAT   9. 20 : B   0. 0141 T-STAT   7. 01

YEAR  1974   HH SIZE  1  : YEAR  1974    HH SIZE 2  : YEAR  1974    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9997 : RSQ 0. 9984 RBARSQ 0. 9984 : RSQ 0. 9976 RBARSQ 0. 9975
RHO 0. 7210 AAPE   0. 9930 : RHO 0. 7617 AAPE   1. 3547 : RHO 0. 7666 AAPE   1. 7588
A   1. 0165 T-STAT 476. 32 : A   0. 9587 T-STAT 200. 89 : A   0. 9155 T-STAT 168. 71
B   0. 0007 T-STAT   0. 74 : B  -0. 0054 T-STAT  -2. 85 : B   0. 0054 T-STAT   2. 81

YEAR  1974   HH SIZE  4  : YEAR  1974    HH SIZE 5  : YEAR  1974    HH SIZE 6
RSQ 0. 9973 RBARSQ 0. 9972 : RSQ 0. 9970 RBARSQ 0. 9970 : RSQ 0. 9972 RBARSQ 0. 9972
RHO 0. 7173 AAPE   1. 7248 : RHO 0. 8084 AAPE   1. 5627 : RHO 0. 8221 AAPE   1. 8918
A   0. 9123 T-STAT 156. 70 : A   0. 9279 T-STAT 144. 41 : A   0. 8798 T-STAT 141. 78
B   0. 0086 T-STAT   4. 65 : B   0. 0121 T-STAT   5. 84 : B   0. 0127 T-STAT   5. 91

YEAR  1975   HH SIZE  1  : YEAR  1975    HH SIZE 2  : YEAR  1975    HH SIZE 3
RSQ 0. 9998 RBARSQ 0. 9998 : RSQ 0. 9989 RBARSQ 0. 9989 : RSQ 0. 9979 RBARSQ 0. 9979
RHO 0. 7668 AAPE   0. 9102 : RHO 0. 6911 AAPE   0. 9148 : RHO 0. 7985 AAPE   1. 4767
A   1. 0136 T-STAT 511. 76 : A   0. 9799 T-STAT 244. 33 : A   0. 9440 T-STAT 182. 47
B  -0. 0022 T-STAT  -2. 36 : B  -0. 0083 T-STAT  -5. 15 : B   0. 0019 T-STAT   1. 03

YEAR  1975   HH SIZE  4  : YEAR  1975    HH SIZE 5  : YEAR  1975    HH SIZE 6
RSQ 0. 9975 RBARSQ 0. 9974 : RSQ 0. 9972 RBARSQ 0. 9972 : RSQ 0. 9969 RBARSQ 0. 9968
RHO 0. 7690 AAPE   1. 3978 : RHO 0. 8215 AAPE   1. 4801 : RHO 0. 8638 AAPE   1. 9450
A   0. 9501 T-STAT 165. 44 : A   0. 9637 T-STAT 151. 75 : A   0. 9401 T-STAT 138. 06
B   0. 0058 T-STAT   3. 15 : B   0. 0075 T-STAT   3. 65 : B   0. 0065 T-STAT   2. 73

YEAR  1976   HH SIZE  1  : YEAR  1976    HH SIZE 2  : YEAR  1976    HH SIZE 3
RSQ 0. 9998 RBARSQ 0. 9998 : RSQ 0. 9990 RBARSQ 0. 9990 : RSQ 0. 9981 RBARSQ 0. 9980
RHO 0. 2747 AAPE   0. 6381 : RHO 0. 7718 AAPE   0. 9036 : RHO 0. 7888 AAPE   1. 4527
A   1. 0046 T-STAT 620. 82 : A   0. 9877 T-STAT 250. 80 : A   0. 9447 T-STAT 188. 12
B  -0. 0027 T-STAT  -3. 58 : B  -0. 0101 T-STAT  -6. 42 : B   0. 0009 T-STAT   0. 53

YEAR  1976   HH SIZE  4  : YEAR  1976    HH SIZE 5  : YEAR  1976    HH SIZE 6
RSQ 0. 9971 RBARSQ 0. 9970 : RSQ 0. 9975 RBARSQ 0. 9974 : RSQ 0. 9970 RBARSQ 0. 9969
RHO 0. 8159 AAPE   1. 7866 : RHO 0. 7795 AAPE   1. 2468 : RHO 0. 7857 AAPE   1. 7795
A   0. 9597 T-STAT 154. 91 : A   0. 9704 T-STAT 159. 45 : A   0. 9329 T-STAT 140. 50
B   0. 0036 T-STAT   1. 79 : B   0. 0050 T-STAT   2. 52 : B   0. 0043 T-STAT   1. 88
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TABLE 2.1 (continued)

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YEAR  1977   HH SIZE  1  ¦ YEAR  1977    HH SIZE 2  ¦ YEAR  1977    HH SIZE 3
RSQ 0.9993 RBARSQ 0.9992 ¦ RSQ 0.9994 RBARSQ 0.9994 ¦ RSQ 0.9990 RBARSQ 0.9990
RHO 0 7929 AAPE   1.6768 ¦ RHO 0 4026 AAPE   0.7927 ¦ RHO 0.3608 AAPE   0 8879
A    0.9883 T-STAT 282.22 ¦ A    0.9834 T-STAT 327.04 ¦ A    0.9493 T-STAT 264.60
B  -0.0002 T-STAT  -0.12 ¦ B  -0 0104 T-STAT  -8.60 ¦ B   0.0001 T-STAT   0.07

YEAR  1977   HH SIZE  4  ¦ YEAR  1977    HH SIZE 5  ¦ YEAR  1977    HH SIZE 6
RSQ 0.9980 RBARSQ 0.9979 ¦ RSQ 0.9966 RBARSQ 0.9966 ¦ RSQ 0.9979 RBARSQ 0.9978
RHO 0.6634 AAPE   1.2446 ¦ RHO 0.7337 AAPE   1.5245 ¦ RHO 0.6181 AAPE   1.1751
A    0.9406 T-STAT 182.23 ¦ A    0.9415 T-STAT 134.92 ¦ A    0.9725 T-STAT 167.61
B    0.0035 T-STAT   2.12 ¦ B    0.0052 T-STAT   2.32 ¦ B    0.0033 T-STAT   1.63

YEAR  1978   HH SIZE  1  ¦ YEAR  1978    HH SIZE 2  ¦ YEAR  1978    HH SIZE 3
RSQ 0.9995 RBARSQ 0.9995 ¦ RSQ 0.9990 RBARSQ 0.9990 ¦ RSQ 0.9986 RBARSQ 0.9985
RHO 0.7160 AAPE   1.3619 ¦ RHO 0.5786 AAPE   0.7821 ¦ RHO 0.6492 AAPE   1.1773
A    0.9823 T-STAT 349.99 ¦ A    0.9789 T-STAT 248.79 ¦ A    0.9683 T-STAT 220.67
B  -0.0011 T-STAT  -0.88 ¦ B  -0.0056 T-STAT  -3.56 ¦ B  -0.0019 T-STAT  -1.24

YEAR  1978   HH SIZE  4  ¦ YEAR  1978    HH SIZE 5  ¦ YEAR  1978    HH SIZE 6
RSQ 0.9966 RBARSQ 0.9965 ¦ RSQ 0.9959 RBARSQ 0.9958 ¦ RSQ 0.9970 RBARSQ 0.9969
RHO 0.7191 AAPE   1.6871 ¦ RHO 0.5369 AAPE   1.5906 ¦ RHO 0.5533 AAPE   1.8359
A    0.9426 T-STAT 142.44 ¦ A    0.9490 T-STAT 122.98 ¦ A    0.9502 T-STAT 141.68
B  -0.0021 T-STAT  -0.97 ¦ B    0.0042 T-STAT   1.67 ¦ B  -0.0009 T-STAT  -0.41

YEAR  1979   HH SIZE  1  ¦ YEAR  1979    HH SIZE 2  ¦ YEAR  1979    HH SIZE 3
RSQ 0.9998 RBARSQ 0.9998 ¦ RSQ 0.9994 RBARSQ 0.9994 ¦ RSQ 0.9988 RBARSQ 0.9988
RHO 0.6773 AAPE   0.5128 ¦ RHO 0.6534 AAPE   0.7935 ¦ RHO 0.6711 AAPE   1.1275
A    0.9914 T-STAT 559.59 ¦ A    0.9805 T-STAT 312.79 ¦ A    0.9523 T-STAT 241.72
B  -0.0051 T-STAT  -6.23 ¦ B  -0.0005 T-STAT  -0.39 ¦ B    0.0033 T-STAT   2.34

YEAR  1979   HH SIZE  4  ¦ YEAR  1979    HH SIZE 5  ¦ YEAR  1979    HH SIZE 6
RSQ 0.9977 RBARSQ 0.9977 ¦ RSQ 0.9985 RBARSQ 0.9984 ¦ RSQ 0.9985 RBARSQ 0.9985
RHO 0.6138 AAPE   1.5121 ¦ RHO 0.6322 AAPE   1.0149 ¦ RHO 0.7019 AAPE   1.2856
A    0.9464 T-STAT 176.47 ¦ A    0.9538 T-STAT 204.24 ¦ A    0.9757 T-STAT 200..95
B    0.0038 T-STAT   2.24 ¦ B    0.0102 T-STAT   6.75 ¦ B    0.0105 T-STAT   6.18

YEAR  1980   HH SIZE  1  ¦ YEAR  1980    HH SIZE 2  ¦ YEAR  1980    HH SIZE 3
RSQ 0.9999 RBARSQ 0.9999 ¦ RSQ 0.9996 RBARSQ 0.9996 ¦ RSQ 0.9992 RBARSQ 0.9992
RHO 0.3615 AAPE   0.3303 ¦ RHO 0.3039 AAPE   0.5081 ¦ RHO 0.3628 AAPE   0.6293
A    1.0030 T-STAT 889.79 ¦ A    0.9906 T-STAT 384.88 ¦ A    0.9845 T-STAT 301.91
B  -0.0007 T-STAT  -1.33 ¦ B    0.0005 T-STAT   0.50 ¦ B    0.0035 T-STAT   3.01

YEAR  1980   HH SIZE  4  ¦ YEAR  1980    HH SIZE 5  ¦ YEAR  1980    HH SIZE 6
RSQ 0.9984 RBARSQ 0.9983 ¦ RSQ 0.9990 RBARSQ 0.9990 ¦ RSQ 0.9992 RBARSQ 0.9992
RHO 0.5981 AAPE   1.1892 ¦ RHO 0.5268 AAPE   0.6725 ¦ RHO 0.5358 AAPE   0.8314
A    0.9652 T-STAT 209.01 ¦ A    1.0051 T-STAT 255.50 ¦ A    0.9755 T-STAT 268.14
B    0.0037 T-STAT   2.53 ¦ B    0.0092 T-STAT   7.21 ¦ B    0.0103 T-STAT   8.08

YEAR  1982   HH SIZE  1  ¦ YEAR  1982    HH SIZE 2  ¦ YEAR  1982    HH SIZE 3
RSQ 0.9968 RBARSQ 0.9967 ¦ RSQ 0.9996 RBARSQ 0.9996 ¦ RSQ 0.9994 RBARSQ 0.9994
RHO 0.8809 AAPE   3.4056 ¦ RHO 0.5622 AAPE   0.8070 ¦ RHO 0.4857 AAPE   0.9196
A    0.9377 T-STAT 124.89 ¦ A    0.9707 T-STAT 364.66 ¦ A    0.9938 T-STAT 327.55
B    0.0226 T-STAT   6.52 ¦ B    0 0089 T-STAT   8.33 ¦ B    0.0062 T-STAT   5.68

YEAR  1982   HH SIZE  4  ¦ YEAR  1982    HH SIZE 5  ¦ YEAR  1982    HH SIZE 6
RSQ 0.9993 RBARSQ 0.9993 ¦ RSQ 0.9993 RBARSQ 0.9993 ¦ RSQ 0.9994 RBARSQ 0.9994
RHO 0.6251 AAPE   0.9040 ¦ RHO 0.7719 AAPE   1 0147 ¦ RHO 0.8720 AAPE   0.9410
A    1.0116 T-STAT 326 57 ¦ A    1.0269 T-STAT 305.28 ¦ A    1.0259 T-STAT 313.11
B    0.0039 T-STAT   3.92 ¦ B    0.0053 T-STAT   4.80 ¦ B    0.0084 T-STAT   7 29
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TABLE 2.2

THE FIT OF THE MODEL.

YEAR 1980 HOUSEHOLD SIZE 1

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00318	0.00296	1136.	1057.	6.9
0.10000	0.00956	0.00942	2276.	2305.	-1.3
0.15000	0.01770	0.01753	2903.	2892.	0.4
0.20000	0.03003	0.02977	4403.	4370.	0.8
0.25000	0.04359	0.04401	4839.	5080.	-5.0
0.30000	0.06242	0.06224	6720.	6507.	3.2
0.35000	0.08387	0.08396	7654.	7752.	-1.3
0.40000	0.10886	0.10943	8919.	9088.	-1.9
0.45000	0.13878	0.13936	10676.	10682.	-0.1
0.50000	0.17361	0.17394	12429.	12342.	0.7
0.55000	0.21291	0.21299	14024.	13934.	0.6
0.60000	0.25729	0.25733	15840.	15823.	0.1
0.65000	0.30735	0.30725	17864.	17817.	0.3
0.70000	0.36334	0.36317	19979.	19953.	0.1
0.75000	0.42713	0.42672	22767.	22679.	0.4
0.80000	0.49869	0.49819	25536.	25506.	0.1
0.85000	0.58096	0.58041	29361.	29342.	0.1
0.90000	0.67664	0.67790	34144.	34792.	-1.9
0.95000	0.79436	0.79454	42010.	41623.	0.9
1.00000	1.00000	1.00000	73385.	73322.	0.1

YEAR 1980 HOUSEHOLD SIZE 2

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00444	0.00455	2064.	2116.	-2.5
0.10000	0.01403	0.01430	4463.	4533.	-1.6
0.15000	0.02769	0.02789	6356.	6326.	0.5
0.20000	0.04443	0.04471	7785.	7822.	-0.5
0.25000	0.06412	0.06445	9159.	9183.	-0.3
0.30000	0.08721	0.08740	10740.	10676.	0.6
0.35000	0.11332	0.11358	12149.	12177.	-0.2
0.40000	0.14302	0.14317	13814.	13767.	0.3
0.45000	0.17606	0.17617	15368.	15348.	0.1
0.50000	0.21341	0.21336	17376.	17298.	0.4
0.55000	0.25474	0.25454	19225.	19156.	0.4
0.60000	0.30154	0.30205	21771.	22105.	-1.5
0.65000	0.35444	0.35287	24609.	23640.	3.9
0.70000	0.40734	0.40760	24609.	25460.	-3.5
0.75000	0.47049	0.46893	29373.	28526.	2.9
0.80000	0.53559	0.53793	30286.	32099.	-6.0
0.85000	0.61636	0.61564	37573.	36147.	3.8
0.90000	0.69713	0.69759	37573.	38121.	-1.5
0.95000	0.79754	0.79949	46707.	47405.	-1.5
1.00000	1.00000	1.00000	94180.	93271.	1.0

YEAR 1980 HOUSEHOLD SIZE 3

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00510	0.00528	1402.	1452.	-3.6
0.10000	0.01640	0.01651	3106.	3085.	0.7
0.15000	0.03139	0.03150	4121.	4123.	-0.1
0.20000	0.04969	0.04995	5030.	5070.	-0.8
0.25000	0.07190	0.07213	6107.	6099.	0.1
0.30000	0.09776	0.09801	7109.	7112.	-0.1
0.35000	0.12731	0.12756	8122.	8123.	-0.0
0.40000	0.16066	0.16076	9169.	9128.	0.5
0.45000	0.19794	0.19786	10248.	10200.	0.5
0.50000	0.23876	0.23938	11220.	11414.	-1.7
0.55000	0.28551	0.28579	12851.	12757.	0.7
0.60000	0.33554	0.33384	13754.	13209.	4.0
0.65000	0.38558	0.38532	13754.	14151.	-2.9
0.70000	0.44338	0.44229	15889.	15662.	1.4
0.75000	0.50447	0.50495	16793.	17225.	-2.6
0.80000	0.57323	0.57470	18903.	19173.	-1.4
0.85000	0.64956	0.64827	20983.	20225.	3.6
0.90000	0.72589	0.72740	20983.	21750.	-3.7
0.95000	0.82327	0.82459	26768.	26719.	0.2
1.00000	1.00000	1.00000	48582.	48219.	0.7

YEAR 1980 HOUSEHOLD SIZE 4

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00653	0.00708	1933.	2095.	-8.4
0.10000	0.01976	0.02054	3911.	3980.	-1.8
0.15000	0.03753	0.03832	5258.	5258.	-0.0
0.20000	0.05967	0.06031	6548.	6506.	0.6
0.25000	0.08575	0.08637	7715.	7708.	0.1
0.30000	0.11553	0.11600	8810.	8766.	0.5
0.35000	0.14905	0.14927	9913.	9841.	0.7
0.40000	0.18655	0.18711	11094.	11193.	-0.9
0.45000	0.22922	0.22835	12621.	12198.	3.4
0.50000	0.27188	0.26958	12621.	12198.	3.4
0.55000	0.31455	0.31497	12621.	13425.	-6.4
0.60000	0.36526	0.36453	14999.	14660.	2.3
0.65000	0.41716	0.41612	15353.	15263.	0.6
0.70000	0.47003	0.47282	15641.	16770.	-7.2
0.75000	0.53535	0.53574	19320.	18613.	3.7
0.80000	0.60066	0.59870	19320.	18624.	3.6
0.85000	0.66598	0.66584	19320.	19860.	-2.8
0.90000	0.74236	0.74274	22595.	22748.	-0.7
0.95000	0.83330	0.83537	26901.	27399.	-1.9
1.00000	1.00000	1.00000	49310.	48699.	1.2

TABLE 2.2 (continued)

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            YEAR 1980     HOUSEHOLD SIZE 5             |            YEAR 1980    HOUSEHOLD SIZE 6
ACTUAL  | ACTUAL|ESTIM.  | ACTUAL| ESTIM. |RESID.  |ACTUAL  | ACTUAL|ESTIM.  |ACTUAL  | ESTIM. |RESID.
% POP.  | % AGI | % AGI  | $ AGI | $ AGI  |   %    |% POP.  | % AGI | % AGI  | $ AGI  | $ AGI  |   %
--------|-------|--------|-------|--------|--------|--------|-------|--------|--------|--------|--------
0.05000|0.00563|0.00566|   826. |   832. |  -0.7 |0.05000|0.00637|0.00679|   553. |   590. |  -6.7
0.10000|0.01807|0.01814|  1828. |  1833. |  -0.2 |0.10000|0.01896|0.01960|  1095. |  1113. |  -1.7
0.15000|0.03476|0.03486|  2452. |  2456. |  -0.2 |0.15000|0.03583|0.03649|  1467. |  1468. |  -0.1
0.20000|0.05569|0.05559|  3074. |  3044. |   1.0 |0.20000|0.05614|0.05675|  1765. |  1761. |   0.2
0.25000|0.08042|0.08035|  3632. |  3636. |  -0.1 |0.25000|0.07978|0.08022|  2056. |  2041. |   0.7
0.30000|0.10886|0.10884|  4177. |  4186. |  -0.2 |0.30000|0.10698|0.10702|  2364. |  2329. |   1.5
0.35000|0.14075|0.14067|  4684. |  4675. |   0.2 |0.35000|0.13709|0.13692|  2617. |  2600. |   0.7
0.40000|0.17596|0.17686|  5173. |  5315..|  -2.7 |0.40000|0.17054|0.17019|  2907. |  2892. |   0.5
0.45000|0.21637|0.21623|  5934. |  5783. |   2.5 |0.45000|0.20721|0.20772|  3188. |  3263. |  -2.3
0.50000|0.25830|0.25643|  6160. |  5904. |   4.2 |0.50000|0.24869|0.24848|  3606. |  3544. |   1.7
0.55000|0.30024|0.30094|  6160. |  6538. |  -6.1 |0.55000|0.29277|0.29054|  3831. |  3656. |   4.6
0.60000|0.34869|0.34870|  7117. |  7015. |   1.4 |0.60000|0.33684|0.33661|  3831. |  4005. |  -4.5
0.65000|0.39967|0.39900|  7488. |  7387. |   1.3 |0.65000|0.38703|0.38623|  4363. |  4313. |   1.1
0.70000|0.45312|0.45556|  7851. |  8308. |  -5.8 |0.70000|0.44073|0.44123|  4668. |  4781. |  -2.4
0.75000|0.51727|0.51749|  9422. |  9097. |   3.4 |0.75000|0.49896|0.50129|  5062. |  5221. |  -3.1
0.80000|0.58141|0.57952|  9422. |  9110. |   3.3 |0.80000|0.56619|0.56592|  5844. |  5618. |   3.9
0.85000|0.64556|0.64483|  9422. |  9594. |  -1.8 |0.85000|0.63342|0.63210|  5844. |  5753. |   1.6
0.90000|0.72064|0.72088| 11028. | 11170. |  -1.3 |0.90000|0.71037|0.71027|  6689. |  6795. |  -1.6
0.95000|0.81616|0.81657| 14029. | 14054. |  -0.2 |0.95000|0.80598|0.80634|  8311. |  8352. |  -0.5
1.00000|1.00000|1.00000| 27003. | 26943. |   0.2 |1.00000|1.00000|1.00000| 16866. | 16834. |   0.2

            YEAR 1975     HOUSEHOLD SIZE 1             |            YEAR 1975    HOUSEHOLD SIZE 2
ACTUAL  | ACTUAL|ESTIM.  | ACTUAL| ESTIM. |RESID.  |ACTUAL  | ACTUAL|ESTIM.  |ACTUAL  | ESTIM. |RESID.
% POP.  | % AGI | % AGI  | $ AGI | $ AGI  |   %    |% POP.  | % AGI | % AGI  | $ AGI  | $ AGI  |   %
--------|-------|--------|-------|--------|--------|--------|-------|--------|--------|--------|--------
0.05000|0.00495|0.00360|   896. |   653. |  27.2 |0.05000|0.00480|0.00503|  1263. |  1324. |  -4.8
0.10000|0.00990|0.00914|   896. |  1002. | -11.8 |0.10000|0.01495|0.01538|  2669. |  2722. |  -2.0
0.15000|0.01786|0.01695|  1443. |  1416. |   1.8 |0.15000|0.02883|0.02944|  3653. |  3698. |  -1.2
0.20000|0.03072|0.02928|  2329. |  2234. |   4.1 |0.20000|0.04607|0.04687|  4535. |  4586. |  -1.1
0.25000|0.04357|0.04301|  2329. |  2487. |  -6.8 |0.25000|0.06635|0.06729|  5335. |  5370. |  -0.7
0.30000|0.06127|0.06055|  3207. |  3176. |   1.0 |0.30000|0.09004|0.09092|  6232. |  6219. |   0.2
0.35000|0.08273|0.08216|  3886. |  3916. |  -0.8 |0.35000|0.11731|0.11808|  7175. |  7143. |   0.4
0.40000|0.10605|0.10671|  4226. |  4447. |  -5.2 |0.40000|0.14814|0.14864|  8109. |  8040. |   0.9
0.45000|0.13620|0.13670|  5460. |  5432. |   0.5 |0.45000|0.18264|0.18276|  9075. |  8977. |   1.1
0.50000|0.16983|0.17065|  6091. |  6150. |  -1.0 |0.50000|0.22129|0.22099| 10167. | 10057. |   1.1
0.55000|0.20884|0.20955|  7067. |  7046. |   0.3 |0.55000|0.26390|0.26319| 11209. | 11102. |   1.0
0.60000|0.25413|0.25437|  8204. |  8118. |   1.0 |0.60000|0.31073|0.31107| 12320. | 12595. |  -2.2
0.65000|0.30302|0.30376|  8855. |  8947. |  -1.0 |0.65000|0.36179|0.36130| 13433. | 13215. |   1.6
0.70000|0.35910|0.35981| 10160. | 10153. |   0.1 |0.70000|0.42212|0.42003| 15870. | 15448. |   2.7
0.75000|0.42327|0.42367| 11623. | 11567. |   0.5 |0.75000|0.48522|0.48154| 16599. | 16183. |   2.5
0.80000|0.49610|0.49593| 13194. | 13091. |   0.8 |0.80000|0.54831|0.54962| 16599. | 17908. |  -7.9
0.85000|0.58037|0.57935| 15263. | 15110. |   1.0 |0.85000|0.62324|0.62437| 19709. | 19666. |   0.2
0.90000|0.67735|0.67775| 17568. | 17825. |  -1.5 |0.90000|0.70417|0.70616| 21290. | 21516. |  -1.1
0.95000|0.79537|0.79482| 21379. | 21206. |   0.8 |0.95000|0.80622|0.80821| 26848. | 26845. |   0.0
1.00000|1.00000|1.00000| 37067. | 37166. |  -0.3 |1.00000|1.00000|1.00000| 50976. | 50455. |   1.0
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TABLE 2.2 (continued)

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               YEAR 1975     HOUSEHOLD SIZE 3          |              YEAR 1975    HOUSEHOLD SIZE 4
ACTUAL  | ACTUAL|ESTIM.   | ACTUAL| ESTIM. |RESID.   |ACTUAL   | ACTUAL|ESTIM.   |ACTUAL   | ESTIM. |RESID.
% POP.  | % AGI | % AGI  | $ AGI | $ AGI  |   %     |% POP.   | % AGI | % AGI  | $ AGI   | $ AGI  |   %
--------|-------|--------|-------|--------|---------|---------|-------|--------|---------|--------|--------
0.05000|0.00534|0.00633|   857. |   1016. | -18.5  |0.05000|0.00686|0.00756|   1201. |   1324. | -10.3
0.10000|0.01759|0.01885|  1966. |   2009. |  -2.2  |0.10000|0.02116|0.02181|   2504. |   2495. |   0.4
0.15000|0.03427|0.03543|  2677. |   2662. |   0.6  |0.15000|0.03953|0.04010|   3216. |   3202. |   0.5
0.20000|0.05453|0.05553|  3252. |   3226. |   0.8  |0.20000|0.06230|0.06258|   3987. |   3937. |   1.3
0.25000|0.07863|0.07927|  3867. |   3809. |   1.5  |0.25000|0.08886|0.08900|   4650. |   4627. |   0.5
0.30000|0.10618|0.10652|  4421. |   4374. |   1.1  |0.30000|0.11886|0.11884|   5253. |   5225. |   0.5
0.35000|0.13737|0.13736|  5006. |   4949. |   1.1  |0.35000|0.15221|0.15209|   5840. |   5822. |   0.3
0.40000|0.17173|0.17146|  5513. |   5473. |   0.7  |0.40000|0.18878|0.18948|   6402. |   6547. |  -2.3
0.45000|0.20953|0.20915|  6067. |   6048. |   0.3  |0.45000|0.22838|0.22917|   6935. |   6953. |  -0.3
0.50000|0.25093|0.25118|  6644. |   6745. |  -1.5  |0.50000|0.27066|0.27023|   7402. |   7186. |   2.9
0.55000|0.29588|0.29683|  7214. |   7326. |  -1.5  |0.55000|0.32012|0.31894|   8660. |   8528. |   1.5
0.60000|0.34418|0.34415|  7752. |   7595. |   2.0  |0.60000|0.37144|0.36873|   8987. |   8719. |   3.0
0.65000|0.40184|0.39943|  9253. |   8871. |   4.1  |0.65000|0.42276|0.41996|   8987. |   8970. |   0.2
0.70000|0.46005|0.45653|  9341. |   9164. |   1.9  |0.70000|0.47409|0.47573|   8987. |   9765. |  -8.7
0.75000|0.51826|0.51751|  9341. |   9785. |  -4.7  |0.75000|0.53193|0.53479|  10128. |  10340. |  -2.1
0.80000|0.58013|0.58342|  9930. |  10578. |  -6.5  |0.80000|0.59762|0.59782|  11502. |  11035. |   4.1
0.85000|0.65506|0.65587| 12025. |  11628. |   3.3  |0.85000|0.66331|0.66498|  11502. |  11760. |  -2.2
0.90000|0.73341|0.73534| 12574. |  12752. |  -1.4  |0.90000|0.74237|0.74304|  13844. |  13667. |   1.3
0.95000|0.83138|0.83179| 15723. |  15480. |   1.5  |0.95000|0.84069|0.83914|  17216. |  16828. |   2.3
1.00000|1.00000|1.00000| 27060. |  26994. |   0.2  |1.00000|1.00000|1.00000|  27894. |  28165. |  -1.0

               YEAR 1975     HOUSEHOLD SIZE 5          |              YEAR 1975    HOUSEHOLD SIZE 6
ACTUAL  | ACTUAL|ESTIM.   | ACTUAL| ESTIM. |RESID.   |ACTUAL   | ACTUAL|ESTIM.   |ACTUAL   | ESTIM. |RESID.
% POP.  | % AGI | % AGI  | $ AGI | $ AGI  |   %     |% POP.   | % AGI | % AGI  | $ AGI   | $ AGI  |   %
--------|-------|--------|-------|--------|---------|---------|-------|--------|---------|--------|--------
0.05000|0.00672|0.00713|   665. |    706. |  -6.1  |0.05000|0.00616|0.00749|    464. |    564. | -21.5
0.10000|0.02019|0.02090|  1334. |   1364. |  -2.2  |0.10000|0.01996|0.02161|   1039. |   1063. |  -2.3
0.15000|0.03845|0.03911|  1808. |   1803. |   0.3  |0.15000|0.03800|0.03974|   1358. |   1365. |  -0.5
0.20000|0.06122|0.06139|  2255. |   2206. |   2.2  |0.20000|0.06020|0.06156|   1671. |   1643. |   1.7
0.25000|0.08737|0.08741|  2589. |   2576. |   0.5  |0.25000|0.08543|0.08640|   1900. |   1870. |   1.6
0.30000|0.11722|0.11709|  2956. |   2939. |   0.6  |0.30000|0.11401|0.11441|   2151. |   2108. |   2.0
0.35000|0.15012|0.14984|  3258. |   3243. |   0.5  |0.35000|0.14563|0.14555|   2381. |   2344. |   1.5
0.40000|0.18604|0.18668|  3556. |   3648. |  -2.6  |0.40000|0.18019|0.17979|   2602. |   2578. |   0.9
0.45000|0.22474|0.22550|  3832. |   3844. |  -0.3  |0.45000|0.21778|0.21811|   2830. |   2885. |  -1.9
0.50000|0.26796|0.26662|  4279. |   4072. |   4.9  |0.50000|0.25828|0.25870|   3049. |   3056. |  -0.2
0.55000|0.31648|0.31452|  4805. |   4743. |   1.3  |0.55000|0.30478|0.30228|   3501. |   3281. |   6.3
0.60000|0.36500|0.36243|  4805. |   4744. |   1.3  |0.60000|0.35466|0.35140|   3755. |   3698. |   1.5
0.65000|0.41352|0.41156|  4805. |   4865. |  -1.3  |0.65000|0.40455|0.40101|   3755. |   3735. |   0.5
0.70000|0.46204|0.46551|  4805. |   5343. | -11.2  |0.70000|0.45443|0.45411|   3755. |   3997. |  -6.4
0.75000|0.52331|0.52586|  6067. |   5976. |   1.5  |0.75000|0.50976|0.51261|   4165. |   4404. |  -5.7
0.80000|0.58532|0.58664|  6140. |   6019. |   2.0  |0.80000|0.57385|0.57553|   4825. |   4737. |   1.8
0.85000|0.65158|0.65269|  6561. |   6540. |   0.3  |0.85000|0.63794|0.63991|   4825. |   4846. |  -0.4
0.90000|0.72769|0.72869|  7536. |   7525. |   0.1  |0.90000|0.71657|0.71837|   5920. |   5906. |   0.2
0.95000|0.82901|0.82632| 10033. |   9667. |   3.7  |0.95000|0.81659|0.81568|   7529. |   7326. |   2.7
1.00000|1.00000|1.00000| 16931. |  17198. |  -1.6  |1.00000|1.00000|1.00000|  13807. |  13876. |  -0.5
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TABLE 2.2 (continued)

YEAR 1970 HOUSEHOLD SIZE 1

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00424	0.00327	458.	353.	22.9
0.10000	0.00848	0.00844	458.	559.	-22.0
0.15000	0.01782	0.01692	1010.	917.	9.2
0.20000	0.02861	0.02818	1165.	1216.	-4.4
0.25000	0.04675	0.04450	1960.	1763.	10.1
0.30000	0.06490	0.06218	1960.	1910.	2.5
0.35000	0.08304	0.08206	1960.	2148.	-9.6
0.40000	0.10640	0.10653	2524.	2644.	-4.7
0.45000	0.13662	0.13645	3264.	3232.	1.0
0.50000	0.16683	0.16857	3264.	3471.	-6.3
0.55000	0.20603	0.20743	4235.	4198.	0.9
0.60000	0.24877	0.25083	4617.	4688.	-1.5
0.65000	0.30003	0.30126	5538.	5449.	1.6
0.70000	0.35502	0.35661	5941.	5980.	-0.7
0.75000	0.42163	0.42154	7195.	7014.	2.5
0.80000	0.49516	0.49402	7943.	7830.	1.4
0.85000	0.57910	0.57718	9069.	8983.	0.9
0.90000	0.67633	0.67567	10504.	10640.	-1.3
0.95000	0.79241	0.79188	12540.	12554.	-0.1
1.00000	1.00000	1.00000	22426.	22484.	-0.3

YEAR 1970 HOUSEHOLD SIZE 2

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00551	0.00570	909.	940.	-3.4
0.10000	0.01552	0.01622	1649.	1733.	-5.1
0.15000	0.02891	0.03021	2205.	2305.	-4.5
0.20000	0.04692	0.04817	2969.	2959.	0.3
0.25000	0.06788	0.06902	3453.	3435.	0.5
0.30000	0.09113	0.09249	3830.	3867.	-1.0
0.35000	0.11938	0.12014	4655.	4556.	2.1
0.40000	0.15080	0.15098	5178.	5080.	1.9
0.45000	0.18538	0.18507	5698.	5619.	1.4
0.50000	0.22392	0.22314	6351.	6272.	1.2
0.55000	0.26690	0.26538	7080.	6959.	1.7
0.60000	0.31388	0.31313	7742.	7868.	-1.6
0.65000	0.36451	0.36295	8342.	8208.	1.6
0.70000	0.41966	0.41882	9088.	9207.	-1.3
0.75000	0.48022	0.47882	9978.	9886.	0.9
0.80000	0.54648	0.54818	10918.	11428.	-4.7
0.85000	0.62089	0.62242	12260.	12232.	0.2
0.90000	0.70846	0.70731	14430.	13988.	3.1
0.95000	0.80392	0.80591	15729.	16246.	-3.3
1.00000	1.00000	1.00000	32308.	31981.	1.0

YEAR 1970 HOUSEHOLD SIZE 3

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00749	0.00874	785.	916.	-16.7
0.10000	0.02133	0.02316	1451.	1510.	-4.1
0.15000	0.03964	0.04149	1917.	1921.	-0.2
0.20000	0.06129	0.06308	2269.	2262.	0.3
0.25000	0.08675	0.08814	2667.	2626.	1.5
0.30000	0.11613	0.11682	3079.	3004.	2.4
0.35000	0.14874	0.14873	3416.	3344.	2.1
0.40000	0.18379	0.18342	3672.	3634.	1.0
0.45000	0.22319	0.22201	4128.	4043.	2.1
0.50000	0.26531	0.26433	4413.	4434.	-0.5
0.55000	0.30968	0.30949	4648.	4732.	-1.8
0.60000	0.35832	0.35680	5096.	4956.	2.7
0.65000	0.41012	0.40877	5427.	5445.	-0.3
0.70000	0.46516	0.46384	5767.	5769.	-0.0
0.75000	0.52432	0.52462	6198.	6368.	-2.7
0.80000	0.58856	0.59090	6730.	6945.	-3.2
0.85000	0.66202	0.66192	7697.	7441.	3.3
0.90000	0.74120	0.74092	8296.	8277.	0.2
0.95000	0.83045	0.83197	9351.	9539.	-2.0
1.00000	1.00000	1.00000	17764.	17605.	0.9

YEAR 1970 HOUSEHOLD SIZE 4

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00888	0.01013	1018.	1162.	-14.1
0.10000	0.02531	0.02669	1884.	1899.	-0.8
0.15000	0.04640	0.04736	2419.	2370.	2.0
0.20000	0.07171	0.07193	2902.	2817.	2.9
0.25000	0.09989	0.09979	3232.	3194.	1.2
0.30000	0.13100	0.13063	3566.	3536.	0.8
0.35000	0.16619	0.16508	4035.	3950.	2.1
0.40000	0.20312	0.20272	4235.	4316.	-1.9
0.45000	0.24241	0.24227	4505.	4534.	-0.7
0.50000	0.28512	0.28351	4897.	4729.	3.4
0.55000	0.32952	0.32936	5091.	5258.	-3.3
0.60000	0.37706	0.37695	5451.	5456.	-0.1
0.65000	0.42779	0.42746	5817.	5792.	0.4
0.70000	0.48178	0.48382	6191.	6463.	-4.4
0.75000	0.53930	0.54204	6595.	6675.	-1.2
0.80000	0.60458	0.60426	7486.	7135.	4.7
0.85000	0.67529	0.67316	8108.	7900.	2.6
0.90000	0.74600	0.74614	8108.	8368.	-3.2
0.95000	0.83437	0.83610	10133.	10315.	-1.8
1.00000	1.00000	1.00000	18991.	18793.	1.0

TABLE 2.2 (continued)

YEAR 1970 HOUSEHOLD SIZE 5

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00888	0.00959	655.	707.	-7.9
0.10000	0.02481	0.02569	1174.	1187.	-1.1
0.15000	0.04537	0.04596	1516.	1495.	1.4
0.20000	0.06991	0.06988	1810.	1764.	2.5
0.25000	0.09786	0.09738	2060.	2027.	1.6
0.30000	0.12872	0.12801	2276.	2258.	0.8
0.35000	0.16207	0.16130	2459.	2455.	0.2
0.40000	0.19910	0.19882	2730.	2766.	-1.3
0.45000	0.23808	0.23785	2874.	2878.	-0.1
0.50000	0.27929	0.27805	3039.	2964.	2.5
0.55000	0.32396	0.32382	3293.	3375.	-2.5
0.60000	0.37066	0.37063	3444.	3451.	-0.2
0.65000	0.42001	0.41992	3639.	3634.	0.1
0.70000	0.47303	0.47555	3909.	4102.	-4.9
0.75000	0.52972	0.53310	4180.	4243.	-1.5
0.80000	0.59641	0.59574	4916.	4619.	6.1
0.85000	0.66351	0.66164	4947.	4859.	1.8
0.90000	0.73371	0.73392	5176.	5329.	-3.0
0.95000	0.82385	0.82483	6646.	6703.	-0.9
1.00000	1.00000	1.00000	12988.	12915.	0.6

YEAR 1970 HOUSEHOLD SIZE 6

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00944	0.01105	644.	755.	-17.1
0.10000	0.02596	0.02811	1128.	1165.	-3.3
0.15000	0.04727	0.04922	1456.	1442.	0.9
0.20000	0.07215	0.07353	1699.	1660.	2.3
0.25000	0.09949	0.10038	1867.	1834.	1.8
0.30000	0.12980	0.13005	2070.	2026.	2.1
0.35000	0.16364	0.16291	2311.	2243.	2.9
0.40000	0.19923	0.19810	2430.	2403.	1.1
0.45000	0.23780	0.23709	2634.	2662.	-1.1
0.50000	0.27870	0.27797	2793.	2792.	0.0
0.55000	0.32135	0.31974	2912.	2852.	2.1
0.60000	0.36784	0.36690	3175.	3221.	-1.4
0.65000	0.41695	0.41584	3354.	3342.	0.4
0.70000	0.46931	0.46958	3576.	3669.	-2.6
0.75000	0.52523	0.52756	3818.	3960.	-3.7
0.80000	0.58782	0.58900	4274.	4195.	1.8
0.85000	0.65685	0.65507	4713.	4512.	4.3
0.90000	0.72587	0.72747	4713.	4943.	-4.9
0.95000	0.81552	0.81787	6122.	6173.	-0.8
1.00000	1.00000	1.00000	12597.	12437.	1.3

YEAR 1966 HOUSEHOLD SIZE 1

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00834	0.00537	651.	419.	35.6
0.10000	0.01668	0.01251	651.	556.	14.5
0.15000	0.02503	0.02032	651.	609.	6.4
0.20000	0.03337	0.03010	651.	763.	-17.3
0.25000	0.04171	0.04122	651.	867.	-33.3
0.30000	0.05923	0.05816	1366.	1321.	3.3
0.35000	0.08245	0.08004	1812.	1707.	5.8
0.40000	0.10568	0.10386	1812.	1858.	-2.5
0.45000	0.12891	0.12966	1812.	2013.	-11.1
0.50000	0.15714	0.16010	2202.	2374.	-7.8
0.55000	0.19667	0.19830	3084.	2980.	3.4
0.60000	0.23619	0.23926	3084.	3196.	-3.6
0.65000	0.28513	0.28763	3818.	3773.	1.2
0.70000	0.34049	0.34224	4318.	4260.	1.3
0.75000	0.40401	0.40473	4956.	4875.	1.6
0.80000	0.47539	0.47532	5568.	5506.	1.1
0.85000	0.56150	0.55890	6718.	6520.	2.9
0.90000	0.65902	0.65724	7607.	7672.	-0.8
0.95000	0.77643	0.77469	9159.	9162.	-0.0
1.00000	1.00000	1.00000	17441.	17577.	-0.8

YEAR 1966 HOUSEHOLD SIZE 2

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00527	0.00535	638.	647.	-1.5
0.10000	0.01512	0.01556	1194.	1236.	-3.6
0.15000	0.02832	0.02922	1598.	1654.	-3.5
0.20000	0.04464	0.04610	1977.	2044.	-3.4
0.25000	0.06499	0.06640	2464.	2459.	0.2
0.30000	0.08761	0.08933	2739.	2776.	-1.4
0.35000	0.11525	0.11644	3347.	3283.	1.9
0.40000	0.14490	0.14616	3590.	3599.	-0.2
0.45000	0.18140	0.18101	4420.	4219.	4.5
0.50000	0.21990	0.21885	4662.	4582.	1.7
0.55000	0.26206	0.26049	5104.	5042.	1.2
0.60000	0.30852	0.30782	5626.	5731.	-1.9
0.65000	0.35843	0.35713	6044.	5970.	1.2
0.70000	0.41350	0.41286	6668.	6748.	-1.2
0.75000	0.47370	0.47260	7289.	7234.	0.8
0.80000	0.54493	0.54445	8625.	8700.	-0.9
0.85000	0.62258	0.62038	9403.	9194.	2.2
0.90000	0.70024	0.70049	9403.	9701.	-3.2
0.95000	0.79266	0.79798	11190.	11804.	-5.5
1.00000	1.00000	1.00000	25107.	24462.	2.6

TABLE 2.2 (continued)

YEAR 1966 HOUSEHOLD SIZE 3

ACTUAL % POP.	ACTUAL % AOI	ESTIM. % AOI	ACTUAL $ AOI	ESTIM. $ AOI	RESID. %
0.05000	0.00766	0.00889	597.	692.	-16.0
0.10000	0.02125	0.02323	1058.	1116.	-5.5
0.15000	0.03898	0.04131	1380.	1408.	-2.0
0.20000	0.05963	0.06242	1608.	1643.	-2.2
0.25000	0.08614	0.08802	2064.	1993.	3.5
0.30000	0.11551	0.11668	2286.	2231.	2.4
0.35000	0.14851	0.14877	2569.	2498.	2.7
0.40000	0.18509	0.18420	2847.	2758.	3.2
0.45000	0.22336	0.22219	2980.	2958.	0.7
0.50000	0.26591	0.26468	3312.	3307.	0.1
0.55000	0.31001	0.30967	3434.	3502.	-2.0
0.60000	0.35865	0.35692	3786.	3679.	2.8
0.65000	0.40847	0.40786	3879.	3965.	-2.2
0.70000	0.46355	0.46288	4288.	4284.	0.1
0.75000	0.52491	0.52470	4777.	4812.	-0.7
0.80000	0.59508	0.59388	5463.	5386.	1.4
0.85000	0.66525	0.66322	5463.	5398.	1.2
0.90000	0.73542	0.73766	5463.	5795.	-6.1
0.95000	0.82269	0.82768	6794.	7008.	-3.1
1.00000	1.00000	1.00000	13803.	13415.	2.8

YEAR 1966 HOUSEHOLD SIZE 4

ACTUAL % POP.	ACTUAL % AOI	ESTIM. % AOI	ACTUAL $ AOI	ESTIM. $ AOI	RESID. %
0.05000	0.00949	0.01065	790.	886.	-12.1
0.10000	0.02576	0.02729	1354.	1385.	-2.3
0.15000	0.04667	0.04800	1740.	1724.	0.9
0.20000	0.07094	0.07216	2020.	2011.	0.4
0.25000	0.10069	0.10087	2477.	2389.	3.5
0.30000	0.13253	0.13212	2650.	2601.	1.8
0.35000	0.16679	0.16615	2852.	2832.	0.7
0.40000	0.20433	0.20408	3124.	3157.	-1.1
0.45000	0.24368	0.24365	3275.	3293.	-0.5
0.50000	0.28573	0.28455	3500.	3405.	2.7
0.55000	0.33039	0.33048	3717.	3823.	-2.8
0.60000	0.37764	0.37786	3932.	3944.	-0.3
0.65000	0.42743	0.42784	4144.	4160.	-0.4
0.70000	0.48558	0.48615	4840.	4853.	-0.3
0.75000	0.54839	0.54690	5228.	5056.	3.3
0.80000	0.61120	0.60782	5228.	5070.	3.0
0.85000	0.67401	0.67267	5228.	5398.	-3.3
0.90000	0.73749	0.74189	5283.	5761.	-9.0
0.95000	0.82661	0.83204	7418.	7504.	-1.2
1.00000	1.00000	1.00000	14431.	13979.	3.1

YEAR 1966 HOUSEHOLD SIZE 5

ACTUAL % POP.	ACTUAL % AOI	ESTIM. % AOI	ACTUAL $ AOI	ESTIM. $ AOI	RESID. %
0.05000	0.00958	0.01082	539.	608.	-12.9
0.10000	0.02690	0.02832	974.	984.	-1.0
0.15000	0.04845	0.04968	1211.	1201.	0.8
0.20000	0.07382	0.07451	1426.	1396.	2.1
0.25000	0.10268	0.10287	1623.	1594.	1.8
0.30000	0.13517	0.13461	1827.	1785.	2.3
0.35000	0.16882	0.16829	1892.	1893.	-0.1
0.40000	0.20686	0.20643	2139.	2144.	-0.3
0.45000	0.24490	0.24509	2139.	2174.	-1.6
0.50000	0.28720	0.28591	2378.	2295.	3.5
0.55000	0.33015	0.33075	2415.	2521.	-4.4
0.60000	0.37732	0.37770	2652.	2640.	0.5
0.65000	0.42529	0.42617	2697.	2725.	-1.1
0.70000	0.48457	0.48459	3333.	3284.	1.5
0.75000	0.54507	0.54373	3401.	3325.	2.2
0.80000	0.60557	0.60305	3401.	3335.	2.0
0.85000	0.66607	0.66531	3401.	3500.	-2.9
0.90000	0.73120	0.73453	3661.	3892.	-6.3
0.95000	0.81822	0.82309	4892.	4979.	-1.8
1.00000	1.00000	1.00000	10220.	9946.	2.7

YEAR 1966 HOUSEHOLD SIZE 6

ACTUAL % POP.	ACTUAL % AOI	ESTIM. % AOI	ACTUAL $ AOI	ESTIM. $ AOI	RESID. %
0.05000	0.01002	0.01259	540.	678.	-25.6
0.10000	0.02833	0.03154	986.	1021.	-3.6
0.15000	0.05160	0.05448	1254.	1236.	1.4
0.20000	0.07833	0.08043	1440.	1398.	2.9
0.25000	0.10967	0.10987	1688.	1586.	6.1
0.30000	0.14100	0.14054	1688.	1652.	2.1
0.35000	0.17492	0.17381	1827.	1793.	1.9
0.40000	0.20991	0.20898	1885.	1895.	-0.5
0.45000	0.24915	0.24839	2114.	2124.	-0.5
0.50000	0.28852	0.28857	2121.	2165.	-2.0
0.55000	0.33279	0.33119	2385.	2296.	3.7
0.60000	0.37707	0.37708	2385.	2472.	-3.7
0.65000	0.42631	0.42588	2653.	2629.	0.9
0.70000	0.47756	0.47867	2761.	2844.	-3.0
0.75000	0.53967	0.53920	3346.	3261.	2.5
0.80000	0.60178	0.59994	3346.	3272.	2.2
0.85000	0.66389	0.66208	3346.	3348.	-0.1
0.90000	0.72600	0.73021	3346.	3670.	-9.7
0.95000	0.81210	0.81771	4639.	4714.	-1.6
1.00000	1.00000	1.00000	10124.	9822.	3.0

TABLE 2.3

HISTORY OF THE EXPLANATORY VARIABLES.

```
 YEAR    UN       PCTINC   INFL
            *       +      #
  67     4.00    10.91     3.23# *                       +
  68     3.75    10.97     4.40 *  #                     +
  69     3.68    11.13     5.15 *    #                    +
  70     5.25    11.37     5.37       #                    +
  71     6.27    11.29     4.99      #   *                 +
  72     5.89    11.11     4.16   #     *                 +
  73     5.11    11.38     5.69      * #                   +
  74     5.89    12.18     8.73         *         #            +
  75     8.92    12.18     9.26                   *#           +
  76     8.09    12.23     5.22      #         *               +
  77     7.41    12.49     5.84         #    *                  +
  78     6.31    12.97     8.45          *       #               +
  79     6.05    13.81     7.93         *      #                    +
  80     7.35    14.91     8.98              *    #                     +
  81     7.78    16.31    11.40               *            #                +
  82     9.82    16.75     6.60           #          *
            *       +      #
                              3.228     6.106     8.983    11.861    14.739
   UN
1967        3.998      3.752      3.682      5.254      6.274
1972        5.887      5.114      5.887      8.919      8.093
1977        7.408      6.310      6.054      7.347      7.784
1982        9.819

   PCTINC
1967       10.908     10.967     11.129     11.369     11.289
1972       11.111     11.375     12.182     12.185     12.228
1977       12.488     12.966     13.811     14.907     16.313
1982       16.754

   INFL
1967        3.228      4.402      5.149      5.369      4.986
1972        4.156      5.690      8.733      9.259      5.217
1977        5.844      8.454      7.930      8.983     11.401
1982        6.605
```

TABLE 2.4

PARAMETER EXPECTATIONS AND QUALITATIVE ESTIMATION RESULTS.

Variable	UN		PCTINC		INFL		TIME	
Parameter	A	B	A	B	A	B	A	B
Expectation	+	-	+	+	+	-	+	-
household size								
1	(-)*	(-)	(-)*	+	+	-	(-)*	-
2	(-)*	(-)	(+)	+	(+)	(-)	(+)	(-)
3	(+)	(-)	(+)	+	(+)	(-)	+	-
4	+	(-)	+	+	(+)	(-)	+	-
5	+	(-)	(+)	(+)	(+)	(-)	(+)	(-)
6+	+	(-)	(-)*	+	(-)*	(-)	+	-

* indicates the sign was contrary to expectations
parentheses indicate the coefficient was not statistically different from 0 at the 5% level.

TABLE 2.5

TIME-SERIES REGRESSION RESULTS.

B1 is the intercept.
B2 is the unemployment rate.
B3 is the share of income in dividends and interest.
B4 is the inflation rate.
B5 is the time trend.

```
PARAM A      HH SIZE  1 | PARAM B      HH SIZE 1 | PARAM A      HH SIZE 2
RSQ 0.7479 RBARSQ 0.6563 | RSQ 0.7806 RBARSQ 0.7008 | RSQ 0.3530 RBARSQ 0.1177
RHO 0.1451 AAPE   0.8004 | RHO 0.1195 AAPE     --   | RHO 0.3659 AAPE   0.8714
B1  1.1106 T-STAT  44.36 | B1 -0.0229 T-STAT  -2.04 | B1  0.9346 T-STAT  37.85
B2 -0.0014 T-STAT  -0.45 | B2 -0.0000 T-STAT  -0.00 | B2 -0.0009 T-STAT  -0.31
B3 -0.0083 T-STAT  -2.15 | B3  0.0086 T-STAT   4.97 | B3  0.0022 T-STAT   0.57
B4  0.0062 T-STAT   2.98 | B4 -0.0023 T-STAT  -2.49 | B4  0.0015 T-STAT   0.73
B5 -0.0017 T-STAT  -0.87 | B5 -0.0032 T-STAT  -3.59 | B5  0.0004 T-STAT   0.22

PARAM B      HH SIZE  2 | PARAM A      HH SIZE 3 | PARAM B      HH SIZE 3
RSQ 0.6382 RBARSQ 0.5067 | RSQ 0.9411 RBARSQ 0.9197 | RSQ 0.7909 RBARSQ 0.7149
RHO -.2788 AAPE     --   | RHO 0.4500 AAPE   1.0322 | RHO -.0078 AAPE     --
B1 -0.0315 T-STAT  -3.79 | B1  0.7144 T-STAT  28.09 | B1  0.0093 T-STAT   1.70
B2 -0.0007 T-STAT  -0.74 | B2  0.0018 T-STAT   0.59 | B2 -0.0002 T-STAT  -0.27
B3  0.0053 T-STAT   4.16 | B3  0.0064 T-STAT   1.64 | B3  0.0024 T-STAT   2.82
B4 -0.0010 T-STAT  -1.48 | B4  0.0023 T-STAT   1.11 | B4 -0.0007 T-STAT  -1.64
B5 -0.0013 T-STAT  -2.00 | B5  0.0051 T-STAT   2.56 | B5 -0.0014 T-STAT  -3.11

PARAM A      HH SIZE  4 | PARAM B      HH SIZE 4 | PARAM A      HH SIZE 5
RSQ 0.9782 RBARSQ 0.9703 | RSQ 0.9021 RBARSQ 0.8664 | RSQ 0.9602 RBARSQ 0.9457
RHO -.0455 AAPE   0.5719 | RHO -.1773 AAPE     --   | RHO -.3311 AAPE   1.0254
B1  0.6906 T-STAT  41.78 | B1  0.0259 T-STAT   4.58 | B1  0.6775 T-STAT  25.34
B2  0.0105 T-STAT   5.29 | B2 -0.0001 T-STAT  -0.13 | B2  0.0142 T-STAT   4.42
B3  0.0077 T-STAT   3.00 | B3  0.0023 T-STAT   2.67 | B3  0.0049 T-STAT   1.18
B4  0.0005 T-STAT   0.37 | B4 -0.0006 T-STAT  -1.37 | B4  0.0020 T-STAT   0.90
B5  0.0033 T-STAT   2.50 | B5 -0.0020 T-STAT  -4.52 | B5  0.0043 T-STAT   2.04

PARAM B      HH SIZE  5 | PARAM A      HH SIZE 6 | PARAM B      HH SIZE 6
RSQ 0.8100 RBARSQ 0.7409 | RSQ 0.9809 RBARSQ 0.9740 | RSQ 0.8057 RBARSQ 0.7350
RHO -.1472 AAPE     --   | RHO -.1311 AAPE   0.9067 | RHO -.1149 AAPE     --
B1  0.0340 T-STAT   3.98 | B1  0.5982 T-STAT  24.03 | B1  0.0227 T-STAT   2.78
B2 -0.0020 T-STAT  -1.97 | B2  0.0090 T-STAT   3.02 | B2 -0.0012 T-STAT  -1.17
B3  0.0015 T-STAT   1.12 | B3 -0.0023 T-STAT  -0.59 | B3  0.0029 T-STAT   2.31
B4 -0.0006 T-STAT  -0.85 | B4 -0.0007 T-STAT  -0.32 | B4 -0.0008 T-STAT  -1.21
B5 -0.0012 T-STAT  -1.71 | B5  0.0138 T-STAT   7.01 | B5 -0.0017 T-STAT  -2.68
```

TABLE 2.6

REGRESSION EQUATION FOR FORECASTING FEDERAL INCOME TAX POPULATION BASE. (NUMBER OF EXEMPTIONS OTHER THAN AGE OR BLINDNESS)

```
      SEE =     1.6960   RSQR =  0.9926 RBARSQ =  0.9923  NOBS =   26
      RHO =     0.5131    DW  =   0.974 AAPE   =    0.79
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
PT                     0.866464  190.34    0.946  3786.61       205.3683
TIME                   0.655869   12.04    0.054   165.35        15.5000
NEX                          DEPENDENT VARIABLE - - - - - -     188.11630


DATE  ACTUAL   PREDIC    MISS
      IS *     IS +     IS A-P *         *          *         *         *
 57   154.68   152.38      2.30+*
 58   158.19   155.67      2.52  + *
 59   161.49   159.85      1.64     +*
 60   162.00   163.14     -1.14      *+
 61   165.30   166.44     -1.14          +
 62   168.54   169.73     -1.19           *+
 63   171.60   172.15     -0.55              +
 64   172.58   175.44     -2.86              * +
 65   176.17   177.86     -1.69                 *+
 66   179.51   181.15     -1.64                   * +
 67   182.71   183.57     -0.86                      +
 68   186.55   185.98      0.57                        +
 69   189.51   188.40      1.11                          +
 70   192.33   190.81      1.52                           +*
 71   196.75   193.23      3.52                             + *
 72   195.10   195.64     -0.54                              *+
 73   195.09   197.18     -2.09                              * +
 74   197.57   199.59     -2.02                                *+
 75   202.05   202.01      0.04                                   +
 76   205.17   203.54      1.63                                    +*
 77   204.52   205.96     -1.44                                     *+
 78   208.68   208.64      0.04                                        +
 79   213.20   211.44      1.76                                          +*
 80   215.89   214.34      1.55                                            +*
 81   217.87   217.05      0.82                                              +
 82   217.98   219.69     -1.71                                              * +
      IS *     IS +     IS A-P *         *          *         *         *
                            152.379   166.700    181.021   195.342   209.663
```

TIME = TIME TREND -- 1 IN 1955, 2 IN 1956 ETC...
PT = NONINSTITUTIONAL POPULATION OF U.S.
NEX = IRS REPORTED NUMBER OF EXEMPTIONS.

TABLE 2.7

REGRESSION EQUATIONS FOR FORECASTING THE SHARE OF TOTAL POPULATION FROM EACH OF THE HOUSEHOLD SIZE CATEGORIES (1-6+). (INCLUDES A FORECAST TO 1995)

SHPOP1-6 = THE SHARE OF POPULATION FROM EACH CATEGORY
POPO = THE PERCENT OF THE POPULATION 65 YEARS OR OLDER

```
      SEE =       0.4381   RSQR =  0.9442 RBARSQ =  0.9402  NOBS =    16
      RHO =       0.4084     DW =   1.183  AAPE  =    2.41
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT             41.416710    24.95    0.000   574.18         0.0000
POPO                  -2.639858   -15.39   -1.600   323.24         9.6548
SHPOP1                         DEPENDENT VARIABLE  - - - - - -    15.92937


DATE  ACTUAL   PREDIC    MISS
      IS *      IS +   IS A-P *         *         *         *         *
 67    13.39    13.29     0.10+
 68    14.13    13.62     0.51  +  *
 69    14.29    13.79     0.50   +  *
 70    13.61    14.11    -0.50  *  +
 71    13.62    14.44    -0.82  *    +
 72    14.61    14.76    -0.15        *+
 73    15.48    15.26     0.22             +*
 74    15.95    15.65     0.30               + *
 75    15.63    16.14    -0.51               *   +
 76    16.17    16.66    -0.49                   *  +
 77    17.27    17.07     0.20                         +*
 78    17.93    17.43     0.50                           +   *
 79    18.29    17.77     0.52                              +  *
 80    18.17    18.04     0.13                                +
 81    18.22    18.29    -0.07                                 +
 82    18.11    18.55    -0.44                                *  +
 83    18.31    18.31     0.00                                 +
 84    18.63    18.63     0.00                                    +
 85    18.95    18.95     0.00                                      +
 86    19.18    19.18     0.00                                       +
 87    19.42    19.42     0.00                                         +
 88    19.61    19.61     0.00                                          +
 89    19.77    19.77     0.00                                           +
 90    19.94    19.94     0.00                                            +
 91    20.04    20.04     0.00                                             +
 92    20.11    20.11     0.00                                              +
 93    20.12    20.12     0.00                                              +
 94    20.19    20.19     0.00                                              +
 95    20.24    20.24     0.00                                               +
      IS *      IS +   IS A-P *         *         *         *         *
                            13.287    14.767    16.247    17.726   19.206
```

TABLE 2.7 (continued)

```
      SEE =      0 1837   RSGR =  0.9830 RBARSQ =  0.9818  NOBS =   16
      RHO =      0.0600    DW  =   1 880  AAPE   =    0.79
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           38 735923    55.64   0 000  1390 40         0 0000
POPO                -2.049074   -28.48  -1 044   667.79         9 6548
SHPOP2                   DEPENDENT VARIABLE  - - - - - -       18.95250


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    16.96    16.90     0.06+
 68    17.24    17.16     0.08  +
 69    17.50    17.29     0.21   + *
 70    17.48    17.54    -0.06     +
 71    17.60    17 80    -0.20      *+
 72    18.08    18.05     0.03         +*
 73    18.67    18.43     0.24             + *
 74    18.39    18.74    -0.35            *  +
 75    19.17    19.12     0.05                   +
 76    19.35    19.52    -0.17                     *+
 77    19.71    19.84    -0 13                        *+
 78    20.11    20.12    -0.01                           +
 79    20.22    20.38    -0.16                            * +
 80    20.46    20.59    -0.13                              * +
 81    21.05    20.78     0 27                                 +  *
 82    21.25    20 98     0.27                                   + *
 83    20.96    20.96     0.00                                   +
 84    21.10    21.10     0.00                                    +
 85    21.32    21.32     0.00                                      +
 86    21.48    21.48     0.00                                       +
 87    21.67    21.67     0.00                                         +
 88    21.81    21 81     0.00                                          +
 89    21.94    21.94     0.00                                           +
 90    22.06    22.06     0.00                                            +
 91    22.14    22.14     0.00                                             +
 92    22.20    22.20     0.00                                              +
 93    22.21    22.21     0.00                                              +
 94    22.26    22.26     0.00                                              +
 95    22.30    22.30     0.00                                               +
       IS *     IS +   IS A-P *         *         *         *         *
                            16.901    18.050    19.199    20.347    21.496
```

TABLE 2.7 (continued)

```
      SEE =     0 1559   RSGR =  0 9695 RBARSQ =  0.9673  NOBS =   16
      RHO =     0.0881    DW  =   1.824  AAPE  =    0.73
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           28.444153    48.15    0.000  1190 61         0.0000
POPO                -1 287094   -21.08   -0.776   472 27         9 6548
SHPOP3                   DEPENDENT VARIABLE  - - - - - -        16.01749


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    14.79    14.73     0.06+
 68    14.85    14.89    -0.04 *+
 69    14.77    14 98    -0.21*  +
 70    15.01    15.13    -0.12   * +
 71    15.46    15.29     0 17       +  *
 72    15.46    15.45     0.01         +*
 73    15.94    15.69     0 25             +  *
 74    15.93    15 88     0.05               +*
 75    16.16    16.12     0.04                   +
 76    16.31    16.38    -0 07                     *+
 77    16.59    16.58     0.01                         +
 78    16.40    16 75    -0.35                       *   +
 79    16.89    16 91    -0.02                             *+
 80    17.15    17.05     0.10                                +*
 81    17.40    17 17     0 23                                 +   *
 82    17.17    17.29    -0.12                                 * +
 83    17.26    17 26     0.00                                   +
 84    17.37    17.37     0.00                                    +
 85    17.50    17.50     0.00                                      +
 86    17.61    17 61     0.00                                       +
 87    17.72    17.72     0.00                                         +
 88    17.81    17 81     0.00                                          +
 89    17.89    17.89     0.00                                           +
 90    17.97    17.97     0.00                                            +
 91    18.02    18.02     0.00                                             +
 92    18.05    18.05     0.00                                              +
 93    18.06    18.06     0.00                                              +
 94    18.09    18 09     0.00                                              +
 95    18.12    18.12     0.00                                               +
       IS *     IS +   IS A-P *         *         *         *         *
                            14 729    15.451    16.172    16.894    17.615
```

TABLE 2.7 (continued)

```
      SEE =     0 2407   RSQR =  0 9262 RBARSQ =  0 9209  NOBS =    16
      RHO =     0. 2303   DW   =   1. 539  AAPE   =    0 99
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           32 240360    35. 34   0. 000   849 84         0 0000
POPO                -1 249220  -13. 25  -0. 598  268. 03         9 6548
SHPOP4                   DEPENDENT VARIABLE  - - - - - -        20 17937


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P  *         *         *         *         *
 67    18. 84   18. 93   -0. 09 *+
 68    18. 74   19. 09   -0 35*    +
 69    19. 00   19. 17   -0. 17   * +
 70    19. 55   19. 32    0. 23       +  *
 71    19. 55   19. 47    0. 08         +*
 72    19 92    19. 63    0. 29           +   *
 73    19. 72   19. 86   -0 14              * +
 74    19. 94   20. 05   -0. 11                *+
 75    20. 67   20. 28    0. 39                    +     *
 76    20. 90   20. 53    0 37                         +    *
 77    20. 73   20. 72    0. 01                          +
 78    20. 75   20. 89   -0. 14                           * +
 79    21. 08   21. 05    0. 03                               +
 80    20. 93   21. 18   -0. 25                             *  +
 81    20. 94   21. 30   -0 36                              *    +
 82    21. 61   21. 42    0 19                                     + *
 83    21. 44   21. 44    0. 00                                    +
 84    21. 50   21. 50    0 00                                      +
 85    21. 63   21. 63    0. 00                                      +
 86    21. 72   21. 72    0. 00                                        +
 87    21. 83   21. 83    0 00                                          +
 88    21. 92   21. 92    0. 00                                          +
 89    22. 00   22. 00    0. 00                                            +
 90    22. 08   22. 08    0 00                                               +
 91    22. 12   22. 12    0 00                                               +
 92    22. 16   22. 16    0. 00                                              +
 93    22. 16   22 16     0. 00                                              +
 94    22. 19   22. 19    0. 00                                              +
 95    22. 22   22. 22    0 00                                                 +
       IS *     IS +   IS A-P  *         *         *         *         *
                             18 740    19 480    20 221    20 961    21 702
```

TABLE 2.7 (continued)

```
      SEE =     0.1754   RSQR =  0 9713 RBARSQ =  0.9693  NOBS =   16
      RHO =     0.1665    DW  =   1.667  AAPE  =    0 98
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           -0 581119    -0.87    0 000     2 69         0 0000
POPO                 1 495678    21 77    1 042   490 36         9 6548
SHPOPS                   DEPENDENT VARIABLE  - - - - - -        13 85937


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    15.34    15.36    -0.02                                              *+
 68    15.06    15.17    -0 11                                           *+
 69    14 74    15.07    -0.33                                       *   +
 70    14.93    14.89     0.04                                         +
 71    15.05    14.70     0 35                                       +   *
 72    14.71    14.52     0.19                                     + *
 73    14.06    14.24    -0 18                               * +
 74    14.05    14.02     0.03                               +
 75    13.77    13.74     0.03                           +*
 76    13.69    13.44     0.25                        +  *
 77    13.17    13.21    -0.04                    *+
 78    12.91    13 01    -0 10                 * +
 79    12.72    12.82    -0.10               *+
 80    12.76    12.66     0 10              + *
 81    12.63    12.52     0.11             +*
 82    12.16    12.38    -0.22        *  +
 83    12.37    12.37     0.00           +
 84    12.28    12.28     0.00          +
 85    12.13    12.13     0.00        +
 86    12.01    12.01     0.00       +
 87    11.88    11.88     0.00     +
 88    11.77    11.77     0 00    +
 89    11.68    11.68     0.00   +
 90    11.59    11.59     0.00  +
 91    11.53    11.53     0.00 +
 92    11.49    11.49     0.00+
 93    11.48    11.48     0.00+
 94    11.45    11.45     0.00+
 95    11.42    11.42     0 00+
       IS *     IS +   IS A-P *         *         *         *         *
                            11.416    12.254    13.093    13.931    14 770
```

TABLE 2.7 (continued)

```
      SEE =      0 2554   RSQR =  0 9957 RBARSQ =  0 9954  NOBS =    16
      RHO =      0.1002     DW   =    1.800  AAPE   =     1 36
VARIABLE           REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT           -40.178463    -41 51     0 000  1013.80         0.0000
POPO                  5 721986     57.20     3.667  1432 11         9.6548
SHPOP6                     DEPENDENT VARIABLE  - - - - - -         15.06625


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    20.68    20.79    -0 11                                              *+
 68    19.98    20.07    -0 09                                             +
 69    19.71    19 70     0.01                                            +
 70    19.42    19 01     0 41                                          +*
 71    18.73    18.30     0.43                                        +*
 72    17.22    17.60    -0.38                                    * +
 73    16.12    16.52    -0 40                                 *+
 74    15.75    15.67     0 08                                +
 75    14.59    14.61    -0 02                            +
 76    13.58    13 47     0.11                         +
 77    12.52    12.58    -0.06                      +
 78    11.90    11.82     0.08                    +
 79    10.80    11.08    -0.28                *+
 80    10.53    10.50     0.03               +*
 81     9.75     9 95    -0.20            *+
 82     9 78     9.39     0 39           +*
 83     9.55     9.55     0 00           +
 84     9.06     9.06     0.00          +
 85     8 45     8.45     0 00        +
 86     8.00     8.00     0 00       +
 87     7 49     7.49     0.00     +
 88     7.08     7.08     0.00    +
 89     6.73     6.73     0.00   +
 90     6.38     6.38     0 00  +
 91     6.16     6 16     0 00 +
 92     6.01     6.01     0.00+
 93     5.98     5.98     0.00+
 94     5.84     5.84     0 00+
 95     5.72     5.72     0.00+
       IS *     IS +   IS A-P *         *         *         *         *
                             5.718     8.926    12.133    15.341    18.549
```

TABLE 2.8

REGRESSION EQUATIONS FOR FORECASTING THE SHARE OF TOTAL AGI FROM EACH OF THE HOUSEHOLD SIZE CATEGORIES (1-6+). (INCLUDES A FORECAST TO 1995)

SHINC1-6 = SHARE OF INCOME FROM EACH CATEGORY.
POPO = THE PERCENT OF THE POPULATION 65 YEARS OR OLDER.

```
     SEE =      0.3727   RSQR =  0.9713 RBARSQ =  0.9693  NOBS =    16
     RHO =      0.6137     DW =    0.773  AAPE  =    1.63
VARIABLE           REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
INTERCEPT            49.988019    35.39    0.000   851.08          0.0000
POPO                 -3.178889   -21.78   -1.591   490.59          9.6548
SHINC1                       DEPENDENT VARIABLE  - - - - - - -    19.29643
```

```
DATE  ACTUAL    PREDIC    MISS
       IS *      IS +   IS A-P *
 67    16.60     16.11     0.48+
 68    17.02     16.52     0.51
 69    17.04     16.72     0.32
 70    17.04     17.11    -0.07
 71    16.94     17.50    -0.56
 72    17.79     17.89    -0.10
 73    18.07     18.49    -0.42
 74    19.00     18.96     0.04
 75    19.02     19.55    -0.53
 76    19.58     20.18    -0.60
 77    20.52     20.68    -0.15
 78    21.13     21.10     0.02
 79    21.73     21.51     0.22
 80    21.98     21.84     0.15
 81    22.52     22.14     0.38
 82    22.77     22.45     0.32
 83    22.58     22.58     0.00
 84    22.76     22.76     0.00
 85    23.05     23.05     0.00
 86    23.27     23.27     0.00
 87    23.53     23.53     0.00
 88    23.75     23.75     0.00
 89    23.94     23.94     0.00
 90    24.13     24.13     0.00
 91    24.25     24.25     0.00
 92    24.33     24.33     0.00
 93    24.34     24.34     0.00
 94    24.43     24.43     0.00
 95    24.49     24.49     0.00
       IS *      IS +   IS A-P *
```

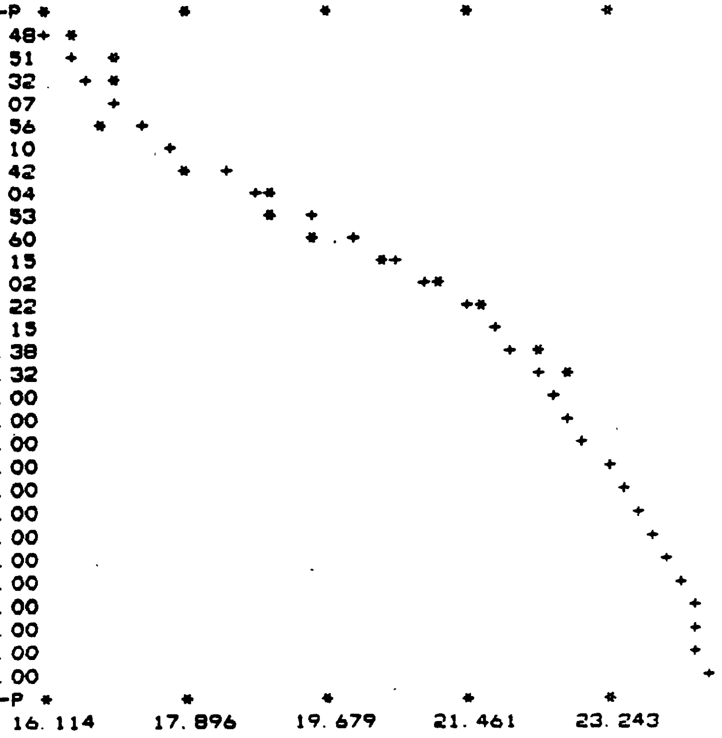


TABLE 2.8 (continued)

```
      SEE =     0.2374   RSGR =  0.9599 RBARSQ =  0.9570  NOBS =   16
      RHO =     0.1876    DW  =   1.625  AAPE  =    0.68
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           43.821184    48 71    0.000 1205.54          0 0000
POPO                -1.701729   -18.30   -0.600  399.31          9.6548
SHINC2                   DEPENDENT VARIABLE  - - - - - -        27.39130


DATE  ACTUAL    PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    25.72    25.69     0.03+
 68    25.90    25.90    -0.01  +
 69    26.38    26.01     0.37   +   *
 70    25.96    26.22    -0.26  *  +
 71    26.36    26.43    -0.07       +
 72    26.62    26.64    -0.02         +
 73    27.30    26.96     0.35             +  *
 74    27.01    27.21    -0.20             * +
 75    27.58    27.53     0.06                   +
 76    27.63    27.87    -0.23                    * +
 77    27.97    28.13    -0.16                       * +
 78    28.20    28.36    -0.16                          *+
 79    28.31    28.58    -0.27                           *  +
 80    28.62    28.75    -0.13                              * +
 81    29.13    28.91     0.22                                 +  *
 82    29.56    29.08     0.48                                   +    *
 83    29.13    29.13     0.00                                    +
 84    29.19    29.19     0.00                                    +
 85    29.36    29.36     0.00                                      +
 86    29.49    29.49     0.00                                       +
 87    29.65    29.65     0.00                                         +
 88    29.77    29.77     0.00                                          +
 89    29.87    29.87     0.00                                           +
 90    29.98    29.98     0.00                                            +
 91    30.04    30.04     0.00                                             +
 92    30.08    30.08     0.00                                              +
 93    30.09    30.09     0.00                                              +
 94    30.14    30.14     0.00                                              +
 95    30.17    30.17     0.00                                               +
       IS *     IS +   IS A-P *         *         *         *         *
                            25.688    26.642    27.596    28.550    29.504
```

TABLE 2.8 (continued)

```
      SEE =     0.1456   RSQR =  0.4559 RBARSQ =  0.4170  NOBS =   16
      RHO =     0.1349    DW  =   1.730  AAPE  =    0.69
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           18 604428    33.71    0.000   806.58         0 0000
POPO                -0.195297    -3.42   -0.113    35.57         9.6548
SHINC3                   DEPENDENT VARIABLE  - - - - - -        16.71887


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    16.57    16.52     0.04              +  *
 68    16.42    16.55    -0.13        *       +
 69    16.29    16.56    -0.27*                +
 70    16.53    16.58    -0.05               *  +
 71    16.82    16.61     0.21                    +            *
 72    16.59    16.63    -0.04                  *  +
 73    16.90    16.67     0.23                       +              *
 74    16.77    16.70     0.07                         +    *
 75    16.83    16.73     0.10                           +      *
 76    16.88    16.77     0.11                              +      *
 77    16.79    16.80    -0.01                               *+
 78    16.59    16.83    -0.23                   *             +
 79    16.93    16.86     0.08                                   +    *
 80    16.91    16.87     0.03                                    + *
 81    16.94    16.89     0.05                                     +   *
 82    16.73    16.91    -0.18                           *           +
 83    16.88    16.88     0.00                                     +
 84    16.92    16.92     0.00                                       +
 85    16.94    16.94     0.00                                         +
 86    16.96    16.96     0.00                                          +
 87    16.98    16.98     0.00                                           +
 88    16.99    16.99     0.00                                            +
 89    17.00    17.00     0.00                                            +
 90    17.02    17.02     0.00                                             +
 91    17.02    17.02     0.00                                              +
 92    17.03    17.03     0.00                                              +
 93    17.03    17.03     0.00                                              +
 94    17.03    17 03     0.00                                              +
 95    17.04    17.04     0.00                                               +
       IS *     IS +   IS A-P *         *         *         *         *
                            16.290    16.449    16.608    16.767    16.927
```

TABLE 2.8 (continued)

```
      SEE =     0.1964   RSQR =  0.3949 RBARSQ =  0.3516  NOBS =   16
      RHO =     0.4144    DW =    1.171  AAPE =     0.86
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           20.255278    27.22    0.000   634.26         0.0000
POPO               -0.232433     -3.02   -0.125    28.55         9.6548
SHINC4                   DEPENDENT VARIABLE  - - - - - -        18.01118


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    17.71    17.78    -0.07          *   +
 68    17.54    17.81    -0.27*              +
 69    17.60    17.82    -0.22    *           +
 70    18.09    17.85     0.23                  +            *
 71    17.90    17.88     0.02                   +*
 72    18.02    17.91     0.11                     +     *
 73    17.87    17.95    -0.08                   *   +
 74    17.99    17.99     0.01                         +
 75    18.33    18.03     0.30                            +               *
 76    18.33    18.08     0.25                              +             *
 77    18.19    18.11     0.08                                +   *
 78    18.27    18.14     0.13                                  +      *
 79    18.28    18.17     0.10                                   +     *
 80    18.17    18.20    -0.02                                    *+
 81    17.82    18.22    -0.40                *                     +
 82    18.06    18.24    -0.18                             *         +
 83    18.16    18.16     0.00                                   +
 84    18.22    18.22     0.00                                      +
 85    18.27    18.27     0.00                                         +
 86    18.29    18.29     0.00                                          +
 87    18.32    18.32     0.00                                           +
 88    18.33    18.33     0.00                                            +
 89    18.35    18.35     0.00                                             +
 90    18.36    18.36     0.00                                              +
 91    18.37    18.37     0.00                                               +
 92    18.38    18.38     0.00                                               +
 93    18.38    18.38     0.00                                               +
 94    18.39    18.39     0.00                                               +
 95    18.39    18.39     0.00                                                +
       IS *     IS +   IS A-P *         *         *         *         *
                             17.541    17.722    17.903    18.083    18.264
```

TABLE 2.8 (continued)

```
      SEE =     0.1648   RSQR =  0.9818 RBARSQ =  0.9805  NOBS =   16
      RHO =     0.6875    DW  =   0.625  AAPE  =    1.26
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT           -6.711601   -10.74    0.000   204.05        0 0000
POPO                 1.772086    27.45    1.645   640.46         9.6548
SHINC5                   DEPENDENT VARIABLE  - - - - - -        10.39756


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 67    11.95    12.17    -0.22                                            *  +
 68    11.86    11.95    -0.08                                           *+
 69    11.66    11.83    -0.17                                         * +
 70    11.62    11.62     0.00                                         +
 71    11.56    11.40     0.16                                       +*
 72    11.30    11.18     0.12                                     +*
 73    10.84    10.85    -0.01                                 +
 74    10.67    10 58     0.09                               +
 75    10.36    10 26     0.11                           +*
 76    10.08     9.90     0.18                        + *
 77     9.85     9.63     0.23                     + *
 78     9.50     9.39     0.11                   +*
 79     9.13     9.16    -0.03                +
 80     9.00     8.98     0.02              +*
 81     8.71     8.81    -0.10            *+
 82     8.24     8.64    -0.40       *   +
 83     8.40     8.40     0.00         +
 84     8.35     8.35     0.00        +
 85     8.22     8.22     0.00       +
 86     8.12     8.12     0.00      +
 87     7.99     7.99     0.00    +
 88     7.88     7.88     0.00   +
 89     7.79     7.79     0.00  +
 90     7.69     7.69     0.00 +
 91     7.63     7.63     0.00 +
 92     7.58     7.58     0.00+
 93     7.58     7.58     0.00+
 94     7.53     7.53     0 00+
 95     7.50     7.50     0.00+
       IS *     IS +   IS A-P *         *         *         *         *
                             7.499     8.493     9.488    10.482    11.476
```

TABLE 2.8 (continued)

```
      SEE =      0. 1429   RSQR =  0. 9965 RBARSQ =  0. 9963  NOBS =    16
      RHO =      0. 2165    DW   =    1. 567  AAPE  =     1. 34
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT             -25. 955564    -47. 92     0 000  1184 59        0 0000
POPO                    3 536092     63. 18     4. 171  1591. 44       9 6548
SHINC6                     DEPENDENT VARIABLE  - - - - - -          8 18475


DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *          *         *         *         *
 67    11. 45  11. 72    -0. 27                                             * +
 68    11. 25  11. 28    -0. 02                                            +
 69    11. 02  11. 05    -0. 03                                           +
 70    10. 76  10. 62     0. 14                                         +*
 71    10. 43  10. 18     0. 25                                       +*
 72     9. 68   9. 75    -0. 07                                    *+
 73     9. 02   9. 09    -0. 06                                 +
 74     8. 55   8. 56    -0. 01                              *+
 75     7. 87   7. 90    -0. 03                           +
 76     7. 49   7. 20     0. 29                        +*
 77     6. 67   6. 65     0. 02                     +
 78     6. 31   6. 18     0. 14                   +
 79     5. 62   5. 72    -0. 10                +
 80     5. 32   5. 36    -0. 04              +
 81     4. 87   5. 02    -0. 15            *+
 82     4. 63   4. 68    -0. 05           +
 83     4. 74   4. 74     0. 00           +
 84     4. 47   4. 47     0. 00          +
 85     4. 10   4. 10     0. 00        +
 86     3. 82   3. 82     0. 00       +
 87     3. 50   3. 50     0. 00     +
 88     3. 25   3. 25     0. 00    +
 89     3. 03   3. 03     0. 00   +
 90     2. 81   2. 81     0. 00  +
 91     2. 68   2. 68     0. 00 +
 92     2. 59   2. 59     0. 00+
 93     2. 57   2. 57     0. 00+
 94     2. 48   2. 48     0. 00+
 95     2. 41   2. 41     0. 00+
       IS *     IS +   IS A-P *          *         *         *         *
                             2. 408     4. 390   6. 372    8. 355   10. 337
```

TABLE 2.9

REGRESSION EQUATION FOR FORECASTING THE AVERAGE HOUSEHOLD SIZE IN THE SIX AND OVER CATEGORY.

```
      SEE =      0.0189   RSQR =  0.9528 RBARSQ =  0.9491  NOBS =   15
      RHO =      0.2540    DW  =   1.492  AAPE  =    0.24
VARIABLE           REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
INTERCEPT              5.492552   73.05     0.000  1928.42          0.0000
YNG                    3.508745   16.20     0.181   360.20          0.3463
HHZ6                          DEPENDENT VARIABLE  - - - - - -     6.70760

DATE  ACTUAL   PREDIC    MISS
       IS *     IS +   IS A-P *         *         *         *         *
 68    6.81     6.82     -0.01                                         * +
 69    6.84     6.81      0.03                                         +     *
 70    6.82     6.80      0.02                                        +  *
 71    6.78     6.79     -0.01                                      *+
 72    6.78     6.77      0.01                                    + *
 73    6.74     6.76     -0.02                               *  +
 74    6.71     6.74     -0.02                            *  +
 75    6.73     6.72      0.01                            +*
 76    6.70     6.70      0.01                         +*
 77    6.65     6.67     -0.02                  *  +
 78    6.63     6.65     -0.02                * +
 79    6.61     6.63     -0.02            *  +
 80    6.61     6.61      0.00            +
 81    6.61     6.59      0.02        +   *
 82    6.58     6.57      0.02      + *
       IS *     IS +   IS A-P *         *         *         *         *
                            6.525     6.592     6.660     6.727     6.795
```

YNG = PERCENTAGE OF PERSONS AGED 16 AND UNDER IN POPULATION

HHZ6 = AVERAGE SIZE OF HOUSEHOLD IN THE SIX AND OVER CATEGORY

(HHZ6 GOES TO 6.5 BY 1995 IN A TYPICAL FORECAST)

TABLE 2.10

POPULATION AND INCOME DISTRIBUTION BY VENTILE AND HOUSEHOLD SIZE - 1981.

Exemptions Other than Age or Blindness in Thousands

Household Size	1	2	3	4	5	6	TOTAL
Ventile							
1	2588.8	1582.8	1584.8	1811.1	1412.4	1813.6	10793.6
2	1632.9	1358.2	1490.4	1788.4	1585.3	2938.3	10793.6
3	1614.4	1239.0	1570.1	1968.7	1767.1	2634.3	10793.6
4	1573.8	1284.0	1647.5	2160.8	1879.4	2248.2	10793.6
5	1538.6	1343.3	1730.0	2332.6	1956.7	1892.4	10793.6
6	1521.2	1411.3	1792.6	2491.2	1986.9	1590.3	10793.6
7	1514.5	1488.8	1850.9	2626.4	1973.1	1339.9	10793.6
8	1520.1	1576.6	1905.4	2737.1	1920.0	1134.5	10793.6
9	1534.2	1679.9	1956.7	2820.3	1835.3	967.2	10793.6
10	1566.5	1800.1	2009.5	2872.0	1726.5	818.9	10793.6
11	1608.2	1939.7	2056.6	2890.2	1596.8	702.0	10793.6
12	1671.5	2102.7	2106.6	2862.7	1449.6	600.5	10793.6
13	1752.9	2293.4	2144.5	2792.0	1294.2	516.7	10793.6
14	1855.4	2518.8	2179.5	2672.4	1139.2	428.3	10793.6
15	1988.1	2774.5	2193.5	2492.5	972.6	372.4	10793.6
16	2156.1	3085.6	2178.7	2258.8	820.1	294.2	10793.6
17	2383.5	3431.3	2119.8	1954.2	663.2	241.6	10793.6
18	2680.2	3827.7	1982.4	1594.8	519.8	188.7	10793.6
19	3100.8	4216.3	1727.2	1234.9	383.6	130.7	10793.6
20	3624.2	4459.2	1334.7	875.1	329.2	171.2	10793.6
TOTALS	39425.8	45413.0	37561.4	45236.4	27210.9	21024.1	215871.4

Adjusted Gross Income in Millions of Dollars.

Household Size	1	2	3	4	5	6	TOTAL
Ventile							
1	713.9	1010.7	1000.3	1157.2	940.8	1277.4	6100.3
2	2578.5	2273.6	2459.2	2973.8	2534.1	4601.1	17420.2
3	3668.3	2875.7	3581.9	4489.5	4018.4	5938.6	24572.5
4	4484.4	3650.5	4648.6	6135.1	5308.8	6337.7	30565.2
5	5124.7	4489.9	5784.4	7785.6	6521.6	6293.8	35999.9
6	5771.8	5399.1	6859.3	9524.3	7587.4	6058.5	41200.4
7	6545.3	6399.2	7950.8	11276.9	8478.0	5745.0	46395.3
8	7243.5	7512.2	9101.6	13080.1	9169.5	5407.5	51514.4
9	8096.8	8862.1	10317.2	14854.8	9669.9	5083.0	56883.7
10	9066.7	10457.8	11633.2	16649.5	9995.0	4745.7	62547.9
11	10247.0	12341.1	13092.4	18376.0	10142.7	4456.8	68656.0
12	11658.4	14670.4	14686.0	19981.5	10108.1	4180.0	75284.3
13	13455.6	17630.1	16479.8	21438.5	9928.5	3945.2	82877.7
14	15760.6	21391.1	18495.7	22664.6	9644.0	3637.2	91593.0
15	18787.4	26258.9	20721.7	23525.1	9178.3	3482.9	101954.2
16	23020.0	32917.8	23227.5	24025.3	8704.9	3136.2	115031.7
17	29227.3	42142.5	25968.1	23900.1	8085.7	2929.8	132253.4
18	39217.3	55976.6	28882.8	23171.3	7481.1	2677.9	157406.9
19	58203.6	78911.7	31984.0	22567.6	6921.7	2207.5	200796.0
20	129084.5	166316.5	46712.4	31789.7	12361.1	5797.5	392061.7
TOTALS	401955.6	521487.2	303586.8	319366.4	156779.5	87939.2	1791114.0

CHAPTER 3

THE INCOME TAX MODEL.

This chapter describes a procedure developed for modeling the federal income tax. The procedure is dependent on and consistent with the income distribution model described in the previous chapter. The income tax model generates forecasts of the total amount and distribution of taxes. These data as well as forecasts of the amount and distribution of disposable income are used in the Inforum model.

The technique used to estimate the size distribution of AGI has been described in Chapter 2. As it enters the tax model, the distribution is defined in terms of twenty equally populated ventiles containing persons from all six household sizes. The method yields estimates for the total dollar amount of AGI for each ventile, the dollar amount of AGI accruing to each household size within each ventile, and the number of persons from each household size within each ventile. The ventiles are arranged in ascending order according to per capita income, so that a person from household size five with family income of fifty thousand is in the same ventile as a single person with a ten thousand dollar income. The income distribution so defined for the year 1981 is shown in table 2.10. While the data are calculated and arranged in ventiles, each household size's contribution to its ventile's income and population are calculated and maintained separately. In other words, the household sizes are combined while being kept track of separately.

Household sizes are kept separate because tax liability is calculated on the basis of household income. An estimate of average household income is obtained for 120 groups. These 120 groups are homogeneous in that they contain people from the same household size and in the same ventile. The average household income for these groups is obtained by dividing their total income by number of people and then multiplying by household size. These average household incomes are then applied to the tax laws to obtain tax liabilities and after-tax incomes. The tax laws applied are the rate schedules, the earned income credit, (all income at the lower end of the distribution is assumed to be "earned,") the personal exemption amount, the standard deduction, or zero bracket amount, and an abbreviated way to account for all other provisions such as itemized deductions.

Applying the Tax Laws.

The first step is to convert average AGI from each group to taxable income. The average per household AGI for each household size and each ventile is first reduced by the household size times the personal exemption amount. This amount is $1,000 per exemption in 1984, and is indexed to inflation beginning in 1985. (For example, the personal exemption amount was $1,040 in 1985.) The amount resulting from the subtraction is called taxable income and is applied to the legislated tax rate schedule. The procedure used takes the average income in the ventile and finds the appropriate legislated tax bracket, and calculates the tax from the Internal Revenue Service tax table. The taxes calculated in this manner will be referred to as "standard" taxes because they are the taxes that would be paid on the average income if the standard deduction were taken and no advantage was taken of any other special provisions in the tax law. Note that as of yet, there has not been any attempt to take into account itemized deductions, tax credits, or other special provisions in the tax code. These adjustments will be made later.

For the groups in the household size of one, the single rate schedule, IRS schedule X, is applied, while the married filing joint schedule, IRS schedule Z, is applied to the remaining returns. Taxpayers who are married but file separate returns are subject to the higher rates of schedule X, but these only amounted to 1.2 percent of tax returns in 1982, and therefore are treated as if they file jointly. Qualifying widows and widowers account for less than 0.2 percent of returns, and are treated as single. The other filing status, head of household, accounts for about nine percent of returns. Their tax rate schedule (schedule Y) is lower than the single rates but higher than married rates, but because the reported data don't sufficiently distinguish heads of household by household size and income interval, they are assumed to pay the slightly lower tax rates in the married schedule.

For low income households, the earned income credit is subtracted from tax liability. It is assumed for the purposes of this model that all income is earned when calculating the earned income credit. A policy simulation lever is built in here, where additive credits or surcharges which change tax liability by a fixed dollar amount per return, and multiplicative credits or surcharges which change tax liability by a fixed percentage of original tax liability can be added to the standard tax liabilities.

The standard taxes must then be converted to effective taxes, which are the estimates of actual tax liability from each group. This step relaxes the assumption that the standard deduction is taken by all taxpayers. It also allows for tax credits and other tax preferences to be taken into account. The difference between standard and effective taxes arises from many provisions in the tax code. The provisions fall into the following classes:

1) Itemized deductions (interest, taxes, medical expenses, etc.)

2) Tax credits (child care, residential energy, political contribution, investment tax credit, credit for the elderly, etc.)

3) The extra personal exemptions for elderly and/or blind taxpayers.

4) Other special provisions (maximum tax, income averaging, etc.)

5) The additional taxes (minimum and alternative taxes, recapture of investment credit, self-employed tax, etc.)

Note that the special tax provisions which exempt certain types of income from taxation are not listed above. The exclusions such as interest from state and local bonds, transfer, payments and other specially sheltered investment income account for some of the difference between AGI and personal income. Other sources of the difference between personal and adjusted gross income are the statutory adjustments, such as moving and other employee business expenses, IRA deposits and the like. These exclusions and adjustments are explicitly taken into account when aggregate AGI is determined (see Chapter 4). The income tax model as described in this chapter, only deals with forecasts of the AGI and its distribution.

The difference between standard and effective taxes is for practical purposes independent of the definition of AGI. Standard taxes are lowered to effective taxes by provisions such as tax credits and deductions, not by statutory adjustments or exclusions from gross income in determining AGI. In other words, if there were no itemized deductions or tax credits, standard taxes would always equal effective taxes, no matter what the definition of AGI. Effective taxes are expected to be less than standard taxes. While some provisions take the form of additional taxes which work in the opposite direction, tending to make effective taxes higher relative to standard taxes, these are not as important as the tax-reducing provisions.

Conversion of Standard to Effective Tax Rates.

Standard tax rates are converted to effective tax rates by equations that were estimated over the 1966-1982 period. The mathematical appendix describes how historical observations on effective tax rates were obtained. Briefly, the ventiles were constructed as before, and effective tax rates were derived for each ventile. Because the income intervals published do not correspond to income ventiles, the effective rates by ventile could only be approximated by interpolating the IRS data. The effective tax rates were calculated at the household size level, and aggregated to the ventile level with each household size's weight in proportion to the shares of each household size in the corresponding ventile.

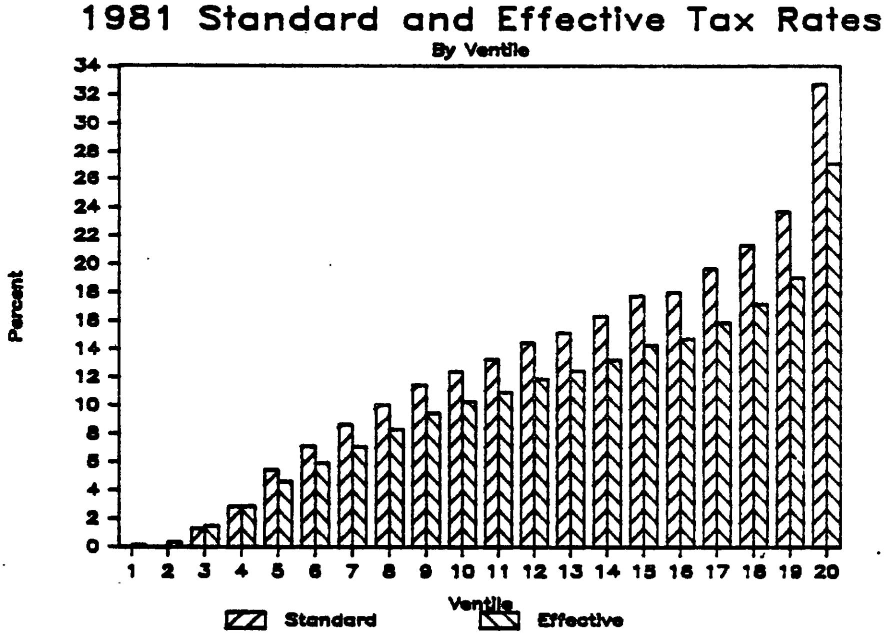
Standard tax rates for the historical period were calculated with help from the above method. The average household incomes were calculated as above for each of the 120 groups. These incomes were then applied to the tax rate schedules, the personal exemption amount, the standard deduction amount, and surcharges and per capita credits were varied according to the particular year's tax laws. The earned income credit was added to the calculations starting in 1976. These also included the Vietnam war temporary surtax and the special schedule for low income earners, which was the predecessor of the earned income credit. In other words, every effort was made for the calculation of standard taxes to take into account all provisions of the historical tax laws which were universally available to taxpayers, and as long as they only affected standard taxes. Those other provisions, such as itemization of income deductions, which are optional in nature are the primary determinant of the difference between standard and effective tax rates, and therefore are irrelevant to the estimation of historical standard tax rates.

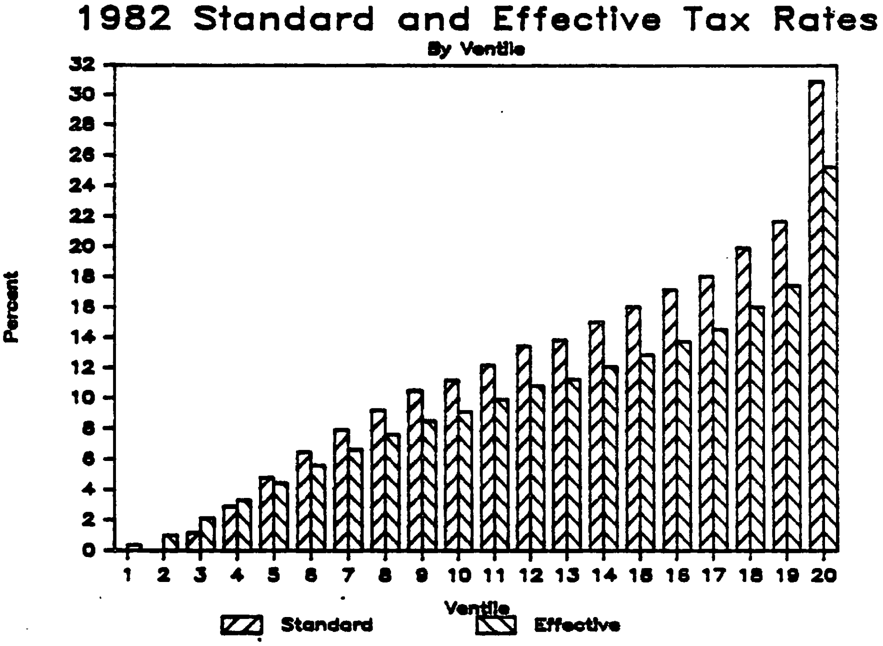
Effective taxes are almost always either the same or lower than standard taxes. Therefore, effective tax rates are easily expressed as a fraction of the computed standard rates. The fraction varies according to income ventile because a household's relative position in the income distribution determines in part the tax preferences available. One would expect that a higher income would result in a larger difference between standard and effective tax rates. This is because high income earners typically spend more on deductible items such as state income taxes. These households, because of their high tax brackets also have the most to gain by channeling their spending to the tax preferred items so as to minimize their taxes.

Figure 3.1 displays the standard and effective tax rates per ventile calculated for the years 1981 and 1982. Except for the lowest ventiles, effective rates are below the standard tax rates. Note that the largest difference is in ventile 20, but the ratio of the two rates for the last ventile is not much different than in the other ventiles.

The fraction of effective over standard varies over time. This

FIGURE 3.1


1981 Standard and Effective Tax Rates
By Ventile
Percent
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Ventile
Standard
Effective


1982 Standard and Effective Tax Rates
By Ventile
Percent
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Ventile
Standard
Effective

variation is the result of three processes. First, inflation has caused nominal incomes to rise over time, thus increasing the tax-reducing value of deductions and other items. Any given ventile's average per capita income has increased over time, so because of the resulting bracket creep due to inflation and the progressive tax rate schedule, a constant amount deducted in real terms will mean an increasing tax break relative to income. Second, real incomes have also been rising. This results not only in bracket creep as above, but also results in increasing propensity to spend on deductible items and an increasing incentive to avoid taxes. In other words, as real income increases, not only can a family more easily afford tax shelters, it has more incentive to shelter its higher income. This incentive is also experienced when inflation causes nominal incomes only to rise. Finally, the tax code has not been constant over the sample period. It may have been relatively easier for certain income groups to avoid taxes in the later years of the sample as the code became more complex. These three effects were captured econometrically by estimating a time trend in the ratio of effective to standard tax rates.

The transformation of standard to effective tax rates was modeled in the following way: it was assumed that effective rates were a fraction of standard rates, that is:

3.1) $$ETR_i = b_i * STR_i$$

where ETR_i are the effective tax rates for ventile i and STR_i are the standard tax rates. The coefficients b_i represent the amount of standard taxes which cannot be reduced by the special provisions. It was further assumed that the b_i's vary over time according to

3.2) $$b_i = c_i + d_i * TIME$$

This second equation is substituted into the first and the c's and d's are estimated with ordinary least squares. The equations estimated are of the form

$$3.3)\qquad ETR_i = c_i * STR_i + d_i * TIME_i * STR_i$$

The results of the estimation of these equations are shown in table 3.1. One equation was estimated for each ventile. That is, the historical tax rates were aggregated by household size. A ventile's tax rate is a weighted average of its six household size's tax rates where the income shares for each household size per ventile serve as the weights.

These equations fit the data very well for such a simple specification. This indicates that the method used in calculating standard taxes is a good one. The middle ventiles have especially good fits as indicated by their low average absolute percentage errors. The term labled "TREND" in the charts of table 3.1 is $TIME*STR_i$. Its coefficient d is related to the b's by $b_i = c_i + d_i * TIME$. The pattern of the estimated b's is shown in table 3.2. This table corresponds to the estimated STR/ETR ratios for 1982, and the numbers are calculated as $c + d*TIME_{1982}$.

The equations were also estimated at the disaggregated household size level, that is, for the 120 income groups as displayed in table 2.10. It might be expected that household size would be a factor in a family's ability to avoid taxes. This might be the case for families with small children because they may have higher medical bills, or may be more likely to be homeowners with large mortgage interest deductions. It turned out that this influence of household size was of some significance. Especially for the upper ventiles, the pattern of effective-to-standard tax ratios varied over household size with the larger sizes having, on average, a slightly better ability to avoid taxes. Table 3.3 shows the estimated ratios of standard to effective taxes for 1982 both at the aggregate ventile level and the household size level.

However, estimation at the household size level may not be the most reliable method. The disaggregated groups at the household size level tend to have highly variable effective and standard tax rates in the low ventiles (in relative terms). The effective rate may be two percent one year and only one-half of one percent the next year. This volatility can result in questionable estimates of the time-adjusted effective to standard tax rate ratios. In addition, 120 standard-to-effective tax rate equations are considerably more cumbersome to work with than are twenty. They must be estimated and used to forecast, and they would be particularly cumbersome for policy simulation exercises, where each one would have to be judgmentally altered on an individual basis. The forecast uses just the twenty aggregate equations.

The bottom of each page of tables 3.1 shows the historical standard and effective rates by ventile. Effective tax rates vary quite closely with the computed standard tax rates. It is also obvious that the ratio of effective and standard tax rates do vary over time. Over time, the gap has narrowed in the lower ventiles, while it has widened in the upper ventiles. This can also be seen by the values of the d_i's which are the coefficients for the "TREND" term in table 3.2. Those coefficients are positive in the lower ventiles, indicating a decreasing gap, and negative in the upper ventile indicating a widening gap between standard and effective tax rates over time. This can be explained by the argument outlined below.

One might easily think that for the lower ventiles, standard taxes would be equal to effective taxes. However, there are tax avoidance opportunities which are available to some taxpayers regardless of their income. For example, taxpayers over the age of 65 are allowed an extra personal exemption, and are eligible for an additional tax credit for the elderly. The other tax credits available independently of income such as the residential energy, child care, and political contributions credits have dollar ceiling amounts which apply regardless of income. These and other similar tax avoidance items are available to low income taxpayers, and could represent a large percentage savings in their tax liabilities. These same items are available to high income taxpayers, but represent a much lower percent of tax savings. If these limited-amount items were the only tax avoidance items, then one would expect the lower ventiles to have low ratios of effective to standard tax rates, with the ratios rising towards unity in the highest ventiles. In other words, what is the same dollar amount of tax avoidance for the fourth ventile and the sixteenth ventile is a much larger share of taxes and income in the fourth ventile, and the equations are indeed estimated in terms of tax shares of income.

There are, however, other tax avoidance items which come into play as incomes rise. For example, a married taxpayer filing jointly must have at least $3,400 of itemized deductions before they reduce his tax bill. There is no dollar limit on most of those deductions. These and other items like income averaging and maximum tax become relatively more important as income rises. In 1982 only about 35% of families itemized deductions, and in 1979 the percentage was 28.5. While there are taxpayers in all ventiles who benefit from itemizing, that opportunity is probably not widely used until around the fourteenth ventile. This is a crude estimate, because to be sure, there are itemizers in all ventiles and of all household sizes. But if only the top 35% in per capita income recipients itemize, that would be from ventile 14 and above. The higher the ventile, the more tax avoidance incentive and opportunities. Therefore, the ratio of effective to standard tax rates begins to decline with income in the higher ventiles, where these avoidance items become important.

The effects of the additional taxes must also be taken into account. These taxes include the self-employment tax, recapture of investment credit, FICA tax on gratuity income, and the minimum and alternative minimum taxes. The minimum tax is a fifteen percent charge on certain tax preferences, primarily business-related items like accelerated depreciation, amortization, bad debt, and research expenses. Self-employed persons frequently occupy the lower ventiles because a very high proportion of their income is deductible as business expense. They are frequently required to pay the additional minimum tax. These additional taxes help explain the fact that all the lowest income intervals reported in SOI, even those with negative AGI report some taxes paid. These additional taxes also resolve the seemingly odd fact that in the lower ventiles, estimated effective taxes sometimes exceed standard taxes. Again, these taxes affect the low ventiles much more relative to their incomes. But the effect is in the opposite direction of the limited tax avoidance items available to low income earners discussed above. The effect of the additional taxes, in fact, seems to dominate in the lower ventiles, resulting in high ratios of effective to standard taxes.

Table 3.3 shows the estimates of the b's (the ratios of effective to standard tax rates) for both the aggregate level and the household size equations. The pattern of the ratios indicates the effects of both types of tax avoidance items as well as the additional taxes. Except for the lowest ventiles in the small household sizes, the ratios follow a pattern that is rising somewhat with respect to income, but with a slight decrease in the higher ventiles. The effects of the widely available but limited-amount avoidance items are canceled out by the additional taxes in the low ventiles, and the ratios begin to decline in the higher ventiles, where the more income-dependent and open-ended tax avoidance items become more important. Though the table only shows the 1982 estimated ratios, the pattern of rising then falling ratios is universal throughout the sample.

As mentioned before, there is a related pattern revealed in the time trend coefficient, d, of the estimated equations, shown in table 3.2. For the lowest ventiles, the gap between standard and effective tax rates seems to have narrowed over time, and for the middle and higher ventiles, the gap seems to have widened. (Parameter d is positive in the lower ventiles and negative in the higher ones.) Incomes, both real and nominal, have been rising. By the argument from the previous page, the gap should shrink with rising incomes in the lower ventiles, and widen in the upper ventiles. The narrowing gap in the lower ventiles over time indicates the process of increasing incomes making the limited avoidance items, which are fixed in dollar terms, become relatively less important. The widening gap in the upper ventiles reflects the process of itemized deductions and the like, which are limited only by AGI, becoming relatively more important as incomes increase.

If these equations were used for forecasting, then, the gap between standard and effective taxes would shrink for the lower ventiles and widen for the upper ones. However, when the tax system became indexed in 1985, the inflation portion of bracket creep was eliminated. Both the bracket bounds and the personal exemption amount will be indexed. So the only source of possible gap widening, then, is real growth, which was probably the weakest. Therefore, in the forecasting model, it was decided that the best long-term forecast properties will be achieved if the coefficients reported in table 3.2 are taken as constants, eliminating the time trend. This procedure will assure the ratios of effective-to-standard tax rates will remain at their estimated 1982 levels. Note that what is used is not the actual vector of ratios, but the estimated vector of ratios fit to the data in 1982. Those estimated coefficients are used rather than the actual calculated ratios in order to eliminate any random component of the observed ratios which might be peculiar to the year 1982.

At this point, one may be asking why not just estimate a simple linear regression equation of the effective tax rates on the standard ones? This was indeed the first method tried. The results of those estimations, reported in table 3.4 were encouraging at first glance. The slope term on standard tax rates declined steadily with increasing ventiles, indicating rising opportunity and incentive for tax avoidance. The fits are even better than the specifications used above. The problem, however, lies in the simulation properties of that specification. One of the reasons for building the tax model was to perform tax reform simulations. The equation parameters in table 3.4 typically have high intercept terms, and low slope terms. Take, for example, ventile 20 where the slope term is about .48. This means that if the standard tax rate for that ventile were raised, about 60% of the extra tax burden to those households could be avoided by deductions. Likewise, a tax cut in the form of lower marginal rates in the schedule would only actually accrue to those households in the amount of 40% of the rate cuts in a simulation. That simulation property seemed unreasonable, especially in light of the fact that even the highest ventile actually pays close to 80% percent of its standard taxes. While the fit of those equations is good, the values of the parameter estimates make little economic sense in a policy simulation context.

Determination of the Distribution of Disposable AGI.

An estimate of disposable income is necessary for the tax model to be of use in forecasting consumption. The removal of taxes from income is fairly intuitive. However, some assumptions must be made about taxes other than the federal income tax. In addition, the resulting distribution of disposable income must be expressed in the index form used in the personal consumption part of the model.

The average effective tax rate per ventile and household size is applied to each group's average AGI, and the federal income tax is subtracted out. Four other types of personal taxes must be removed before disposable income can be determined. These are state and local income taxes, state and local other taxes, and nontaxes from both the federal and state and local levels. All these taxes except the state and local income taxes are assumed to be an exogenously set flat percentage of personal income determined by historical percentages. State and local income taxes are assumed to be an exogenously set percentage of the federal income tax liability. These other taxes are then subtracted. Estimates of total disposable AGI in each of the twenty ventiles are the result.

The cutoff levels of disposable per capita AGI are estimated by first taking the pre-tax AGI cutoff points already determined, and applying the appropriate average federal income tax rates to those cutoff incomes. The appropriate federal rates are not the ventile effective tax rates whose derivations have just been described. Those rates represent the rate on the average income in each ventile, not the effective rate on the cutoff income. The appropriate tax rates for the cutoff incomes are linear interpolations of the average ventile rates. The interpolations of the tax rates are based on the positions of the cutoff AGIs relative to the ventile average AGIs. After the federal tax rates are determined for the cutoff levels of AGI, the other taxes on the cutoff incomes are determined as flat percentages of the cutoff income as before, and a distribution of disposable AGI is obtained. See the tables of Chapters 1 and 5 for illustrations of the output and capabilities of the income tax model.

Advantages of the Framework.

The tax system can easily be indexed to inflation under this framework. Indexation, as defined by the current tax law, requires that the bracket boundaries and the personal exemption amounts are changed every year in proportion to the inflation rate. Note that the standard deduction amount does not have to be separately indexed, because it is incorporated into the rate schedule as the upper boundary of the zero tax bracket. The bracket boundaries are read in with the tax rate schedule, and the personal exemption amounts are also read in as data. These variables can then be easily set to grow with the GNP price deflator beginning in any year one desires. As one can imagine, indexation, whether full or partial, makes a large difference in the forecast of taxes collected, and hence, the outcome of the interindustry model.

Changes in the definition of adjusted gross income can also be modeled. One must first determine how much the change will affect the total amount of AGI. Then one must either fix AGI to be that amount, or alter the AGI determination procedure described in Chapter 4 so that it produces the desired results. Next, one must decide how that change will affect the distribution of income, if at all. If the change will not affect how AGI is distributed then no further modifications to the model are necessary. However, if the distribution is to be affected, one must change the AGI of each ventile and household size individually.

The framework is particularly well-suited for modeling changes in the marginal tax rates. These rates are just read in from the entire tax schedules for single and married taxpayers, and can be easily changed.

Changes in tax credits and deductions and other tax preference items affect the relation of standard taxes to effective taxes. The relationship is just read in as the data from table 3.2. These numbers can easily be changed. The difficult part is in determining how to change them. An obvious example would be that the ratios should all be 1.0's if all deductions, credits, etc., were eliminated. Then effective taxes would equal standard taxes.

Examples of all of the changes discussed in the previous four paragraphs can be found in the simulation study of tax reform done with this model. That study, the subject of Chapter 5, analyzed the distributional effects of the tax burden under current tax law and the proposed version of tax reform. This study well illustrates the flexibility of this income tax modeling framework.

The results of the work as described thus far are estimates of the amount and distribution of taxes and the amount and distribution of disposable AGI. This is not quite the concept of income that the consumption section of the model was built to use. Disposable AGI must be converted to disposable personal income. Estimates of the amounts and distribution of transfer payments and the other differences between personal income and AGI must be made and incorporated into the model. This is the subject of the next chapter.

TABLE 3.1

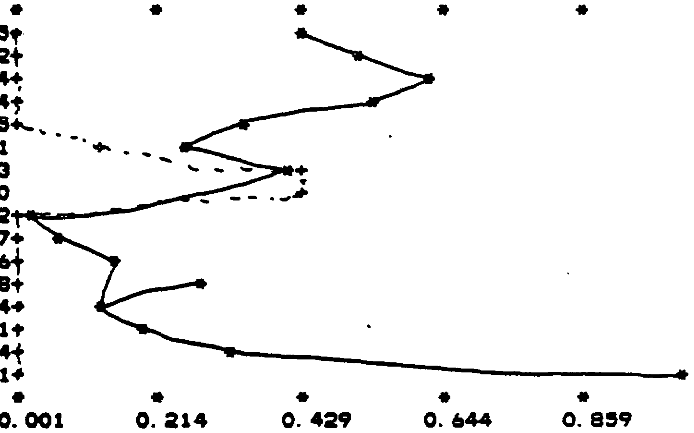
EQUATIONS AND PLOTS FOR STANDARD AND EFFECTIVE TAX RATES.

```
*   REGRESSION VENTILE  2

   1  SEE =       0.4179    RSQR = -1.9070 RBARSG = -2.1146  NOBS =   16
      RHO =       0.8747      DW =    0.251  AAPE  =    84.51
VARIABLE              REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR2                     3.736800    0.17     0.670      0.10        0.0654
TREND                   -0.142159   -0.12    -0.495      0.05        1.2678
ATR2                       DEPENDENT VARIABLE  - - - - - -           0.36444
NE  22
```

```
  REGRESSION VENTILE  2

DATE  ACTUAL    PREDIC    MISS
       IS *      IS +    IS A-P *
 67    0.45      0.00     0.45
 68    0.52      0.00     0.52
 69    0.64      0.00     0.64
 70    0.54      0.00     0.54
 71    0.35      0.00     0.35
 72    0.26      0.15     0.11
 73    0.41      0.44    -0.03
 74    0.43      0.44    -0.00
 75    0.02      0.00     0.02
 76    0.07      0.00     0.07
 77    0.16      0.00     0.16
 78    0.28      0.00     0.28
 79    0.14      0.00     0.14
 80    0.21      0.00     0.21
 81    0.34     -0.00     0.34
 82    1.01      0.00     1.01
       IS *      IS +    IS A-P *
```



```
E END
```

```
  PLOT VENTILE  2

DATE  ATR2      STR2
       IS *      IS +    IS
 67    0.45      0.00     0.00
 68    0.52      0.00     0.00
 69    0.64      0.00     0.00
 70    0.54      0.00     0.00
 71    0.35      0.00     0.00
 72    0.26      0.13     0.00
 73    0.41      0.42     0.00
 74    0.43      0.49     0.00
 75    0.02      0.00     0.00
 76    0.07      0.00     0.00
 77    0.16      0.00     0.00
 78    0.28      0.00     0.00
 79    0.14      0.00     0.00
 80    0.21      0.00     0.00
 81    0.34      0.01     0.00
 82    1.01      0.00     0.00
       IS *      IS +    IS
```

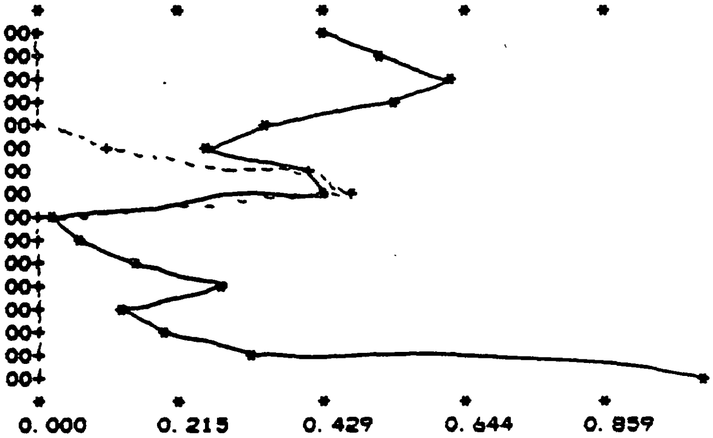


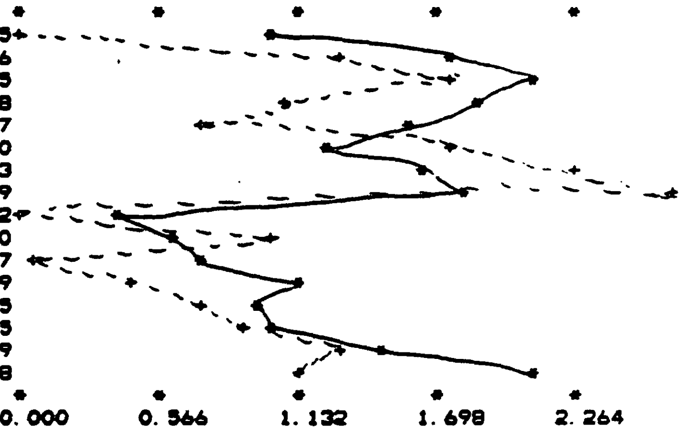
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE  3

   1  SEE =      0.6531   RSQR = -0.5083 RBARSQ = -0.6160  NOBS =   16
      RHO =      0.4864    DW  =    1.027  AAPE  =   47.64
VARIABLE              REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR3                     0.351296     0.62     0.338      1.38         1.3232
TREND                    0.024244     0.83     0.457      2.40        25.9596
ATR3                         DEPENDENT VARIABLE  - - - - - -           1.37681
NE  22
```

```
  REGRESSION VENTILE  3

DATE  ACTUAL    PREDIC    MISS
       IS *      IS +    IS A-P
 67    1.07      0.02     1.05
 68    1.79      1.33     0.46
 69    2.13      1.78     0.35
 70    1.90      1.11     0.78
 71    1.61      0.74     0.87
 72    1.30      1.79    -0.50
 73    1.67      2.31    -0.63
 74    1.87      2.66    -0.79
 75    0.42      0.00     0.42
 76    0.63      1.03    -0.40
 77    0.75      0.08     0.67
 78    1.18      0.49     0.69
 79    0.99      0.74     0.25
 80    1.07      0.92     0.15
 81    1.52      1.33     0.19
 82    2.14      1.16     0.98
       IS *      IS +    IS A-P
E END
```



```
  PLOT VENTILE  3

DATE  ATR3      STR3
       IS *      IS +     IS
 67    1.07      0.03     0.00
 68    1.79      1.92     0.00
 69    2.13      2.49     0.00
 70    1.90      1.50     0.00
 71    1.61      0.97     0.00
 72    1.30      2.28     0.00
 73    1.67      2.84     0.00
 74    1.87      3.18     0.00
 75    0.42      0.00     0.00
 76    0.63      1.16     0.00
 77    0.75      0.09     0.00
 78    1.18      0.53     0.00
 79    0.99      0.77     0.00
 80    1.07      0.94     0.00
 81    1.52      1.32     0.00
 82    2.14      1.13     0.00
       IS *      IS +     IS
```

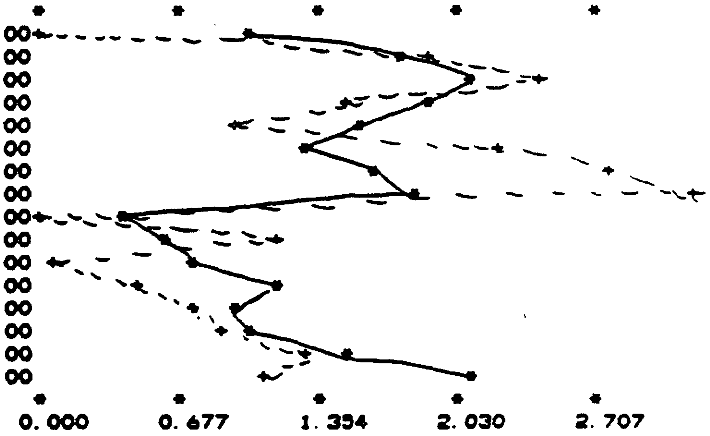


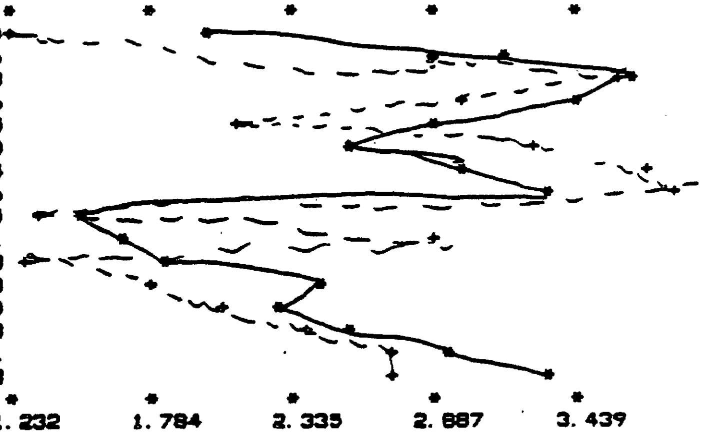
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE  4

   1  SEE =      0.6077   RSQR =  0.1695 RBARSQ =  0.1102  NOBS =   16
      RHO =      0.2216     DW  =    1.557  AAPE  =   20.94
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
STR4                    0.420441     1.92     0.498     12.45        3.1845
TREND                   0.019606     1.75     0.459     10.41       63.0171
ATR4                        DEPENDENT VARIABLE  - - - - - -          2.69112
NE  22

  REGRESSION VENTILE  4

DATE  ACTUAL    PREDIC     MISS
       IS *      IS +    IS A-P *
 67    2.03      1.23      0.80
 68    3.20      2.94      0.26
 69    3.69      3.62      0.08
 70    3.47      3.01      0.46
 71    2.92      2.17      0.75
 72    2.60      3.29     -0.70
 73    3.01      3.74     -0.74
 74    3.36      3.83     -0.46
 75    1.51      1.36      0.15
 76    1.70      2.91     -1.21
 77    1.88      1.30      0.58
 78    2.47      1.79      0.68
 79    2.30      2.10      0.20
 80    2.61      2.43      0.18
 81    2.96      2.75      0.21
 82    3.35      2.72      0.63
       IS *      IS +    IS A-P *
E END
```



```
  PLOT VENTILE  4

DATE  ATR4      STR4
       IS *      IS +    IS
 67    2.03      1.82     0.00
 68    3.20      4.23     0.00
 69    3.69      5.06     0.00
 70    3.47      4.09     0.00
 71    2.92      2.87     0.00
 72    2.60      4.26     0.00
 73    3.01      4.72     0.00
 74    3.36      4.71     0.00
 75    1.51      1.64     0.00
 76    1.70      3.42     0.00
 77    1.88      1.49     0.00
 78    2.47      2.01     0.00
 79    2.30      2.31     0.00
 80    2.61      2.61     0.00
 81    2.96      2.90     0.00
 82    3.35      2.81     0.00
       IS *      IS +    IS
```

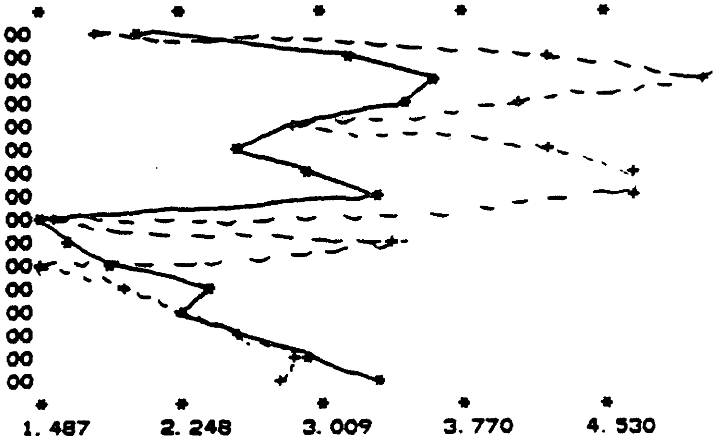


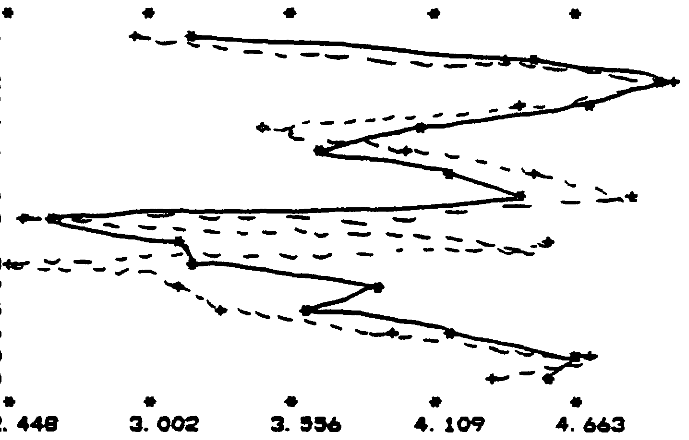
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE  5

   1  SEE =      0.5342   RSQR =  0.3974 RBARSQ =  0.3543  NOBS =   16
      RHO =     -0.0092    DW  =    2.018  AAPE  =    10.65
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR5                  0.581961     4.74     0.701    61.32         4.8082
TREND                 0.011717     1.93     0.284    12.56        96.7365
ATR5                       DEPENDENT VARIABLE  - - - - - -         3.99387
NE  22
```

```
  REGRESSION VENTILE  5

DATE  ACTUAL    PREDIC     MISS
       IS *      IS +    IS A-P *
 67    3.19      2.95      0.24
 68    4.53      4.39      0.14
 69    5.03      5.05     -0.02
 70    4.74      4.47      0.27
 71    4.06      3.49      0.57
 72    3.70      4.04     -0.34
 73    4.19      4.50     -0.31
 74    4.47      4.92     -0.45
 75    2.63      2.54      0.10
 76    3.17      4.58     -1.41
 77    3.17      2.45      0.73
 78    3.93      3.14      0.79
 79    3.64      3.29      0.35
 80    4.20      3.95      0.25
 81    4.66      4.76     -0.10
 82    4.58      4.38      0.20
       IS *      IS +    IS A-P *
E END
```



```
  PLOT VENTILE  5

DATE  ATR5      STR5
       IS *      IS +    IS
 67    3.19      4.02      0.00
 68    4.53      5.88      0.00
 69    5.03      6.67      0.00
 70    4.74      5.81      0.00
 71    4.06      4.47      0.00
 72    3.70      5.09      0.00
 73    4.19      5.60      0.00
 74    4.47      6.02      0.00
 75    2.63      3.06      0.00
 76    3.17      5.45      0.00
 77    3.17      2.88      0.00
 78    3.93      3.64      0.00
 79    3.64      3.76      0.00
 80    4.20      4.46      0.00
 81    4.66      5.30      0.00
 82    4.58      4.81      0.00
       IS *      IS +    IS
```

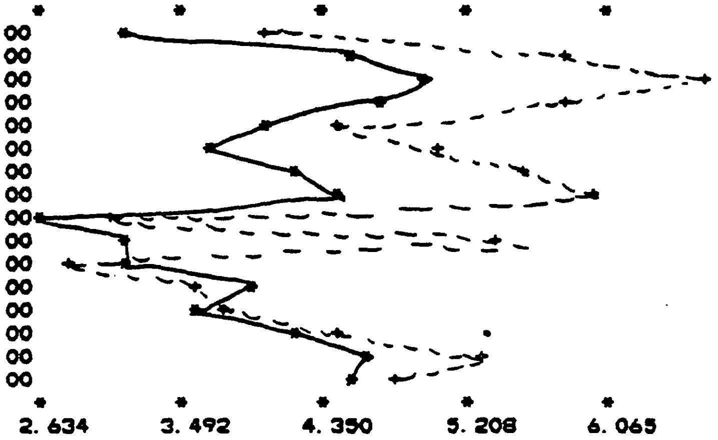


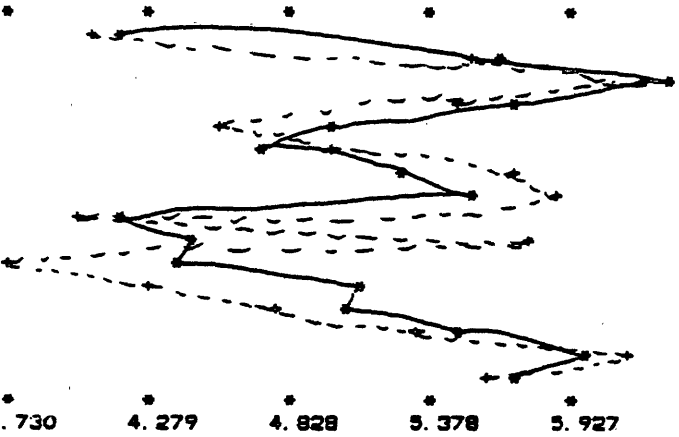
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE  6

   1  SEE =      0.5028   RSGR =  0.4153 RBARSQ =  0.3736  NOBS =   16
      RHO =     -0.0103     DW =   2.021  AAPE  =     7.37
VARIABLE             REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR6                   0.694106     7.65     0.839    127.69         6.2750
TREND                  0.006236     1.43     0.153      7.02       127.7487
ATR6                       DEPENDENT VARIABLE  - - - - - -          5.19375
NE  22
```

```
 REGRESSION VENTILE  6

DATE  ACTUAL   PREDIC    MISS
       IS *     IS +    IS A-P *
 67     4.21     4.10     0.11
 68     5.69     5.58     0.12
 69     6.31     6.20     0.11
 70     5.76     5.52     0.24
 71     5.04     4.60     0.44
 72     4.74     5.04    -0.30
 73     5.30     5.71    -0.41
 74     5.57     5.92    -0.35
 75     4.18     4.04     0.14
 76     4.45     5.80    -1.36
 77     4.39     3.73     0 66
 78     5.11     4.29     0.82
 79     5.08     4.79     0.29
 80     5.52     5.33     0.19
 81     6.03     6.17    -0.13
 82     5.71     5.61     0.10
       IS *     IS +    IS A-P *
E END
```



```
 PLOT VENTILE  6

DATE  ATR6     STR6
       IS *     IS +    IS
 67     4.21     5.29     0.00
 68     5.69     7.14     0.00
 69     6.31     7.87     0.00
 70     5.76     6.95     0.00
 71     5.04     5.75     0.00
 72     4.74     6.25     0.00
 73     5.30     7.03     0.00
 74     5.57     7.23     0.00
 75     4.18     4.90     0.00
 76     4.45     6.98     0.00
 77     4.39     4.45     0.00
 78     5.11     5.08     0.00
 79     5.08     5.64     0.00
 80     5.52     6.22     0.00
 81     6.03     7.15     0.00
 82     5.71     6.46     0.00
       IS *     IS +    IS
```

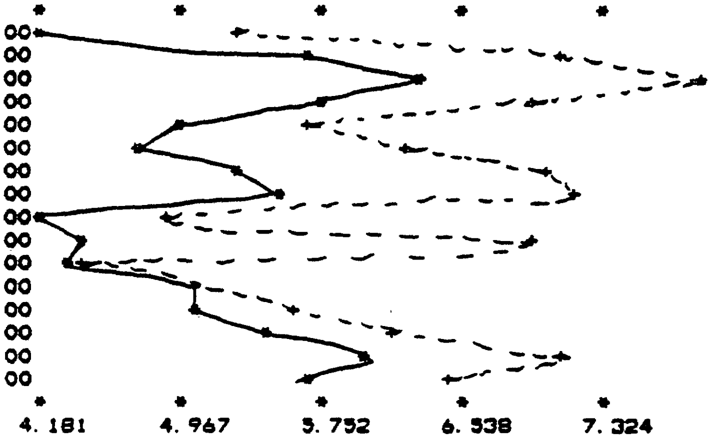


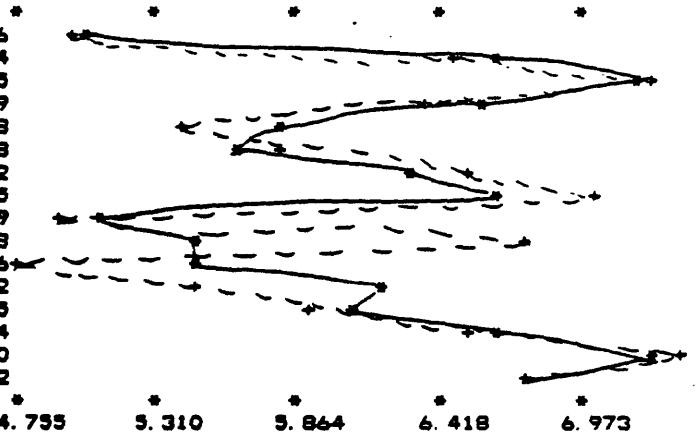
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE  7

  1  SEE =      0.4629   RSQR =  0.5464 RBARSQ =  0.5141  NOBS =   16
     RHO =     -0.1577    DW  =    2.315  AAPE  =     5.22
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
STR7                 0.748409    10.54    0.900   198.92          7.4590
TREND                0.003834     1.14    0.095     4.50        152.8879
ATR7                      DEPENDENT VARIABLE  - - - - - -         6.20224
NE  22
```

```
  REGRESSION VENTILE  7

DATE   ACTUAL    PREDIC     MISS
        IS *      IS +    IS A-P
 67     5.07      5.01      0.06
 68     6.66      6.52      0.14
 69     7.20      7.25     -0.05
 70     6.59      6.40      0.19
 71     5.83      5.46      0.38
 72     5.67      5.85     -0.18
 73     6.31      6.53     -0.22
 74     6.69      7.04     -0.35
 75     5.13      4.93      0.19
 76     5.52      6.79     -1.28
 77     5.51      4.76      0.76
 78     6.22      5.50      0.72
 79     6.12      5.97      0.15
 80     6.69      6.55      0.14
 81     7.26      7.36     -0.10
 82     6.75      6.77     -0.02
        IS *      IS +    IS A-P
E END
```



```
  PLOT VENTILE  7

DATE   ATR7      STR7
        IS *      IS +    IS
 67     5.07      6.27      0.00
 68     6.66      8.13      0.00
 69     7.20      9.00      0.00
 70     6.59      7.90      0.00
 71     5.83      6.71      0.00
 72     5.67      7.15      0.00
 73     6.31      7.95      0.00
 74     6.69      8.54      0.00
 75     5.13      5.95      0.00
 76     5.52      8.16      0.00
 77     5.51      5.68      0.00
 78     6.22      6.55      0.00
 79     6.12      7.07      0.00
 80     6.69      7.72      0.00
 81     7.26      8.64      0.00
 82     6.75      7.91      0.00
        IS *      IS +    IS
```

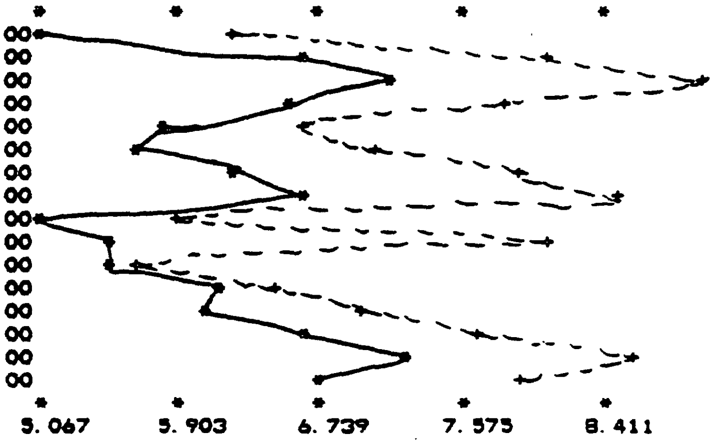


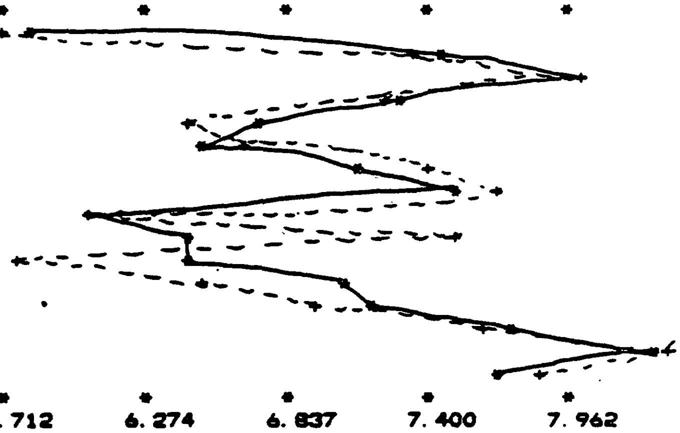
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE  8

  1  SEE =     0.3750   RSQR =  0.7128 RBARSQ =  0.6923  NOBS =   16
     RHO =    -0.0437     DW  =   2.087  AAPE  =    3.64
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR8                   0.761804    15.00     0.914   313.29       8.5309
TREND                  0.003385     1.41     0.083     6.86     175.3692
ATR8                      DEPENDENT VARIABLE  - - - - - -        7.11143
NE  22

 REGRESSION VENTILE  8

DATE  ACTUAL    PREDIC    MISS
        IS *      IS +   IS A-P *
 67     5.87      5.71     0.16
 68     7.47      7.36     0.11
 69     8.04      8.06    -0.02
 70     7.29      7.24     0.05
 71     6.75      6.49     0.26
 72     6.52      6.72    -0.20
 73     7.13      7.40    -0.28
 74     7.56      7.68    -0.12
 75     6.10      6.10    -0.00
 76     6.49      7.52    -1.02
 77     6.47      5.80     0.67
 78     7.07      6.52     0.55
 79     7.21      7.00     0.20
 80     7.78      7.65     0.13
 81     8.32      8.36    -0.04
 82     7.72      7.86    -0.14
        IS *      IS +   IS A-P *
E END
```



```
 PLOT VENTILE  8

DATE  ATR8      STR8
        IS *      IS +   IS
 67     5.87      7.09      0.00
 68     7.47      9.09      0.00
 69     8.04      9.92      0.00
 70     7.29      8.87      0.00
 71     6.75      7.92      0.00
 72     6.52      8.17      0.00
 73     7.13      8.96      0.00
 74     7.56      9.26      0.00
 75     6.10      7.32      0.00
 76     6.49      8.99      0.00
 77     6.47      6.91      0.00
 78     7.07      7.74      0.00
 79     7.21      8.27      0.00
 80     7.78      9.01      0.00
 81     8.32      9.79      0.00
 82     7.72      9.17      0.00
        IS *      IS +   IS
```

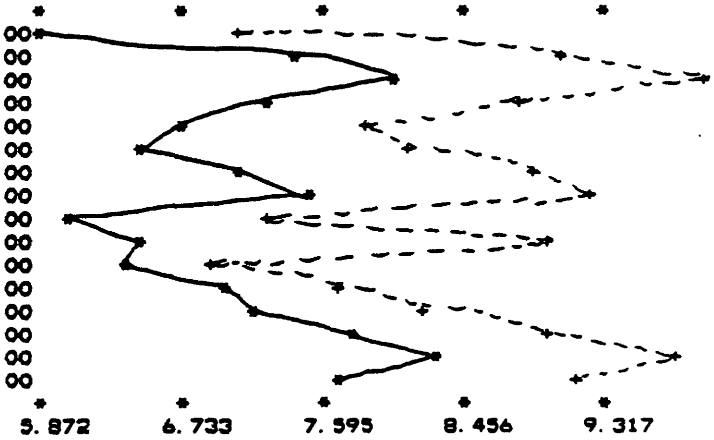


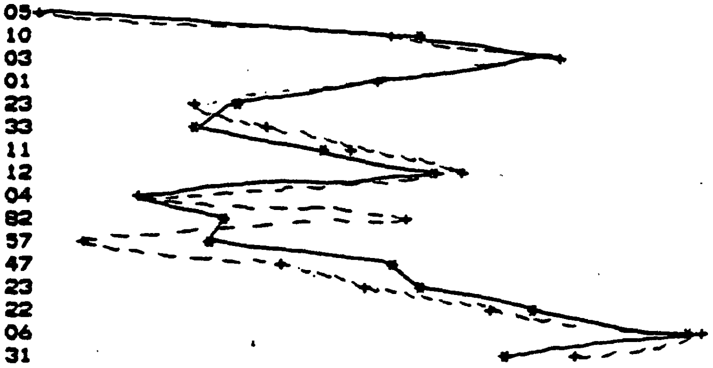
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE  9

   1  SEE =      0. 3282    RSQR =  0. 8247 RBARSQ =  0. 8122  NOBS =   16
      RHO =     -0. 0278     DW  =    2. 056  AAPE  =    2. 98
VARIABLE           REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
STR9                  0. 792148    19. 73     0. 945   436. 75        9. 4772
TREND                 0. 002175     1. 15     0. 054     4. 65      195. 5774
ATR9                      DEPENDENT VARIABLE  - - - - - -             7. 94443
NE  22
```

```
  REGRESSION VENTILE  9

DATE  ACTUAL   PREDIC    MISS
        IS *     IS +   IS A-P *         *         *         *         *
 67     6. 51    6. 46    0. 05+
 68     8. 22    8. 12    0. 10
 69     8. 88    8. 86    0. 03
 70     8. 05    8. 06   -0. 01
 71     7. 43    7. 20    0. 23
 72     7. 20    7. 52   -0. 33
 73     7. 80    7. 91   -0. 11
 74     8. 29    8. 42   -0. 12
 75     6. 96    6. 92    0. 04
 76     7. 36    8. 18   -0. 82
 77     7. 27    6. 70    0. 57
 78     8. 08    7. 60    0. 47
 79     8. 21    7. 98    0. 23
 80     8. 77    8. 54    0. 22
 81     9. 43    9. 49   -0. 06
 82     8. 64    8. 95   -0. 31
        IS *     IS +   IS A-P *         *         *         *         *
                               6. 463    7. 108    7. 753    8. 398    9. 043
E END
```



```
  PLOT VENTILE  9

DATE  ATR9     STR9
        IS *     IS +   IS       *         *         *         *         *
 67     6. 51    7. 88    0. 00*
 68     8. 22    9. 87    0. 00
 69     8. 88   10. 74    0. 00
 70     8. 05    9. 74    0. 00
 71     7. 43    8. 68    0. 00
 72     7. 20    9. 05    0. 00
 73     7. 80    9. 49    0. 00
 74     8. 29   10. 07    0. 00
 75     6. 96    8. 26    0. 00
 76     7. 36    9. 74    0. 00
 77     7. 27    7. 96    0. 00
 78     8. 08    9. 01    0. 00
 79     8. 21    9. 43    0. 00
 80     8. 77   10. 07    0. 00
 81     9. 43   11. 16    0. 00
 82     8. 64   10. 49    0. 00
        IS *     IS +   IS       *         *         *         *         *
                               6. 511    7. 500    8. 488    9. 477   10. 466
```

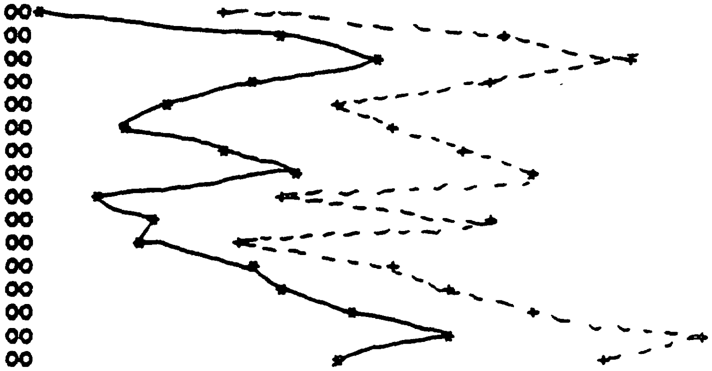


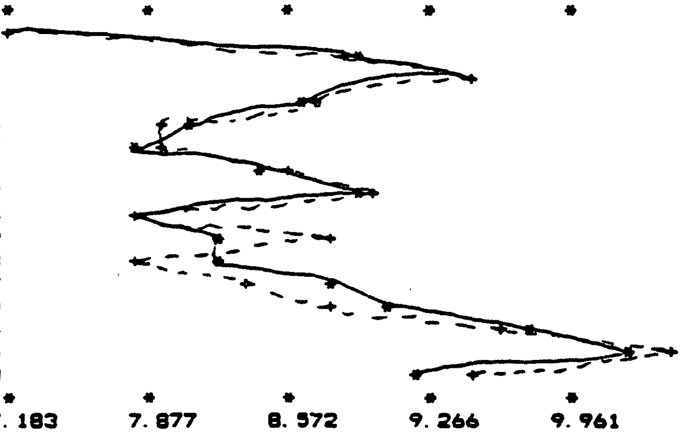
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 10

   1  SEE =      0.2576   RSQR =  0.8957 RBARSQ =  0.8883  NOBS =   16
      RHO =      0.1561     DW  =   1.688  AAPE  =    2.13
VARIABLE           REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR10                 0.812132    27.91    0.964   652.62       10.3347
TREND                 0.001437     1.06    0.035     3.91      213.6876
ATR10                     DEPENDENT VARIABLE  - - - - - -       8.70680
NE  22
```

```
  REGRESSION VENTILE 10

DATE  ACTUAL    PREDIC    MISS
       IS *      IS +    IS A-P
 67     7.18      7.19    -0.01
 68     8.95      8.87     0.09
 69     9.51      9.53    -0.01
 70     8.70      8.73    -0.03
 71     8.10      7.96     0.14
 72     7.86      7.98    -0.12
 73     8.47      8.58    -0.11
 74     8.93      9.03    -0.09
 75     7.83      7.87    -0.04
 76     8.24      8.82    -0.59
 77     8.29      7.81     0.48
 78     8.80      8.41     0.39
 79     9.10      8.80     0.30
 80     9.77      9.63     0.14
 81    10.31     10.45    -0.14
 82     9.26      9.54    -0.28
       IS *      IS +    IS A-P
E END
```



```
  PLOT VENTILE 10

DATE  ATR10     STR10
       IS *      IS +    IS
 67     7.18      8.65     0.00
 68     8.95     10.66     0.00
 69     9.51     11.43     0.00
 70     8.70     10.46     0.00
 71     8.10      9.52     0.00
 72     7.86      9.52     0.00
 73     8.47     10.22     0.00
 74     8.93     10.73     0.00
 75     7.83      9.34     0.00
 76     8.24     10.46     0.00
 77     8.29      9.25     0.00
 78     8.80      9.93     0.00
 79     9.10     10.38     0.00
 80     9.77     11.34     0.00
 81    10.31     12.28     0.00
 82     9.26     11.20     0.00
       IS *      IS +    IS
```

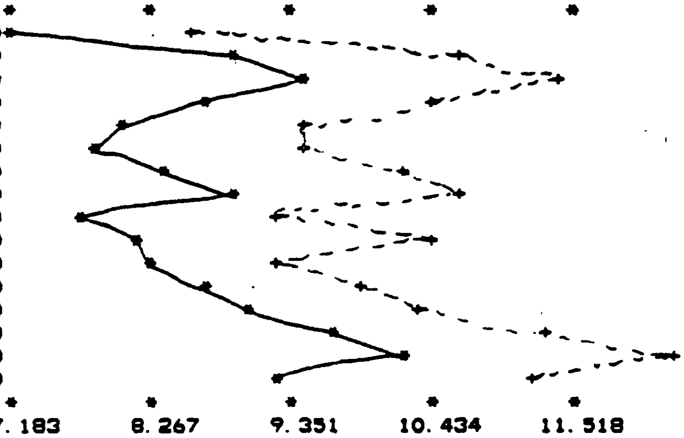


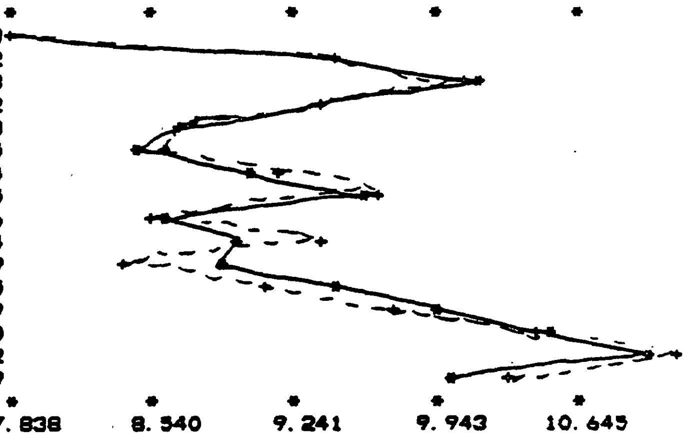
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 11

  1  SEE =      0.2242   RSQR =  0.9258 RBARSQ =  0.9205  NOBS =   16
     RHO =      0.1333    DW  =   1.733  AAPE  =   1.71
VARIABLE           REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR11                 0.842082    35.50    0.993   853.93        11.0864
TREND                 0.000281     0.25    0.007     0.23       229.6351
ATR11                     DEPENDENT VARIABLE  - - - - - -         9.40493
NE  22
```

```
  REGRESSION VENTILE 11

DATE  ACTUAL    PREDIC    MISS
       IS *      IS +    IS A-P
 67     7.84      7.87    -0.03
 68     9.51      9.49     0.02
 69    10.22     10.14     0.08
 70     9.38      9.40    -0.02
 71     8.73      8.70     0.03
 72     8.49      8.64    -0.15
 73     9.09      9.23    -0.14
 74     9.64      9.69    -0.05
 75     8.64      8.58     0.06
 76     8.97      9.40    -0.44
 77     8.95      8.46     0.49
 78     9.45      9.11     0.35
 79     9.96      9.77     0.19
 80    10.54     10.44     0.10
 81    11.02     11.14    -0.12
 82    10.04     10.33    -0.29
       IS *      IS +    IS A-P
```



```
E END
```

```
  PLOT VENTILE 11

DATE  ATR11     STR11
       IS *      IS +    IS
 67     7.84      9.30    0.00
 68     9.51     11.21    0.00
 69    10.22     11.99    0.00
 70     9.38     11.10    0.00
 71     8.73     10.28    0.00
 72     8.49     10.20    0.00
 73     9.09     10.89    0.00
 74     9.64     11.44    0.00
 75     8.64     10.11    0.00
 76     8.97     11.09    0.00
 77     8.95      9.97    0.00
 78     9.45     10.73    0.00
 79     9.96     11.51    0.00
 80    10.54     12.29    0.00
 81    11.02     13.11    0.00
 82    10.04     12.16    0.00
       IS *      IS +    IS
```

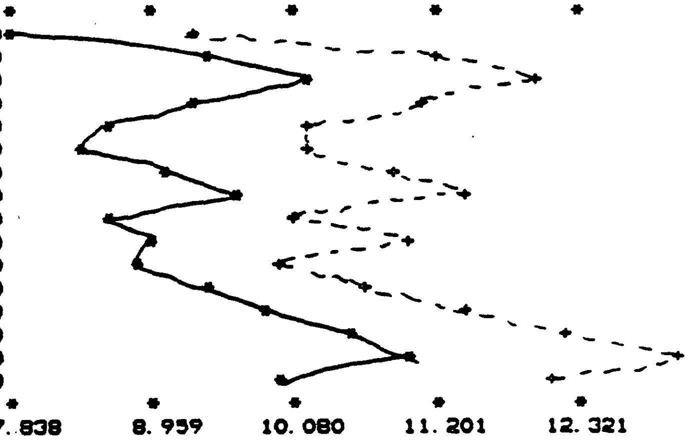


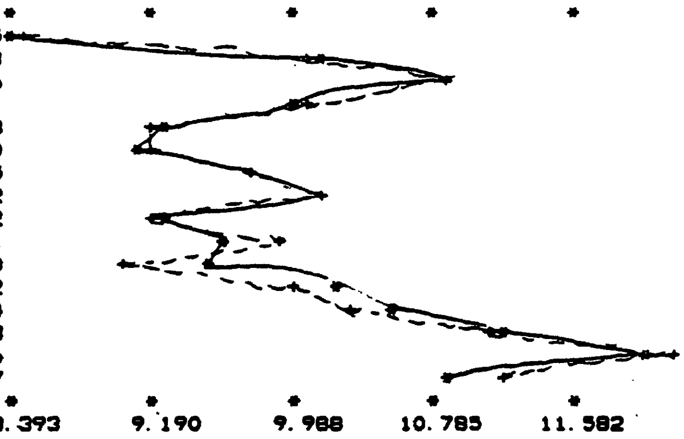
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 12

   1  SEE =      0.2183    RSQR =  0.9406 RBARSQ =  0.9364  NOBS =   16
      RHO =      0.1177     DW  =   1.765  AAPE  =    1.70
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR12                  0.859933    39.85    1.010   969.79        11.8496
TREND                 -0.000447    -0.45   -0.011     0.71       245.8107
ATR12                       DEPENDENT VARIABLE  - - - - - -       10.08568
NE  22

  REGRESSION VENTILE 12

DATE   ACTUAL     PREDIC      MISS
        IS *       IS +     IS A-P
 67     8.39       8.54     -0.15
 68    10.23      10.09      0.13
 69    10.88      10.94     -0.06
 70    10.02      10.13     -0.11
 71     9.33       9.25      0.08
 72     9.12       9.22     -0.10
 73     9.76       9.81     -0.05
 74    10.19      10.21     -0.02
 75     9.32       9.20      0.12
 76     9.63       9.95     -0.31
 77     9.55       9.06      0.50
 78    10.27      10.04      0.22
 79    10.58      10.34      0.24
 80    11.23      11.11      0.13
 81    11.98      12.14     -0.16
 82    10.88      11.25     -0.37
        IS *       IS +     IS A-P
E END
```



```
  PLOT VENTILE 12

DATE   ATR12      STR12
        IS *       IS +     IS
 67     8.39      10.00     0.00
 68    10.23      11.82     0.00
 69    10.88      12.82     0.00
 70    10.02      11.88     0.00
 71     9.33      10.85     0.00
 72     9.12      10.82     0.00
 73     9.76      11.52     0.00
 74    10.19      12.00     0.00
 75     9.32      10.82     0.00
 76     9.63      11.70     0.00
 77     9.55      10.66     0.00
 78    10.27      11.83     0.00
 79    10.58      12.18     0.00
 80    11.23      13.09     0.00
 81    11.98      14.32     0.00
 82    10.88      13.28     0.00
        IS *       IS +     IS
```

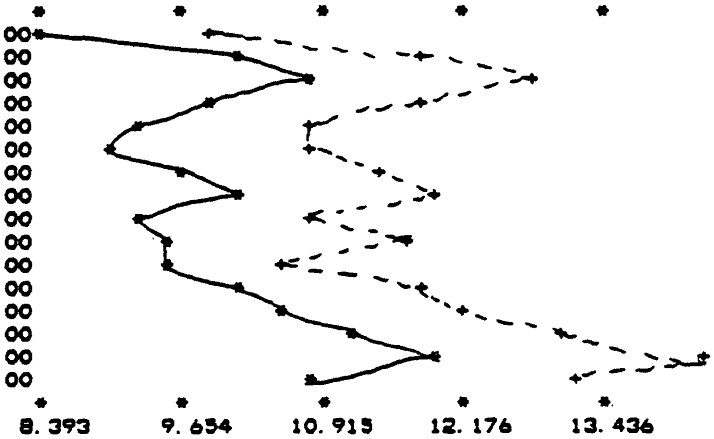


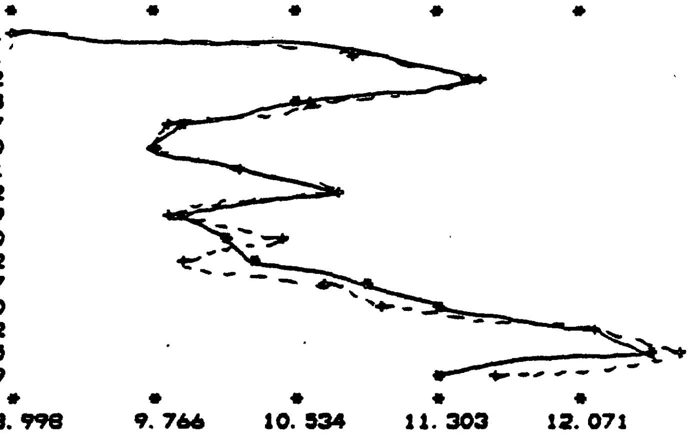
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 13

   1  SEE =      0.1886    RSQR =  0.9560 RBARSQ =  0.9529  NOBS =   16
      RHO =      0.1160     DW  =    1.768  AAPE  =    1.20
VARIABLE             REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR13                   0.878241    49.64    1.028  1230.51       12.5567
TREND                 -0.001185    -1.44   -0.029      7.18      260.6453
ATR13                      DEPENDENT VARIABLE  - - - - - -        10.72424
NE  22
```

```
  REGRESSION VENTILE 13

DATE  ACTUAL    PREDIC     MISS
       IS *      IS +    IS A-P *
 67     9.00      9.00     0.01
 68    10.88     10.89    -0.01
 69    11.46     11.58    -0.12
 70    10.59     10.67    -0.08
 71     9.99      9.91     0.07
 72     9.82      9.82    -0.00
 73    10.27     10.28    -0.01
 74    10.82     10.84    -0.02
 75     9.98      9.89     0.09
 76    10.16     10.46    -0.30
 77    10.35      9.93     0.42
 78    10.93     10.76     0.17
 79    11.34     11.04     0.30
 80    12.21     12.19     0.02
 81    12.46     12.61    -0.15
 82    11.34     11.63    -0.29
       IS *      IS +    IS A-P *
E END
```



```
  PLOT VENTILE 13

DATE  ATR13     STR13
       IS *      IS +    IS
 67     9.00     10.43     0.00
 68    10.88     12.64     0.00
 69    11.46     13.46     0.00
 70    10.59     12.42     0.00
 71     9.99     11.55     0.00
 72     9.82     11.46     0.00
 73    10.27     12.01     0.00
 74    10.82     12.68     0.00
 75     9.98     11.59     0.00
 76    10.16     12.28     0.00
 77    10.35     11.67     0.00
 78    10.93     12.66     0.00
 79    11.34     13.01     0.00
 80    12.21     14.39     0.00
 81    12.46     14.90     0.00
 82    11.34     13.76     0.00
       IS *      IS +    IS
```

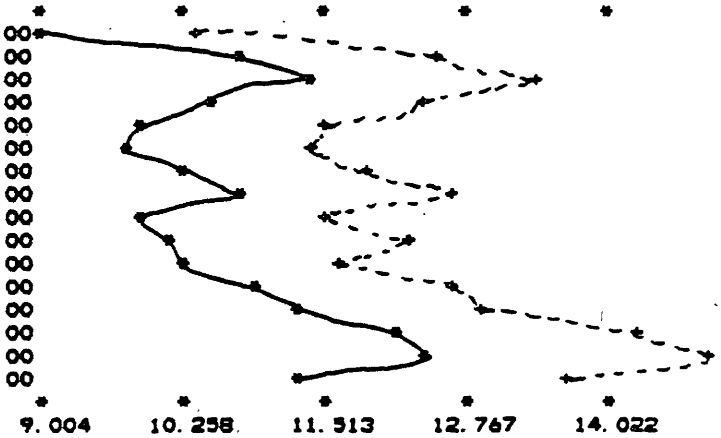


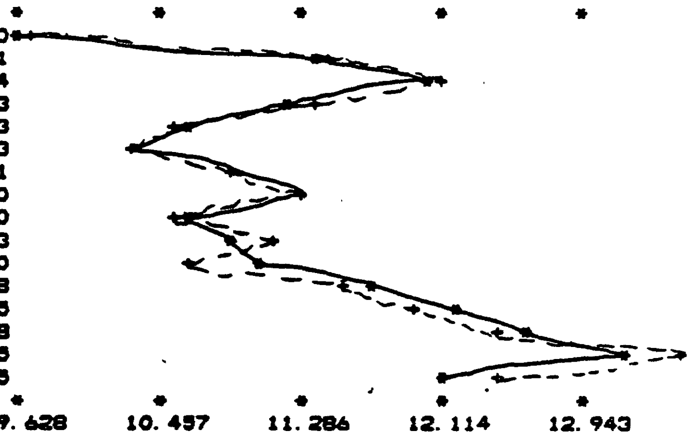
TABLE 3.1 (continued)

```
*    REGRESSION VENTILE 14

   1  SEE =      0.1928   RSQR =  0.9567 RBARSQ =  0.9536  NOBS =   16
      RHO =      0.2856     DW =    1.429  AAPE =     1.23
VARIABLE           REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR14                 0.900539    52.67     1.053  1311.27        13.3287
TREND                -0.002182    -2.76    -0.053    24.24       277.1324
ATR14                       DEPENDENT VARIABLE  - - - - - -        11.40274
NE  22
```

```
  REGRESSION VENTILE 14

DATE   ACTUAL    PREDIC     MISS
        IS *      IS +    IS A-P
 67      9.63      9.72    -0.10
 68     11.44     11.45    -0.01
 69     12.09     12.13    -0.04
 70     11.25     11.38    -0.13
 71     10.64     10.61     0.03
 72     10.37     10.34     0.03
 73     10.95     10.93     0.01
 74     11.36     11.36    -0.00
 75     10.66     10.55     0.10
 76     10.90     11.13    -0.23
 77     11.07     10.67     0.40
 78     11.78     11.60     0.18
 79     12.22     11.97     0.25
 80     12.64     12.47     0.18
 81     13.27     13.52    -0.25
 82     12.18     12.53    -0.35
        IS *      IS +    IS A-P
E END
```



```
  PLOT VENTILE 14

DATE   ATR14     STR14
        IS *      IS +    IS
 67      9.63     11.15     0.00
 68     11.44     13.17     0.00
 69     12.09     13.98     0.00
 70     11.25     13.15     0.00
 71     10.64     12.29     0.00
 72     10.37     12.00     0.00
 73     10.95     12.73     0.00
 74     11.36     13.26     0.00
 75     10.66     12.35     0.00
 76     10.90     13.06     0.00
 77     11.07     12.55     0.00
 78     11.78     13.67     0.00
 79     12.22     14.15     0.00
 80     12.64     14.77     0.00
 81     13.27     16.07     0.00
 82     12.18     14.92     0.00
        IS *      IS +    IS
```

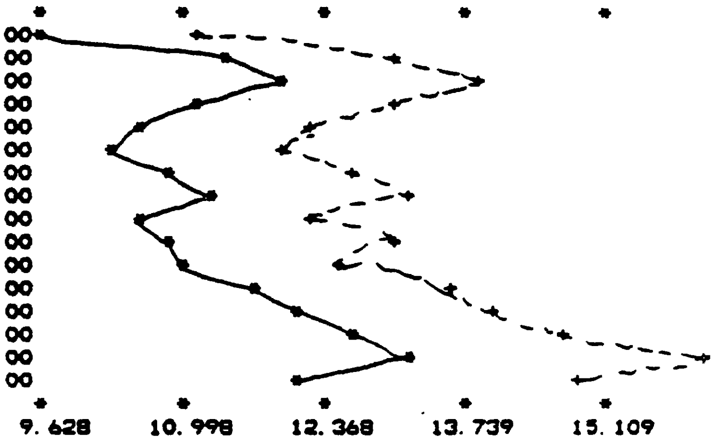


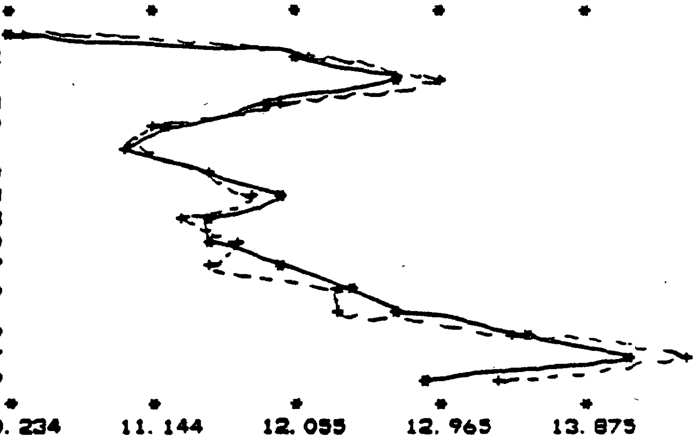
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 15

  1  SEE =      0.2139   RSQR =  0.9539 RBARSQ =  0.9506  NOBS =    16
     RHO =      0.3463     DW =    1.307  AAPE  =    1.37
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
STR15                0.915948    51.13     1.067  1270.19        14.1172
TREND               -0.002780    -3.36    -0.067    34.46       293.8911
ATR15                   DEPENDENT VARIABLE  - - - - - -           12.11999
NE  22
```

```
  REGRESSION VENTILE 15

DATE  ACTUAL    PREDIC     MISS
       IS *      IS +    IS A-P
 67    10.23     10.36    -0.13
 68    12.13     12.15    -0.02
 69    12.77     12.98    -0.21
 70    11.94     12.02    -0.08
 71    11.25     11.16     0.09
 72    11.01     11.00     0.01
 73    11.57     11.57    -0.00
 74    11.99     11.82     0.18
 75    11.51     11.33     0.18
 76    11.56     11.76    -0.20
 77    11.97     11.58     0.39
 78    12.49     12.33     0.16
 79    12.71     12.40     0.31
 80    13.60     13.51     0.09
 81    14.24     14.51    -0.27
 82    12.95     13.34    -0.39
       IS *      IS +    IS A-P
E END
```



```
  PLOT VENTILE 15

DATE  ATR15     STR15
       IS *      IS +    IS
 67    10.23     11.78     0.00
 68    12.13     13.85     0.00
 69    12.77     14.84     0.00
 70    11.94     13.79     0.00
 71    11.25     12.85     0.00
 72    11.01     12.70     0.00
 73    11.57     13.40     0.00
 74    11.99     13.74     0.00
 75    11.51     13.21     0.00
 76    11.56     13.75     0.00
 77    11.97     13.59     0.00
 78    12.49     14.52     0.00
 79    12.71     14.65     0.00
 80    13.60     16.01     0.00
 81    14.24     17.26     0.00
 82    12.95     15.92     0.00
       IS *      IS +    IS
```

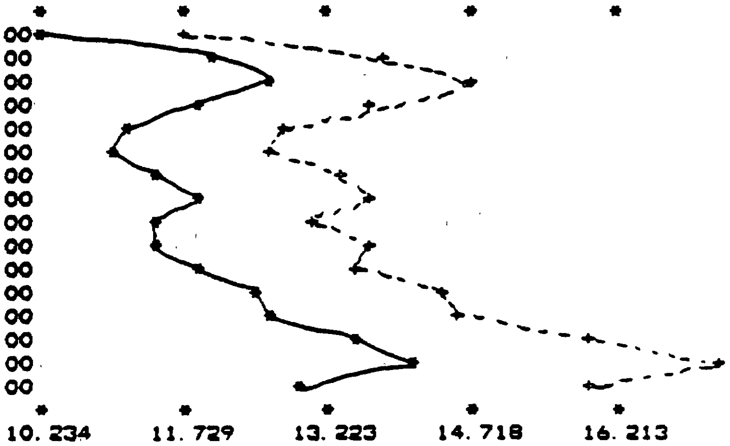


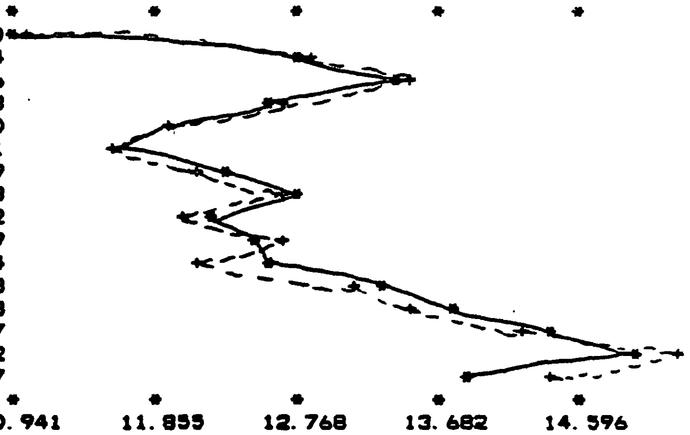
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 16

   1  SEE =      0.2234    RSQR =  0.9545 RBARSQ =  0.9513  NOBS =   16
      RHO =      0.3553     DW  =   1.289  AAPE  =    1.34
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR16                0.941037    53.11     1.093  1322.99        14.9871
TREND               -0.003844    -4.72    -0.093    60.95       312.6180
ATR16                    DEPENDENT VARIABLE  - - - - - -          12.90818
NE  22
```

```
  REGRESSION VENTILE 16

DATE  ACTUAL   PREDIC    MISS
       IS *     IS +    IS A-P
 67    10.94    11.04   -0.10
 68    12.81    12.95   -0.14
 69    13.42    13.58   -0.16
 70    12.64    12.72   -0.08
 71    11.96    11.96    0.00
 72    11.67    11.67    0.01
 73    12.33    12.13    0.19
 74    12.80    12.72    0.08
 75    12.30    12.09    0.22
 76    12.51    12.70   -0.19
 77    12.61    12.17    0.44
 78    13.32    13.20    0.13
 79    13.79    13.56    0.23
 80    14.46    14.29    0.17
 81    15.01    15.24   -0.22
 82    13.95    14.42   -0.47
       IS *     IS +    IS A-P
E END
```



```
  PLOT VENTILE 16

DATE  ATR16    STR16
       IS *     IS +    IS
 67    10.94    12.39    0.00
 68    12.81    14.59    0.00
 69    13.42    15.37    0.00
 70    12.64    14.47    0.00
 71    11.96    13.66    0.00
 72    11.67    13.38    0.00
 73    12.33    13.98    0.00
 74    12.80    14.71    0.00
 75    12.30    14.05    0.00
 76    12.51    14.83    0.00
 77    12.61    14.27    0.00
 78    13.32    15.55    0.00
 79    13.79    16.05    0.00
 80    14.46    16.99    0.00
 81    15.01    18.20    0.00
 82    13.95    17.31    0.00
       IS *     IS +    IS
```

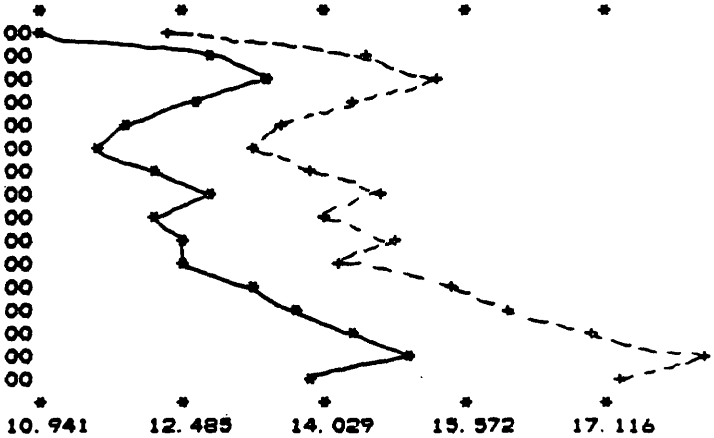


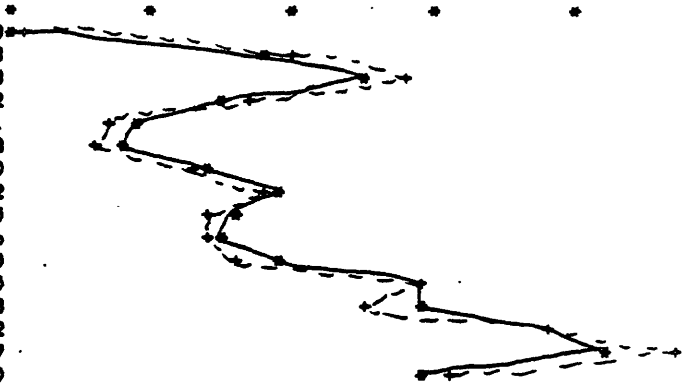
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 17

   1  SEE =      0.2017   RSQR =  0.9653 RBARSQ =  0.9628  NOBS =   16
      RHO =      0.3874    DW  =   1.225  AAPE  =    1.19
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR17                  0.960518    63.13     1.105  1590.24        15.8589
TREND                 -0.004387    -6.27    -0.105    95.23       330.9772
ATR17                        DEPENDENT VARIABLE - - - - - -        13.78855
NE  22

  REGRESSION VENTILE 17

DATE  ACTUAL    PREDIC    MISS
       IS *      IS +    IS A-P *         *         *         *         *
 67    11.79     11.92    -0.13
 68    13.59     13.72    -0.13
 69    14.29     14.52    -0.23
 70    13.32     13.44    -0.12
 71    12.66     12.55     0.11
 72    12.58     12.45     0.13
 73    13.15     13.05     0.10
 74    13.65     13.53     0.12
 75    13.39     13.15     0.25
 76    13.25     13.19     0.06
 77    13.71     13.42     0.30
 78    14.61     14.66    -0.05
 79    14.62     14.30     0.33
 80    15.49     15.50    -0.02
 81    15.93     16.32    -0.39
 82    14.59     14.79    -0.20
       IS *      IS +    IS A-P *         *         *         *         *
                              11.789    12.753    13.718    14.682    15.647
E END
```



```
  PLOT VENTILE 17

DATE  ATR17     STR17
       IS *      IS +    IS               *         *         *         *
 67    11.79     13.20     0.00
 68    13.59     15.26     0.00
 69    14.29     16.22     0.00
 70    13.32     15.10     0.00
 71    12.66     14.17     0.00
 72    12.58     14.12     0.00
 73    13.15     14.87     0.00
 74    13.65     15.51     0.00
 75    13.39     15.14     0.00
 76    13.25     15.26     0.00
 77    13.71     15.61     0.00
 78    14.61     17.14     0.00
 79    14.62     16.80     0.00
 80    15.49     18.31     0.00
 81    15.93     19.38     0.00
 82    14.59     17.65     0.00
       IS *      IS +    IS       *         *         *         *         *
                              11.789    13.405    15.020    16.636    18.252
```

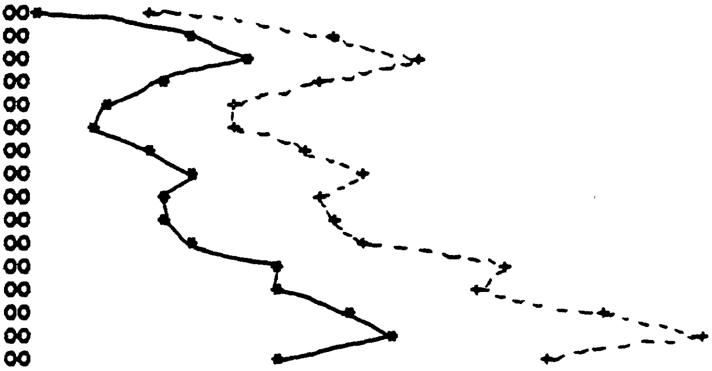


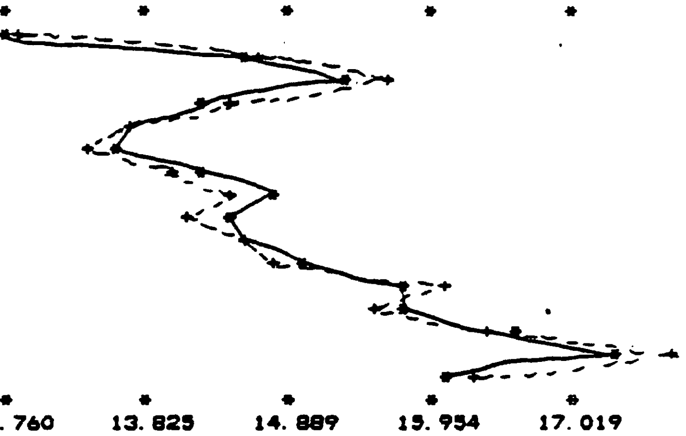
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 18

  1  SEE =      0.2387   RSQR =  0.9593 RBARSQ =  0.9564  NOBS =   16
     RHO =      0.2595    DW  =   1.481  AAPE  =    1.37
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
STR18                 0.995757    59.51     1.142  1493.64          17.1854
TREND                -0.005950    -7.78    -0.143   130.63         359.6185
ATR18                        DEPENDENT VARIABLE  - - - - - -        14.98067
NE  22
```

```
  REGRESSION VENTILE 18

DATE  ACTUAL    PREDIC     MISS
       IS *      IS +    IS A-P
 67   12.76     12.92     -0.16
 68   14.68     14.77     -0.09
 69   15.40     15.65     -0.25
 70   14.35     14.52     -0.17
 71   13.74     13.76     -0.02
 72   13.67     13.48      0.19
 73   14.29     14.05      0.24
 74   14.80     14.52      0.28
 75   14.51     14.16      0.35
 76   14.59     14.60     -0.01
 77   15.09     14.87      0.22
 78   15.82     16.14     -0.31
 79   15.82     15.54      0.28
 80   16.62     16.46      0.15
 81   17.39     17.76     -0.37
 82   16.15     16.34     -0.19
       IS *      IS +    IS A-P
```



```
E END
```

```
  PLOT VENTILE 18

DATE  ATR18     STR18
       IS *      IS +    IS
 67   12.76     14.07     0.00
 68   14.68     16.19     0.00
 69   15.40     17.27     0.00
 70   14.35     16.12     0.00
 71   13.74     15.38     0.00
 72   13.67     15.17     0.00
 73   14.29     15.92     0.00
 74   14.80     16.56     0.00
 75   14.51     16.26     0.00
 76   14.59     16.88     0.00
 77   15.09     17.31     0.00
 78   15.82     18.92     0.00
 79   15.82     18.35     0.00
 80   16.62     19.57     0.00
 81   17.39     21.27     0.00
 82   16.15     19.71     0.00
       IS *      IS +    IS
```

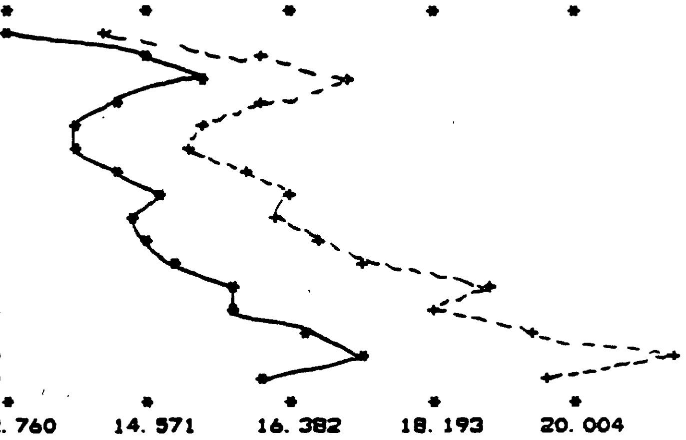


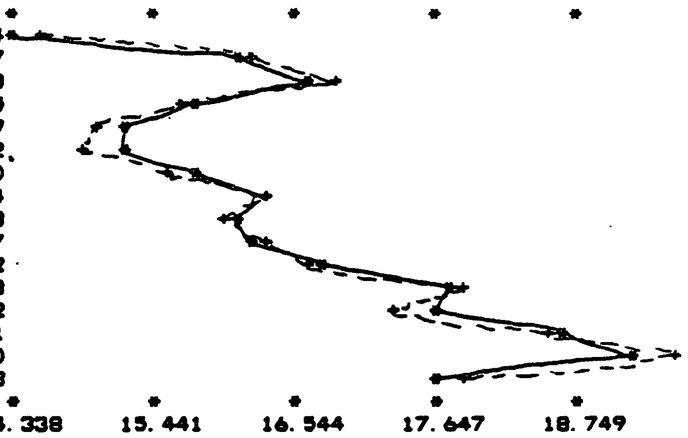
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 19

   1  SEE =        0.2203    RSQR =  0.9720 RBARSQ =  0.9699  NOBS =   16
      RHO =        0.2962     DW  =   1.408  AAPE  =    1.13
VARIABLE             REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
STR19                   1.007091    72.27    1.163  1834.19        19.2102
TREND                  -0.006735   -10.60   -0.163   200.33       402.6417
ATR19                     DEPENDENT VARIABLE  - - - - - -          16.64055
NE  22
```

```
  REGRESSION VENTILE 19

DATE  ACTUAL    PREDIC     MISS
        IS *      IS +    IS A-P *
 67    14.34     14.58    -0.24
 68    16.14     16.31    -0.17
 69    16.74     16.97    -0.23
 70    15.81     15.76     0.05
 71    15.26     15.07     0.19
 72    15.27     14.96     0.32
 73    15.78     15.59     0.20
 74    16.34     16.38    -0.04
 75    16.21     16.08     0.13
 76    16.31     16.38    -0.07
 77    16.83     16.71     0.12
 78    17.79     17.97    -0.18
 79    17.75     17.33     0.42
 80    18.74     18.62     0.11
 81    19.22     19.52    -0.30
 82    17.71     17.94    -0.23
        IS *      IS +    IS A-P *
E END
```



```
  PLOT VENTILE 19

DATE  ATR19     STR19
        IS *      IS +    IS
 67    14.34     15.86      0.00
 68    16.14     17.86      0.00
 69    16.74     18.73      0.00
 70    15.81     17.52      0.00
 71    15.26     16.89      0.00
 72    15.27     16.88      0.00
 73    15.78     17.73      0.00
 74    16.34     18.77      0.00
 75    16.21     18.57      0.00
 76    16.31     19.07      0.00
 77    16.83     19.61      0.00
 78    17.79     21.25      0.00
 79    17.75     20.66      0.00
 80    18.74     22.38      0.00
 81    19.22     23.65      0.00
 82    17.71     21.91      0.00
        IS *      IS +    IS
```

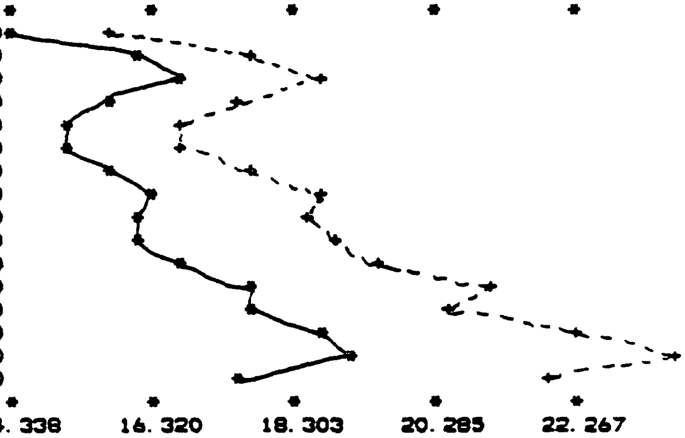


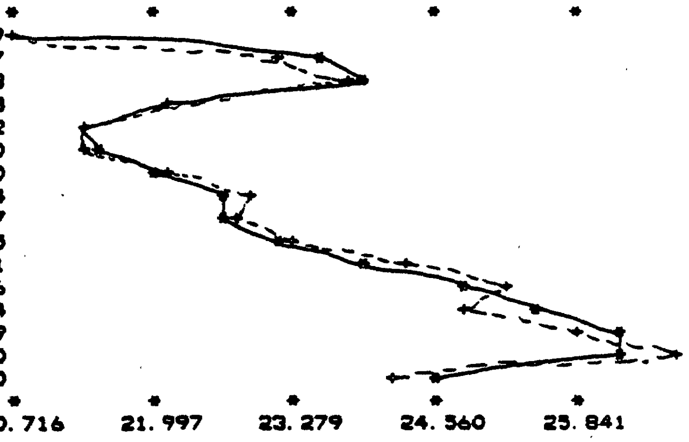
TABLE 3.1 (continued)

```
*   REGRESSION VENTILE 20

   1  SEE  =      0.3102   RSQR  =  0.9673 RBARSQ =  0.9650  NOBS  =   16
      RHO  =     -0.0031    DW   =   2.006  AAPE   =    1.00
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
STR20                  1.043870   76.32    1.241   1942.06        27.9057
TREND                 -0.009644  -15.50   -0.241    326.10       585.9646
ATR20                      DEPENDENT VARIABLE  - - - - - -       23.47973
NE  22

  REGRESSION VENTILE 20

DATE  ACTUAL     PREDIC     MISS
       IS *      IS +    IS A-P
 67    20.72     20.80    -0.09
 68    23.54     23.17     0.37
 69    23.93     23.90     0.03
 70    22.17     22.20    -0.03
 71    21.48     21.36     0.12
 72    21.55     21.45     0.10
 73    22.04     22.24    -0.20
 74    22.76     22.90    -0.14
 75    22.75     22.81    -0.07
 76    23.21     23.36    -0.15
 77    23.93     24.34    -0.41
 78    24.84     25.30    -0.46
 79    25.50     24.86     0.64
 80    26.32     25.93     0.39
 81    26.34     26.74    -0.40
 82    24.60     24.30     0.30
       IS *      IS +    IS A-P
```



```
E END

  PLOT VENTILE 20

DATE  ATR20     STR20
       IS *      IS +    IS
 67    20.72     22.65    0.00
 68    23.54     25.50    0.00
 69    23.93     26.58    0.00
 70    22.17     24.95    0.00
 71    21.48     24.27    0.00
 72    21.55     24.65    0.00
 73    22.04     25.84    0.00
 74    22.76     26.91    0.00
 75    22.75     27.12    0.00
 76    23.21     28.09    0.00
 77    23.93     29.61    0.00
 78    24.84     31.14    0.00
 79    25.50     30.97    0.00
 80    26.32     32.69    0.00
 81    26.34     34.13    0.00
 82    24.60     31.40    0.00
       IS *      IS +    IS
```

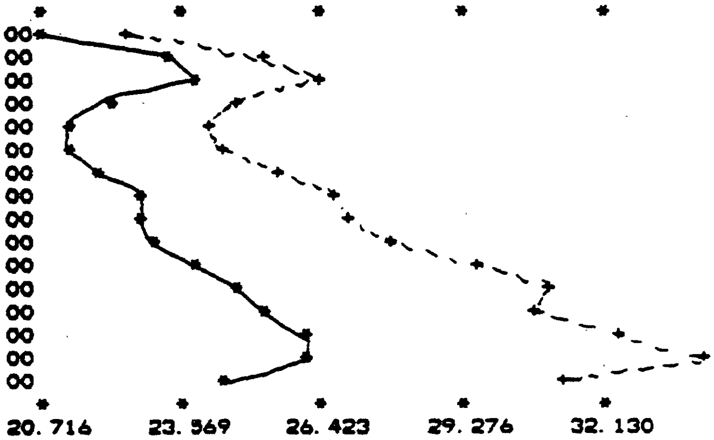


TABLE 3.2

ESTIMATED RATIOS OF EFFECTIVE-TO-STANDARD TAX RATES.

	Ratio Estimate (b)	c	d	R-sq.	Durbin-Watson
Vent 1	*	*	*	*	*
Vent 2	*	*	*	*	*
Vent 3	1.03012	.3513	.0242	*	1.027
Vent 4	0.96940	.4204	.0196	.1695	1.557
Vent 5	0.91004	.5820	.0117	.3974	2.018
Vent 6	0.86870	.6941	.0062	.4153	2.021
Vent 7	0.85577	.7484	.0038	.5464	2.315
Vent 8	0.85658	.7618	.0034	.7128	2.087
Vent 9	0.85305	.7921	.0022	.8247	2.056
Vent 10	0.85236	.8121	.0014	.8957	1.688
Vent 11	0.84995	.8421	.0003	.9258	1.733
Vent 12	0.84741	.8599	-.0004	.9406	1.765
Vent 13	0.84505	.8782	-.0012	.9560	1.768
Vent 14	0.83944	.9005	-.0022	.9567	1.429
Vent 15	0.83810	.9159	-.0028	.9539	1.307
Vent 16	0.83339	.9410	-.0038	.9545	1.289
Vent 17	0.83769	.9605	-.0044	.9653	1.225
Vent 18	0.82915	.9958	-.0060	.9593	1.481
Vent 19	0.81852	1.0071	-.0067	.9720	1.408
Vent 20	0.77384	1.0439	-.0096	.9673	2.006

* - The equation is incalculable or misleading because the standard tax rates on the right hand side are either zero or very small.

This is the system of equations being estimated.

3.1) $$ETR_i = b_i * STR_i$$

3.2) $$b_i = c_i + d_i * TIME$$

The equations estimated are of the form:

3.3) $$ETR_i = c_i * STR_i + d_i * TIME_i * STR_i$$

TABLE 3.3

ESTIMATED RATIOS OF EFFECTIVE-TO-STANDARD TAX RATES BY HOUSEHOLD SIZE.

Vent.	ALL	1	2	3	4	5	6
1	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*
3	1.03012	*	*	*	*	0.86639	0.91238
4	0.96940	*	*	*	0.85347	0.85265	0.87740
5	0.91004	*	0.40536	0.94907	0.85160	0.85644	0.87207
6	0.86870	0.30550	0.56057	0.90429	0.87984	0.85759	0.84554
7	0.85577	0.59220	0.67571	0.91947	0.86726	0.85972	0.82635
8	0.85658	0.69651	0.77047	0.93374	0.86991	0.85524	0.80305
9	0.85305	0.75869	0.83763	0.91719	0.87423	0.83759	0.77759
10	0.85236	0.79588	0.87776	0.90886	0.86789	0.82467	0.75700
11	0.84995	0.82940	0.90890	0.90922	0.85167	0.80430	0.73758
12	0.84741	0.86496	0.92487	0.90603	0.83782	0.78604	0.72449
13	0.84505	0.89374	0.92471	0.89833	0.81574	0.77043	0.71185
14	0.83944	0.91882	0.93087	0.88470	0.79443	0.75223	0.69035
15	0.83810	0.93508	0.94242	0.86616	0.77560	0.73979	0.67038
16	0.83339	0.94599	0.93922	0.84139	0.75584	0.70999	0.65030
17	0.83769	0.95351	0.92535	0.81721	0.73800	0.68029	0.64158
18	0.82915	0.95593	0.89820	0.79258	0.70238	0.65322	0.64651
19	0.81852	0.94268	0.85642	0.75150	0.66810	0.65406	0.64014
20	0.77384	0.87189	0.78402	0.71053	0.66980	0.65316	0.63750

* - The ratio is undefined or distorted because the standard tax rate in the denominator is zero or very small (less than .01 of income).

TABLE 3.4

ESTIMATION RESULTS OF ETR = a + b*STR

	Intercept	Slope	R-Square	Durbin-W.
Vent 1	--	--	--	--
Vent 2	0.35763	0.10418	.0044	0.814
Vent 3	0.89552	0.36374	.4566	0.785
Vent 4	1.39477	0.40708	.5286	0.997
Vent 5	1.75323	0.46600	.5671	1.019
Vent 6	2.05956	0.49972	.5714	1.132
Vent 7	2.03996	0.55802	.6608	1.423
Vent 8	1.59851	0.64623	.7330	1.360
Vent 9	0.93072	0.74006	.8224	1.563
Vent 10	0.50565	0.79355	.8908	1.410
Vent 11	0.54332	0.79933	.9289	1.616
Vent 12	0.85839	0.77870	.9479	1.760
Vent 13	1.17500	0.76049	.9640	1.771
Vent 14	1.63588	0.73277	.9598	1.398
Vent 15	2.16781	0.70497	.9619	1.547
Vent 16	2.87772	0.66927	.9605	1.435
Vent 17	3.43977	0.65255	.9744	1.314
Vent 18	4.56018	0.60636	.9666	1.565
Vent 19	5.40212	0.58502	.9679	1.165
Vent 20	10.02125	0.48229	.8972	0.991

Ventile 1 was not estimable.

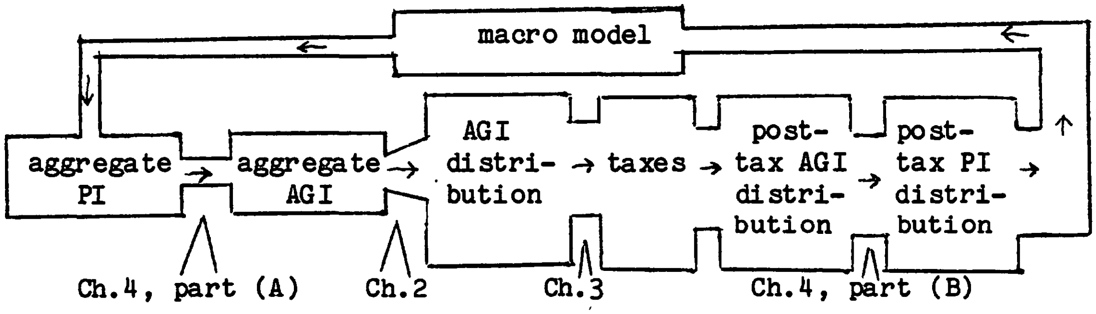
CHAPTER 4

THE RECONCILIATION OF ADJUSTED GROSS INCOME AND PERSONAL INCOME.

The purpose of this chapter is to describe the reconciliation of the distribution of personal income (PI) and adjusted gross income (AGI) in the model. Recall that the consumption part of the model requires a distribution of disposable PI, while the tax model calculates taxes based on a model of the distribution of AGI. This chapter consists of two parts which correspond to the two directions of conversion: part (A), the conversion of PI to AGI in the aggregate, and part (B), the conversion of AGI back to PI in the form that is disaggregated by income ventile. The conversions must be done in both directions.

The starting point for the tax calculations is an estimate of PI obtained from the macro model. Before taxes can even be calculated, this estimate of PI must be converted to an estimate of AGI (part A). When this is done, the distribution of AGI by ventile is calculated as described in Chapter 2. Then taxes are estimated and we obtain an estimate of the post-tax distribution of AGI by ventile as described in Chapter 3. This must be converted to a post-tax distribution of PI (part B) which is compatible with the parameters and concepts of the consumption model. Figure 4.1 illustrates how the two processes described in this chapter relate to the models described in Chapters 2 and 3, and the structure of the entire macro model.

FIGURE 4.1
FLOW CHART.



Part (A): Conversion of PI to AGI in the Aggregate.

PI is a measure of all income accruing to households including all labor compensation, transfer payments less payroll taxes, interest and dividend income less corporate profits, net interest, and imputations. (Gains from the sale of assets are not counted in PI or GNP.) AGI is the income tax base. It excludes many items which are in PI such as transfers, fringe benefits, and interest from state and local governments. It also includes some items not counted in PI such as capital gains and personal contributions for social insurance.

Table 8.14 in the National Income and Product Accounts provides a detailed reconciliation between PI and AGI. That table, reproduced in figure 4.2, breaks the difference down into 13 categories. Those 13 categories are subsequently rearranged into 12 reconciliation categories by aggregating some and splitting up others. Even though here in part (A), we are not concerned with the ventile distribution of income categories, we will be very much concerned about it in part (B). Therefore it was very important that those 12 categories were constructed on the basis of how they are distributed among the twenty

FIGURE 4.2

NIPA TABLE 8.14

March 1986

Table 8.14.—Comparison of Personal Income in the National Income and Product Accounts (NIPA's) with Adjusted Gross Income as Published by the Internal Revenue Service (IRS)

[Billions of dollars]

	Line	1982	1983	1984
Personal income, NIPA's	1	**2,670.8**	**2,836.4**	**3,111.9**
Less: Portion of personal income not included in adjusted gross income.	2	802.3	883.0	....
Transfer payments except taxable military retirement and taxable government pensions.	3	361.1	388.0	....
Other labor income except fees	4	161.4	176.9	....
Imputed income in personal income	5	47.5	53.6	57.6
Investment income of life insurance carriers and private noninsured pension plans [1].	6	72.9	78.5	86.3
Investment income received by nonprofit institutions or retained by fiduciaries.	7	30.5	28.7	....
Differences in accounting treatment between NIPA's and tax regulations, net.	8	40.3	48.6	....
Other personal income exempt or excluded from adjusted gross income.	9	88.7	108.7	....
Plus: Portion of adjusted gross income not included in personal income.	10	191.0	224.8	....
Personal contributions for social insurance	11	112.3	119.8	132.4
Net gain from sale of assets	12	35.0	50.6	....
Taxable private pensions	13	41.5	49.5	....
Small business corporation income	14	-.9	2.0	....
Other types of income	15	3.0	2.9	....
Equals: BEA-derived adjusted gross income	16	**2,059.4**	**2,178.2**	....
Adjusted gross income, IRS	17	**1,852.1**	**1,942.6**	....
Adjusted gross income (AGI) gap [2]	18	**207.3**	**235.6**	....
AGI gap (line 18) as a percentage of BEA-derived AGI (line 16).	19	10.1	10.8	....
AGI of IRS (line 17) as a percentage of BEA-derived AGI (line 16).	20	89.9	89.2	....

1. Equals imputed interest received by persons from life insurance carriers and private noninsured pension plans as shown in table 8.8 (line 50).

2. Consists of income earned by low-income individuals who are not required to file income tax returns, unreported income that is included in the NIPA measure, and gross errors and omissions in lines 2 through 15. Also includes the net effect of errors in the IRS adjusted gross income (line 17) and NIPA personal income (line 1) measures. Such errors can arise from the sample used by IRS to estimate line 17 and from the data sources used by BEA to estimate line 1.

FIGURE 4.3

NIPA TABLE 3.11

March 1986

Table 3.11.—Government Transfer Payments to Persons

[Billions of dollars]

	Line	1982	1983	1984
Government transfer payments to persons	1	**396.2**	**426.6**	**437.4**
Federal	2	**316.3**	**340.0**	**341.4**
Benefits from social insurance funds	3	273.6	294.5	298.4
Old-age, survivors, and disability insurance	4	153.7	164.4	173.0
Hospital and supplementary medical insurance	5	50.8	57.2	62.7
Unemployment insurance	6	25.2	26.4	16.0
State	7	23.4	20.2	13.2
Railroad employees	8	.4	.4	.2
Federal employees	9	.3	.4	.3
Special unemployment benefits	10	1.1	5.5	2.3
Federal employee retirement	11	35.2	37.5	37.4
Civilian [1]	12	19.9	21.2	22.1
Military [2]	13	15.4	16.3	15.3
Railroad retirement	14	5.8	6.0	6.1
Veterans life insurance	15	1.4	1.4	1.4
Workers' compensation	16	.9	.9	1.0
Military medical insurance [3]	17	.5	.6	.7
Veterans benefits	18	14.9	15.0	14.8
Pension and disability	19	13.3	13.7	13.7
Readjustment	20	1.6	1.4	1.1
Other [4]	21	....	....	....
Food stamp benefits	22	9.9	11.1	10.7
Black lung benefits	23	1.7	1.7	1.6
Supplemental security income	24	6.9	7.4	8.3
Direct relief	25	....	....	....
Earned income credit	26	1.2	1.2	1.2
Other [5]	27	8.2	9.1	9.4
State and local	28	**79.9**	**86.6**	**93.0**
Benefits from social insurance funds	29	23.0	25.2	27.6
State and local employee retirement	30	19.3	21.2	23.4
Temporary disability insurance	31	1.0	1.0	1.1
Workers' compensation	32	2.7	3.0	3.2
Public assistance	33	51.8	56.1	60.3
Medical care	34	31.7	34.8	37.7
Aid to families with dependent children	35	13.3	14.2	14.9
Supplemental security income	36	2.1	2.0	2.1
General assistance	37	1.9	2.0	2.3
Energy assistance	38	1.6	1.7	1.9
Other [6]	39	1.2	1.3	1.4
Education	40	2.7	2.9	3.1
Employment and training	41	1.1	1.0	.8
Other [7]	42	1.3	1.4	1.3

1. Consists of civil service, foreign service, Public Health Service officers, Tennessee Valley Authority, and several small retirement programs.
2. Includes the Coast Guard.
3. Consists of payments for medical services for dependents of active duty military personnel at nonmilitary facilities.
4. Consists of mustering out pay, terminal leave pay, and adjusted compensation benefits.
5. Consists largely of payments to nonprofit institutions, aid to students, and payments for medical services for retired military personnel and their dependents at nonmilitary facilities.
6. Consists of emergency assistance and medical insurance premium payments paid on behalf of indigents.
7. Consists largely of foster care, veterans benefits, Alaska dividends, and crime victim payments.

income ventiles. For example, the first reconciliation item in the NIPA table is Transfer payments, line 3. Since different types of transfers, like Social security and Unemployment compensation, are likely to be distributed differently among the income groups, those items are handled separately. Conversely, other items listed separately in the NIPA's such as Investment income of life insurance carriers, line 7, and Investment income received by fiduciaries, line 8, were combined here because they were either distributed similarly, or their distribution was not known. What follows is a list of the 12 reconciliation items used in the model, their relation to the NIPA table 8.14, and how they are estimated by the model. These items make up the entire difference between PI and AGI. Table 4.1 provides a summary of the relation between the reconciliation items and the NIPA accounts. The transfer payments detail is derived from NIPA table 3.11, which is reproduced in figure 4.3.

The first item is OASDI - Old age, survivors and disability insurance. Its value is shown on line 4 of NIPA table 3.11, which is a part of NIPA table 8.14, line 3, Transfer payments except taxable military retirement and taxable government pensions. Its value is determined in the macro model as a function of time, the price level, and the population aged 65 and over. The parameters and estimation results of this and the other equations discussed in this section are found in table 4.2.

The second item, also included in line 3 of the NIPA table 8.14 is HI - Hospital and supplementary medical insurance, found on line 5 of NIPA table 3.11. HI primarily consists of Medicare and Medicaid. It is determined in the macro model as a function of time, the price level, and the population aged 65 and over. Like all the other types of transfers listed here, HI is subtracted from PI in the process of determing AGI.

The next item, also a transfer payment, is UI - Unemployment insurance, table 3.11, line 6. It is calculated in the macro model as a function of time, the number of unemployed and the price level. It includes state, federal, railroad, and special unemployment benefits.

The fourth item, RET, consists of the tax-free portion of retirement income and other items. This is also included in line 3 of table 8.14 as a transfer payment. This category is meant to capture the non-means-tested transfer payments other than social security. It includes one half the retirement income (representing the tax-free portion) of federal, state and local, and railroad retirees. It also includes Veteran's benefits, and State and local transfers for Education, Employment and training, and Other. RET's value is one half of NIPA table 3.11 line 11,14,18 and 29, plus all of lines 40,41, and 42. All those items are calculated in the macro model as a function of time, population over 65, and the price level.

The last transfer category, and the fifth, overall is WELF - which contains Welfare and all the other means-tested transfer programs. It includes Food stamps, Black lung, Supplemental security income, Direct relief, Other, and state and local Public assistance, table 3.11, lines 22 through 27 and line 33. These items, which are distributed primarily to low income families, are subtracted from PI on the way to getting AGI, just like the other transfer items. These items are calculated separately by the macro model as a function of time, population, and the price level.

The sixth reconciliation item is OLI - Other labor income (8.14, line 4). It consists of employer provided fringe benefits such as pension and profit sharing, group health and life insurance, worker's compensation, supplemental unemployment, and other. Its value is found in NIPA table 2.1, line 8. It is calculated by the macro model as a function of income. Since it is a part of PI but is not taxable, it is subtracted when estimated AGI. It is estimated as fixed percentages of labor compensation for private workers, federal workers and state and local government workers. Those labor compensation categories are forecast in the macro model.

The next item is IMPU- Imputed income in personal income (8.14, line 5). It consists primarily of rental income imputed to homeowners when they occupy their own homes, and interest income accrued, but not realized by owners of securities which pay only at wide intervals, or upon maturity, such as savings bonds. This item, which is also subtracted from PI in calculating AGI, is estimated as a function of interest income, the mortgage rate and time.

The 8th reconciliation item is VESI- retained Investment and other income. It consists of several categories of income (8.14, lines 6,7,13,14 & 15). There was no available data on the size distribution of these items, but it is likely that their distribution is similar. This item includes investment income retained by life insurance carriers and private noninsured pension funds, received by nonprofit institutions, or retained by fiduciaries. These incomes are included in PI but not AGI, and thus are subtracted in the reconciliation process. This category also includes taxable private pensions, small business corporate income and other income which is part of AGI but not a part of

PI, and thus is added to PI in the reconciliation process. This category is calculated as a function of t-bill rate, personal income and time.

It is acknowledged that these last two items in particular may not belong in the income measure as it is being used here in this model. All the income being distributed among the income classes is later being distributed again among consumption goods and services as if it were discretionary income. Obviously, imputed rent and imputed services of fiduciaries are not discretionary, but are imputed to specific categories. A more accurate modeling approach would be to subtract such items from the definition of income and add them directly to consumption. This was not done here because it would require changes in the structure of the interindustry model which are beyond the scope of this study.

The 9th item is EXCL - which includes other items which are exempt or excluded from AGI (and thus are subtracted from PI). This item includes from table 8.14 both line 8 which is accounting differences and line 9 which is other items exempt or excluded from AGI. The accounting differences include some unrealized investment income, inventory valuation adjustment for nonfarm, noncorporate business, depletion allowances, defaulter's gain, capital consumption adjustment for farms and proprietors and landlords, IRA and Keogh plan interest received, and other. The exemptions and exclusions include statutory adjustments like moving expenses, tax-free dividends and interest, and tax free military pay. This item was calculated as a fixed percentage of PI.

The next item is CONTR - Personal contributions for social insurance. Since this item is taxable income included in AGI, but is not in PI, it is added to PI in the reconciliation process. This item which is mostly payroll taxes, is calculated by the macro model as percentage of private labor compensation. The percentage applied varies according to the legislated social security contribution rates.

The 11th item is capital gains, CAPG. These represent the taxable portion of capital gains (40% until 1987), and because they are not a part of PI, they are added to PI in getting AGI. These are reported in 8.14, line 12, Net gain from sale of assets, and also in SOI. Capital gains are forecast with a regression equation using as regressors the AAA bond rate minus the lagged percent change in the GNP deflator, and PI.

The last reconciliation item is GAP, the AGI gap. This item, reported in 8.14, line 18, is described by BEA in The Survey of Current Business, May, 1986, as a measure of noncompliance. See Park (1986). It includes things like unreported income included in the NIPA estimate of AGI. It also includes sampling errors, other errors and omissions, and income earned by low income individuals who are not required to file income tax returns. The AGI gap is estimated to be a flat percentage of PI based on recent historical magnitudes, and is added to PI in getting AGI.

Part A is complete when all 12 reconciliation items are forecast in the aggregate and subtracted from (or added to) the aggregate calculation of PI. The result is aggregate AGI which is then split up into the twenty ventiles in the income distribution model described in Chapter 2. Taxes are calculated as described in Chapter 3, with the result being a twenty ventile distribution of taxes and disposable AGI. Now we are ready for part (B) of this chapter, which is to go the other way, and convert AGI back into PI, but this time in the disaggregated twenty ventile distribution form. The procedure is to allocate the 12 reconciliation items among the ventiles, and add them to the post-tax AGI distribution to get the post-tax PI distribution.

Part (B): The AGI-PI Bridge.

The macro model needs to have the PI distribution defined in terms of an index of the cutoff incomes in each ventile. A cutoff income represents the border income between its ventile and the next ventile. (The top ventile is represented by its percentage of aggregate income rather than the highest single per capita income in the economy.) Chapters 2 and 3 described how both the amount of AGI per ventile and each ventile's cutoff AGI was determined. Here, the reconciliation items per ventile, and the per capita reconciliation cutoffs for each ventile must be determined and added to the AGI amounts and cutoffs to get the distribution of PI.

The allocation of each of the 12 AGI-PI reconciliation items to the twenty income ventiles is done by constructing a 20x12 bridge or matrix whose columns contain the share of each item going to each ventile. The bridge, which is shown in table 4.3, is constructed in terms of coefficients rather than flows, so that the sum of each of the twelve columns is one. Each column's coefficients are multiplied by each year's value for the items to get each ventile's dollar share of each item. The twelve dollar flows for each ventile are then summed so that we are left with the dollar difference between AGI and PI for each ventile. That dollar amount is then added to the dollar amount of post-tax AGI from each ventile calculated earlier in the income distribution and tax models to get the dollar amount of AGI per ventile. In matrix notation, let AGI (20x1) be the vector of AGI per ventile, P (20x12) be the AGI-PI bridge, RI (12x1) be the vector of aggregate reconciliation items, RV (20x1) be the dollar amount of reconciliation per ventile, and let PI (20x1) be the vector of PI per ventile. The procedure thus far, then, can be shown as:

4.1) $$RV = P \times RI$$

4.2) $$PI = AGI + RV$$

Next, the cutoffs for personal income are estimated by adding the cutoffs for the reconciliation items to the AGI cutoffs calculated in the income distribution model and tax model. The reconciliation cutoffs are determined as follows: since the cutoffs are defined in terms of per capita incomes, each ventile's reconciliation item total is first divided by ventile population to get the per capita totals by ventile. Then, the per capita reconciliation that occurs at the border between ventiles is estimated based on the relationship between average and cutoff AGI. For example, if the ventile cutoff AGI is two thirds of the way between the average per capita AGI in two ventiles, then the per capita cutoff reconciliation will be estimated as being two thirds of the amount of average per capita reconciliation between the two ventiles. That amount is then added to the AGI cutoff calculated by the income distribution model. (See equations M.30 - M.36 in the mathematical appendix.)

A numerical example would be useful here. The results of the models described in Chapters 2 and 3 give us values for AGI and the cutoff AGIs for each ventile. Suppose that the values for the average per capita AGIs in two adjacent ventile were $1,000 and $2,000, and that the cutoff income of the lower ventile was $1,667 (two thirds of the distance between the averages). Now, suppose the AGI-PI bridge gives us values of average per capita reconciliation items of $100 and $400 for those two ventiles. The per capita cutoff would be calculated as two thirds of the distance between those averages, or $300. The $300 would be added to the AGI cutoff of $1,667, so that the estimated per capita cutoff of PI for the lower of the two ventiles would be $1,967.

The ventile cutoffs for disposable personal incomes are created in exactly the same way. The same per capita cutoff reconciliation amount just calculated is added to the previously calculated per capita cutoff of disposable AGI.[1]

Indexes of disposable PI are then created by dividing the cutoff incomes by the mean income for the first nineteen ventiles. The top ventile is not represented by a cutoff, but by an overall percentage of the total income. These index numbers will be referred to as the PI distribution indexes.

A problem arises here because of differences in the coverage of AGI and PI. The income distribution model is based on AGI and was constructed from IRS data on income tax filers. The ventiles represent persons in families with positive AGIs who file income tax returns. It turns out that about 7.5% of the population has, by necessity, been left out of the AGI distribution because either they did not file income tax returns, or they had negative AGI (actually, 7.2% in 1982 and 7.6% in 1983). The consumption part of the model calls for a forecast of the personal income distribution for the entire population, and thus will not be consistent with an income distribution which does not include persons in nonfiling or negative AGI families.

The problem is that while we have good estimates of how income is distributed among almost 93% of the population, we are forced to make an educated guess of how that income is distributed among the entire population. The fact that we know the missing 7+% is made up of persons from either nonfiling or negative AGI families helps determine the appropriate course of action. In order to compensate for this problem, an adjustment to the per capita disposable PI cutoffs is made.

The adjustment employs the assumption that the persons missing from the AGI sample have incomes lower than those in the sample. This assumption combined with the information already contained in the estimate of the unadjusted PI distribution makes possible an appropriate adjustment. This is accomplished in two steps: first, the calculated ventile cutoffs must be expanded so they each contain 5% of the entire population rather than 5% of the filing population, and second, they must be moved up the distribution in relative location to accomodate the assumption that the extra people are at the bottom.

The adjustment procedure is illustrated in table 4.4. Ignoring the first ventile for a moment, the general notion of the adjustment is as follows: since the population to be covered by the adjusted ventiles is about 7.5% larger, the cutoff income for the 19th ventile is lowered by .075 of the distance between the originally calculated borders of the 18th and 19th ventiles. The 18th ventile's cutoff income is adjusted downward by a factor of .15 between the original 17th and 18th, and so on, until the second ventile is .65 the size of the originally calculated first ventile cutoff personal income. Then the index is created as before using the entire population rather than only the filers in calculating per capita incomes. The adjustment can be expressed as follows where v_i^* denotes the adjusted cutoff income for ventile i, and v_i is the unadjusted cutoff income.

4.3) $v_2^*=.65v_2$

4.4) for i=3,6 $v_i^*=v_{i-1}-(.075(20-i)-1)*(v_{i-1}-v_{i-2})$

4.5) for i=7,19 $v_i^*=v_i-(.075(20-i))*(v_i-v_{i-1})$

The top ventile, which is the share of the total is increased by the appropriate factor (about 7%) to account for its having some people in it that were previously in the 19th ventile.[2]

The adjustment makes the index have a character similar to one estimated with Census data on money income. Table 4.5 shows the index of money income defined in terms of ventile cutoff per capita incomes.[3] The entire population was used in this sample. It was this data that was used to determine what the appropriate adjustment for the first ventile would be.

Theoretically, the only difference between these numbers and the numbers obtained from the procedure described in this chapter including the adjustment lies in the definitions of money income and personal income. Neither definition includes capital gains. However, unlike personal income, money income does not include in-kind transfer payments and other reconciliation items such as medicare (HI), fringe benefits (OLI), social insurance contributions (CONTR), or imputed income (IMPU). Of these four items, only HI is assumed to be distributed more equally than personal income. The model assumes the other items are distributed like AGI, which is to say less equally than personal income. Therefore, a distribution such as money income which does not contain those four items, will show more equality, which it does. Of course there are other possible reasons for the differences, which include errors, omissions and inconsistencies in either data set, or in the estimation procedures.

The data on the distribution of money income does provide a kind of check on the entire reconciliation precedure described in this chapter. The similiarity of the two distributions as shown in table 4.5 is on the whole, encouraging. The patterns are the same with PI being distributed a little less equally; both indexes reach the mean income in the 13th ventile. The largest discrepancies occur in the lowest ventiles (2 through 4). This could be the result of inaccuracy of the assumption regarding the 7.5% of the population not covered by the AGI sample, but there is not enough evidence to suggest further adjustments.

This distribution of personal income may be unique in its coverage of all types of income. It is unique in its definition of income being in terms of per capita cutoff income by ventile. While the numbers themselves may not reveal any surprises as to the shape or equality of the income distribution, such a model can be useful for forecasting the effects of tax reform or reform in transfer programs on the income distribution. The difference between the AGI distribution and that of personal income also shown in table 4.5 is noteworthy. It shows that the definition of income used in making inferences about the distribution of income in the United States does indeed make a difference.

The indexes representing the distribution of personal income and disposable personal income are shown in table 4.6. It is true that the numbers are not very sensitive to changes in the AGI-PI bridge, however, the tax system does affect the income distribution in a significant way. As this and other studies have shown, the federal income tax system is largely progressive, particularly at the ends, and proportional in the middle. This characteristic can be seen by comparing the index numbers before and after taxes. Table 4.7 illustrates this point by showing the ratio of the post-tax indexes to the pre-tax indexes. The lower ventiles improve their relative position while the upper ventiles are relatively worse off after taxes. The indexes measure the position of the ventile cutoffs relative to the mean per capita incomes, not the absolute levels of ventile incomes, so they are appropriate for indicating the progressivity of the tax system.

The Construction of the AGI-PI Bridge.

This section will explain how the AGI-PI bridge was constructed. The object of the procedure is to take a scalar representing the value of one of the twelve reconciliation items and convert it into a vector of length twenty, with each entry representing the portion of that item going to each income ventile. These vectors are the columns of the AGI-PI bridge. For three of the items, it was assumed that the distribution was identical to the distribution of AGI. For four others it was necessary to guess at the distribution. But for the other five categories, there were data provided either by SOI or by the the Census Money Income reports.[4] The SOI had data on the distribution by AGI bracket for Capital gains, Pension income, and Unemployment insurance. The census data showed the distribution of Social security income and Public assistance and welfare by money income category. Because the data showed only the distribution of these items by per household income group, they had to be converted to per capita income ventiles. This process which converts the SOI per household income groups to ventiles will now be described.

It was possible to apply this procedure to the three reconciliation categories reported in SOI, namely UI, CAPG, and RET. The data were reported in SOI by AGI bracket. The dollar amount of each item going to each ventile was determined in a straight-forward way. First, the amount going to each income bracket as reported in the 1982 SOI was allocated among the six household sizes according to the relative share of persons from each household size in the brackets. Then, those values were allocated linearly among the ventiles covered by the SOI brackets. For example, the first SOI bracket is from 0 to $5,000 per household. That would include people in the first seven ventiles who live alone, and people in the first three ventiles from a household size of two. Therefore, the amount from that bracket attributed to household size one was divided evenly among the first seven ventiles and the amount allocated to household size two was split evenly among the first three ventiles. This procedure was followed for all the data, and then each ventile's total was obtained by adding the six household size values. Finally, the numbers were converted to shares to form the columns of the AGI-PI bridge. The ventile bounds were estimated from a simulation of the income distribution model for 1982, using as much actual data as was available for the exogenous variables.

The distributions of OASDI and WELF were obtained by a process in the spirit of that just described, but not identical due to the way in which the data were reported by the Census Bureau and Social Security

Administration. The distributions of these items were reported by money income, not AGI. The census data on the distribution of money income was decomposed as above to get estimates of the shares of money income, social security, and welfare going to each ventile. Then the results for social security and welfare were scaled according to the relative amount the money income shares differed from the AGI shares. The distribution of OASDI was checked with another, less detailed data source and found to be in general consistency. [5]

The distribution of HI, EXCL, VESI, and CNTR were estimated without benefit of hard data. HI (Medicare and Medicaid) was assumed to go in equal shares to each ventile. EXCL (exclusions) was assumed to be distributed similarly, but not quite so unequally as capital gains. CNTR (contributions for social insurance) was assumed to be distributed much like AGI, but with less coming from the top two ventiles. VESI (retained investment income) was assumed to be distributed like pension and annuity income. OLI, IMPU, and GAP were assumed to be distributed like AGI. Table 4.3 shows the AGI-PI bridge. While it is true that some of these estimates are rough approximations at best, the overall distribution of disposable PI and hence the goods mix of consumption expenditures is not very sensitive to small changes in the coefficients of the AGI-PI bridge.

Endnotes

1. It is conceivable that the addition of transfers to the distribution of AGI might result in a re-ordering of some ventiles. In other words, a situation is possible in which two or more adjacent ventiles might have a different order when ranked according to PI or according to AGI. For example, a large transfer program whose benefits accrue to only the lowest AGI ventile might result in that ventile having a larger income and higher income cutoff than some higher AGI ventiles. The result would be an ill-defined PI distribution. While it is true that transfers, on the whole, tend to equalize the income distribution, particularly at the lower end, it is fortunate that the extent of the equalization using our best estimate of the incidence of the reconciliation items does not make this theoretical re-ordering occur.

2. This adjustment makes the theoretical re-ordering problem of endnote 1 even less likely. The adjustment essentially converts the smaller AGI ventiles into PI ventiles which contain more people. The conversion takes place after the reconciliation items are added to the AGI ventiles. One might think the more logical sequence would be to first make the adjustment, then add the reconciliation items to the adjusted PI ventiles. Again, the reason relates to the reported form of the data. For five of the reconciliation items, the distributions among the ventiles were based on "hard" data reported in the SOI by AGI category even though the items themselves are not part of AGI. For these items, it only makes sense to distribute them to AGI ventiles because we have precise estimates of the borders of those ventiles. For

the other reconciliation items not reported by AGI group, we are as unsure of their distribution among return filing ventiles as we are among ventiles of the whole population.

3. This index was calculated from the 1978 data on money income by Devine (1983).

4. See U.S. Census, current population reports, series P-60.

5. The distribution of OASDI was also reported in Grad (1984).

TABLE 4.1

THE RELATION OF THE 12 RECONCILIATION ITEMS TO THE NIPA TABLES.

Reconciliation Item	NIPA Table and Line No.
OASDI	table 3.11 line 4 & table 8.14 line 3 (part)
HI	table 3.11 line 5 & table 8.14 line 3 (part)
UI	table 3.11 line 6 & table 8.14 line 3 (part)
RETO	table 3.11 1/2 lines 11,14,18 and 29 plus lines 40,41, and 42 & table 8.14 line 3 (part)
WELF	table 3.11 lines 22 through 27and 33 & table 8.14 line 3 (part)
OLI	table 8.14 line 4
IMPU	table 8.14 line 5
VESI	table 8.14 lines 6 and 7 minus lines 13,14 and 15
EXCL	table 8.14 lines 8 and 9
CONTR	table 8.14 line 11
CAPG	table 8.14 line 12
SD	table 8.14 line 18

TABLE 4.2
REGRESSION RESULTS OF EQUATIONS USED TO FORECAST RECONCILIATION ITEMS.

```
               IMPU - Imputations forecasting equation.
      SEE =    1.4282   RSQR =  0.9838 RBARSQ =  0.9805  NOBS =   19
      RHO =   -0.0272   DW   =   2.054  AAPE  =    3.08
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL       MEAN
INTERCEPT           11.046912    3.33     0.000     31.92       0.0000
YPIN                 0.060387    5.70     0.298     77.85     171.7520
RCMOR(T-1)          -0.920774   -2.02    -0.239     12.75       9.0197
TIME                 1.033450    5.37     0.623     70.99      21.0000
IMPU                       DEPENDENT VARIABLE - - - - - -     34.81579

DATE  ACTUAL   PREDIC    MISS
       IS *     IS +    IS A-P *         *         *         *         *
 66     21.10    20.92     0.18       +*
 67     22.40    21.81     0.59         +
 68     22.90    22.96    -0.06         +
 69     24.10    24.00     0.10          +
 70     25.50    24.79     0.71          +
 71     26.10    25.58     0.52          +*
 72     26.20    27.62    -1.42           +
 73     28.10    29.57    -1.47            +
 74     30.60    31.41    -0.81             +
 75     33.40    32.23     1.17             +*
 76     34.40    33.75     0.65              +
 77     33.40    35.96    -2.56              *+
 78     40.60    38.77     1.83                +*
 79     43.40    41.69     1.71                 +*
 80     45.10    44.70     0.40                   +
 81     45.50    47.92    -2.42                   *+
 82     47.50    49.26    -1.76                    *+
 83     53.60    50.96     2.64                     +*
 84     57.60    57.60     0.00                        +
 85      0.00    59.70                                  +
 86      0.00    64.12                                    +
 87      0.00    68.37                                      +
 88      0.00    72.80                                        +
 89      0.00    77.03                                          +
 90      0.00    81.52                                           +
 91      0.00    86.66                                              +
 92      0.00    91.89                                                +
 93      0.00    97.22                                                  +
 94      0.00   103.06                                                     +
 95      0.00   109.69                                                        +
       IS *     IS +    IS A-P *         *         *         *         *
                             0.000   23.338    46.676    70.014     93.352
```

IMPU is Imputations in Personal Income from NIPA table 8.14 line 5.
YPIN is personal interest income.
RCMOR (T-1) is the mortgage interest rate lagged one year.
TIME is time with a value of 1 in 1966.
The forecast to 1995 was done with values of the exogenous variables from a typical forecast done with the INFORUM macro model.

TABLE 4.2 (continued)
VESI Forecasting Equation.

```
      SEE =      1.6845   RSQR =  0.9911 RBARSQ =  0.9892  NOBS =   18
      RHO =      0.0739    DW  =   1.852  AAPE  =   11.17
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT           12.638373    2.90     0.000     26.51       0.0000
RTB(T-1)             1.757714    5.74     0.574     83.10       6.9195
PIZ                  0.037237   11.28     2.561    217.65    1458.2644
TIME                -2.824218   -7.27    -2.730    118.45      20.5000
VESI                      DEPENDENT VARIABLE  ------          21.20555

DATE  ACTUAL   PREDIC    MISS
       IS *     IS +  IS A-P *          *          *         *         *
 66     6.40     8.07    -1.67  +
 67     7.80     8.50    -0.70  +
 68     9.60     7.03     2.57  +*
 69     9.60     8.44     1.16  +*
 70     9.30    10.16    -0.86  *+
 71     8.40     9.27    -0.87  +
 72     7.60     6.00     1.60 +*
 73     8.10     7.16     0.94  +
 74    11.40    13.59    -2.19   *+
 75    14.10    16.10    -2.00    *+
 76    16.60    14.81     1.79    +*
 77    17.50    16.31     1.19     +
 78    21.10    21.60    -0.50      +
 79    28.00    30.45    -2.45         +
 80    42.10    40.96     1.14             +
 81    51.50    50.44     1.06                +
 82    59.80    57.68     2.12                  +*
 83    52.80    55.14    -2.34                 +
 84     0.00    58.80                            +
 85     0.00    64.78                              +
 86     0.00    67.37                               +
 87     0.00    71.02                                +
 88     0.00    76.31                                  +
 89     0.00    81.85                                    +
 90     0.00    89.72                                      +
 91     0.00    99.72                                          +
 92     0.00   110.31                                             +
 93     0.00   120.65                                                +
 94     0.00   131.64                                                    +
 95     0.00   145.73                                                         +
       IS *     IS +  IS A-P *          *          *         *         *
                             0.000    31.006    62.012    93.018   124.024
```

VESI is investment income from NIPA table 8.14, lines 6 & 7.
RTB (T-1) is the interest rate on treasury bills lagged one year.
PIZ is personal income
TIME is time with a value of 1 in 1966.
The forecast to 1995 was done with values of the exogenous variables from a typical forecast done with the INFORUM macro model.

TABLE 4.2 (continued)
CAPG Forecasting Equation.

```
      SEE =      2.6057    RSQR =  0.9392 RBARSQ =  0.9311  NOBS =   18
      RHO =      0.0834     DW  =   1.833  AAPE  =   13.33
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT              0.470743    0.30    0.000     0.30        0.0000
REALA(T-1)            -2.191442   -4.74    0.239    58.12        2.3064
PIZ                   -0.011372  -11.42    0.783   211.36     1458.2644
CAPG                       DEPENDENT VARIABLE - - - - - -     -21.16667

DATE  ACTUAL   PREDIC    MISS
      IS *      IS +    IS A-P *         *         *         *         *
 66     -9.90   -11.42     1.52                                        +*
 67    -13.60   -11.03    -2.57                                       *+
 68    -18.00   -13.07    -4.93                                    *  +
 69    -14.60   -12.20    -2.40                                      *+
 70     -8.90   -13.11     4.21                                       + *
 71    -13.10   -15.55     2.45                                      +*
 72    -17.30   -15.95    -1.35                                    *+
 73    -17.10   -18.76     1.66                                    +*
 74    -13.90   -17.13     3.23                                     +*
 75    -14.20   -14.10    -0.10                                      +
 76    -18.70   -15.09    -3.61                                    * +
 77    -21.40   -24.86     3.46                                + *
 78    -24.50   -24.92     0.42                                +
 79    -29.40   -27.88    -1.52                             *+
 80    -29.70   -30.03     0.33                             +
 81    -31.10   -31.44     0.34                            +*
 82    -35.00   -36.60     1.60                         +*
 83    -50.60   -47.87    -2.73                 * +
 84      0.00   -51.04                          +
 85      0.00   -55.97                       +
 86      0.00   -56.95                       +
 87      0.00   -55.68                       +
 88      0.00   -54.45                        +
 89      0.00   -56.18                       +
 90      0.00   -60.33                     +
 91      0.00   -64.31                  +
 92      0.00   -68.26                +
 93      0.00   -71.60              +
 94      0.00   -75.52            +
 95      0.00   -81.23         +
      IS *      IS +    IS A-P *         *         *         *         *
                            -81.229   -63.946   -46.663   -29.381   -12.098
```

CAPG is net gain from sale of assets from NIPA table 8.14 line 12.
REALA is the treasury bill rate minus the % ch. in the GNP deflator.
PIZ is Personal Income.
The forecast to 1995 was done with values of the exogenous variables from a typical forecast done with the INFORUM macro model.

TABLE 4.2 (continued)

REGRESSION RESULTS OF EQUATIONS USED TO FORECAST TRANSFER PAYMENT COMPONENTS.

1. OAS - the dependent variable is Old-age, survivors, and disability insurance per person aged 65 and over divided by the PCE deflator.

```
     SEE =      0.2095     RSQR =  0.9776  RBARSQ =  0.9767   NOBS =   26
     RHO =      0.7856     DW   =  0.429   AAPE   =   4.48
VARIABLE               REGRES-COEF  T-VALUE ELASTICITY MEXPLAVAL       MEAN
INTERCEPT                 0.726827     6.83      0.000     71.53       0.0000
TIME                      0.181129    32.40      0.813    568.79      17.5000
OAS                         DEPENDENT VARIABLE ------                 3.89658
```

2. HI - The dependent variable is Hospital and supplementary medical insurance per capita divided by the PCE deflator.

```
     SEE =      0.0989     RSQR =  0.9656  RBARSQ =  0.9636   NOBS =   19
     RHO =      0.5750     DW   =  0.850   AAPE   =  15.10
VARIABLE               REGRES-COEF  T-VALUE ELASTICITY MEXPLAVAL       MEAN
INTERCEPT                -0.769923    -8.33      0.000    125.36       0.0000
TIME                      0.093103    21.85      1.650    439.35      21.0000
HI                          DEPENDENT VARIABLE ------                 1.18523
```

3. UI - The dependent variable is Unemployment insurance per capita divided by the PCE Deflator.

```
     SEE =      0.4222     RSQR =  0.1493  RBARSQ =  0.1124   NOBS =   25
     RHO =      0.5619     DW   =  0.876   AAPE   =  13.46
VARIABLE               REGRES-COEF  T-VALUE ELASTICITY MEXPLAVAL       MEAN
INTERCEPT                 1.797100     8.14      0.000     96.94       0.0000
TIME                      0.024034     2.01      0.185      8.42      17.0000
UI                          DEPENDENT VARIABLE ------                 2.20568
```

4. RET - The dependent variable is Civilian and railroad retirement income per capita divided by the PCE deflator.

```
     SEE =   1350.2004     RSQR =  0.9682  RBARSQ =  0.9668   NOBS =   26
     RHO =      0.9136     DW   =  0.173   AAPE   =  12.43
VARIABLE               REGRES-COEF  T-VALUE ELASTICITY MEXPLAVAL       MEAN
INTERCEPT             -2771.116758    -4.04      0.000     29.61       0.0000
TIME                    973.638229    27.02      1.194    460.53      17.5000
RET                         DEPENDENT VARIABLE ------             14267.55078
```

TABLE 4.2 (continued)

5. MR - The dependent variable is Military retirement per capita divided by the PCE Deflator.

```
     SEE =    701.4397    RSQR =  0.9781 RBARSQ =  0.9772  NOBS =   26
     RHO =      0.7463     DW  =   0.507  AAPE  =   10.29
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL        MEAN
INTERCEPT         -2209.925312    -6.20    0.000     61.30         0.0000
TIME                613.023293    32.75    1.259    575.88        17.5000
MR                         DEPENDENT VARIABLE  - - - - - -     8517.98047
```

6. VET - The dependent variable is Veteran's benefits per capita divided by the PCE deflator.

```
     SEE =   2515.6138    RSQR =  0.4403 RBARSQ =  0.4170  NOBS =   26
     RHO =      0.9145     DW  =   0.171  AAPE  =   13.15
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL        MEAN
INTERCEPT          9365.551726     7.33    0.000     79.91         0.0000
TIME                291.723122     4.35    0.353     33.67        17.5000
VET                        DEPENDENT VARIABLE  - - - - - -    14470.70508
```

7. SSI - The dependent variable is Benefits from social insurance funds per capita divided by the PCE deflator.

```
     SEE =    792.0486    RSQR =  0.9854 RBARSQ =  0.9848  NOBS =   26
     RHO =      0.8773     DW  =   0.245  AAPE  =    7.21
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL        MEAN
INTERCEPT         -1338.119546    -3.32    0.000     20.86         0.0000
TIME                851.428416    40.28    1.099    728.25        17.5000
SSI                        DEPENDENT VARIABLE  - - - - - -    13561.87695
```

8. FST - The dependent variable is Food stamp benefits per capita divided by the PCE deflator.

```
     SEE =   1169.1084    RSQR =  0.9165 RBARSQ =  0.9130  NOBS =   26
     RHO =      0.7686     DW  =   0.463  AAPE  = $375392
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL        MEAN
INTERCEPT         -4681.388536    -7.88    0.000     89.41         0.0000
TIME                506.452098    16.23    2.120    246.09        17.5000
FST                        DEPENDENT VARIABLE  - - - - - -     4181.52246
```

TABLE 4.2 (continued)

9. SIO - The dependent variable is Veterans life insurance and workers' compensation per capita divided by the PCE deflator.

```
     SEE =    198.4212   RSQR =  0.0027 RBARSQ = -0.0388  NOBS =   26
     RHO =      0.3134    DW  =   1.373   AAPE  =    6.59
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT           2160.179577   21.43     0.000    348.63        0.0000
TIME                   1.354639    0.26     0.011      0.14       17.5000
SIO                        DEPENDENT VARIABLE  - - - - - -      2183.88574
```

10. SLTO - The dependent variable is State and local Education, Other, and Employment and training per capita divided by the PCE deflator.

```
     SEE =    656.9319   RSQR =  0.8800 RBARSQ =  0.8750  NOBS =   26
     RHO =      0.7807    DW  =   0.439   AAPE  =   18.95
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT           -810.356430   -2.43     0.000     11.60        0.0000
TIME                 232.593860   13.27     1.249    188.68       17.5000
SLTO                       DEPENDENT VARIABLE  - - - - - -      3260.03564
```

11. TOTH - The dependent variable is Black lung benefits, Supplementary security income, Direct relief, Earned income credit, Military medical insurance and Other per capita divided by the PCE deflator.

```
     SEE =   2616.9985   RSQR =  0.8970 RBARSQ =  0.8927  NOBS =   26
     RHO =      0.7562    DW  =   0.488   AAPE  =   77.18
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT          -7860.244982   -5.91     0.000     56.71        0.0000
TIME                1009.493803   14.45     1.802    211.52       17.5000
TOTH                       DEPENDENT VARIABLE  - - - - - -      9805.89648
```

12. DR - The dependent variable is State and local Public assistance per capita divided by the PCE deflator.

```
     SEE =   3234.5708   RSQR =  0.9598 RBARSQ =  0.9582  NOBS =   26
     RHO =      0.8433    DW  =   0.313   AAPE  =   11.38
VARIABLE            REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL      MEAN
INTERCEPT          -3471.964420   -2.11     0.000      8.90        0.0000
TIME                2067.193378   23.95     1.106    398.94       17.5000
DR                         DEPENDENT VARIABLE  - - - - - -     32703.91797
```

After

TABLE 4.3

Disposable,

THE ADJUSTED GROSS INCOME - ~~PERSONAL~~ INCOME BRIDGE.

VN	OASDI	HI	UI	RET	WELF	OLI*	IMPU*	VESI	EXCL	CNTR	CAPG	GAP*
1	8.18	7.00	15.43	2.09	19.70	0.43	0.43	2.09	0.00	0.00	3.12	0.43
2	7.36	7.00	14.79	3.37	12.20	0.93	0.93	3.37	0.00	1.00	1.99	0.93
3	7.82	7.00	11.27	3.77	12.10	1.30	1.30	3.77	0.00	2.00	1.67	1.30
4	7.05	7.00	9.97	4.97	10.00	1.64	1.64	4.97	0.00	2.00	1.55	1.64
5	6.85	7.00	7.90	3.83	8.60	1.98	1.98	3.83	0.00	2.00	1.35	1.98
6	6.44	5.00	6.77	5.02	6.80	2.30	2.30	5.02	1.00	3.00	1.55	2.30
7	6.07	5.00	6.53	5.06	5.80	2.62	2.62	5.06	1.00	3.00	1.66	2.62
8	5.26	5.00	3.45	4.85	4.50	2.95	2.95	4.85	2.00	3.00	1.16	2.95
9	4.26	5.00	3.45	4.85	4.50	3.29	3.29	4.85	2.00	4.00	1.16	3.29
10	4.34	5.00	3.45	4.82	4.30	3.63	3.63	4.82	3.00	5.00	1.39	3.63
11	3.64	5.00	3.05	4.84	3.50	4.01	4.01	4.84	3.00	6.00	1.57	4.01
12	3.29	5.00	2.12	4.00	3.50	4.40	4.40	4.00	4.00	7.00	1.23	4.40
13	3.39	5.00	2.05	4.36	2.50	4.84	4.84	4.36	4.00	7.00	1.40	4.84
14	3.17	5.00	2.05	4.66	1.50	5.38	5.38	4.66	5.00	7.00	2.25	5.38
15	3.54	5.00	2.21	5.29	0.50	5.99	5.99	5.29	5.00	8.00	2.33	5.99
16	3.47	3.00	2.16	5.90	0.00	6.78	6.78	5.90	6.00	8.00	2.49	6.78
17	3.50	3.00	1.16	5.85	0.00	7.78	7.78	5.85	7.00	8.00	2.92	7.78
18	4.18	3.00	1.68	6.90	0.00	9.21	9.21	6.90	8.00	8.00	4.54	9.21
19	3.36	3.00	0.51	6.33	0.00	11.64	11.64	6.33	10.00	9.00	6.03	11.64
20	4.83	3.00	0.00	9.24	0.00	18.91	18.91	9.24	39.00	10.00	58.66	18.91

* denotes the item is distributed like AGI.

TABLE 4.4
AN ILLUSTRATION OF THE ADJUSTMENT PROCEDURE.

The example assumes for illustrative purposes a population of 215 million, 200 of which are income tax filers with positive AGI's. The actual values generated by the model will differ. The ventiles of filers estimated in the income distribution model each contain 10 million people. They are adjusted to include the entire population, making 10.75 million people per ventile.

Rank of person at ventile border (filers).	ventile	Rank of person at ventile border (population).	Rank of filer at ventile border (population). Assume 1st 15 million people are not filers.	Factor by which filer cutoff incomes are adjusted.
10	1	10.75	--	set by census data
20	2	21.50	6.50	.65 of 1st ventile
30	3	32.25	17.25	.725 between 1&2
40	4	43.00	28.00	.80 between 2&3
50	5	53.75	38.75	.875 " 3&4
60	6	64.50	49.50	.950 " 4&5
70	7	75.25	60.25	.025 " 6&7
80	8	86.00	71.00	.100 " 7&8
90	9	96.75	81.75	.175 " 8&9
100	10	107.50	92.50	.250 " 9&10
110	11	118.25	103.25	.325 " 10&11
120	12	129.00	114.00	.400 " 11&12
130	13	139.75	124.75	.475 " 12&13
140	14	150.50	135.50	.550 " 13&14
150	15	161.25	146.25	.625 " 14&15
160	16	172.00	157.00	.700 " 15&16
170	17	182.75	167.75	.775 " 16&17
180	18	193.50	178.50	.850 " 17&18
190	19	204.25	189.25	.925 " 18&19
200	20	215.00	200.00	---

TABLE 4.5
THE INDEXES OF INCOME DISTRIBUTION BEFORE AND AFTER NONFILER ADJUSTMENT BEFORE TAXES - 1978.

Ventile	AGI	PI NO ADJ	PI ADJ	MONEY INCOME (census data)
1	15.71	40.16	17.19	17.29
2	24.01	44.52	30.97	26.64
3	30.88	45.25	46.36	34.87
4	37.69	48.43	48.27	41.89
5	44.25	52.28	51.39	48.19
6	50.53	56.79	55.73	54.31
7	56.80	60.81	60.87	60.41
8	63.39	65.64	65.58	66.38
9	69.99	70.89	71.22	72.78
10	76.92	75.75	77.15	79.80
11	84.60	82.10	83.26	87.06
12	92.65	88.88	90.75	95.02
13	102.23	96.70	99.08	103.81
14	113.40	106.67	109.34	113.96
15	126.97	119.09	122.44	125.87
16	144.70	134.71	139.13	141.11
17	168.21	155.33	161.24	161.99
18	205.22	188.19	196.09	191.56
19	276.94	257.60	270.06	245.56
20	18.30	17.35	18.56	17.74

AGI - Adjusted Gross Income - distributed among filers with positive AGI.

PI - NOADJ - The distribution of Personal Income among filers with positive AGI after including all reconciliation items.

PI - ADJ - The distribution of Personal Income among the total population.

Money Income - distributed among the census sample of total population.

TABLE 4.6
INDEX OF VENTILE LIMITS FOR PERSONAL INCOME.

	1977	1984	1986	1988	1991	1993	1995
	----	----	----	----	----	----	----
Ventile				Pre-Tax			
1	17.88	17.46	17.62	17.75	17.19	17.02	16.90
2	29.06	28.37	28.63	28.85	27.94	27.65	27.45
3	47.83	46.68	46.96	47.08	45.85	45.34	45.02
4	49.32	48.01	48.19	48.25	47.31	46.86	46.62
5	52.16	50.83	50.89	50.98	50.29	49.97	49.80
6	56.29	54.95	54.89	55.00	54.50	54.29	54.21
7	61.30	59.98	59.96	60.18	59.84	59.74	59.75
8	65.84	64.69	64.70	65.00	64.80	64.81	64.87
9	71.38	70.08	70.01	70.34	70.22	70.30	70.41
10	77.26	76.03	76.00	76.44	76.46	76.63	76.80
11	83.27	82.15	82.20	82.77	82.90	83.16	83.38
12	90.70	89.61	89.62	90.26	90.47	90.83	91.10
13	98.97	97.70	97.86	98.64	98.96	99.40	99.73
14	109.20	107.60	107.82	108.68	109.03	109.55	109.91
15	122.22	120.51	120.74	121.84	122.24	122.86	123.25
16	138.85	136.56	136.67	137.95	138.40	139.14	139.55
17	160.85	157.38	157.64	159.05	159.44	160.27	160.66
18	195.55	189.88	190.13	191.67	191.92	192.71	192.88
19	269.01	262.31	261.78	265.24	265.95	267.62	267.87
20	18.32	20.20	20.08	19.52	19.66	19.49	19.40
Personal income per capita mean (in thousands):							
	7.30	13.13	14.60	16.01	18.77	21.29	23.90
				Post-Tax			
1	20.41	19.87	20.19	20.35	19.85	19.72	19.62
2	33.16	32.29	32.82	33.07	32.25	32.04	31.88
3	54.57	52.93	53.60	53.73	52.61	52.20	51.92
4	56.09	53.88	54.37	54.42	53.56	53.19	52.98
5	58.78	56.28	56.55	56.62	56.03	55.79	55.66
6	62.66	60.05	60.17	60.25	59.89	59.77	59.73
7	67.35	64.85	65.01	65.19	65.03	65.02	65.07
8	71.30	69.17	69.29	69.53	69.48	69.57	69.67
9	76.25	74.09	74.07	74.30	74.34	74.48	74.62
10	81.49	79.58	79.57	79.91	80.07	80.27	80.47
11	86.83	85.14	85.15	85.57	85.80	86.07	86.30
12	93.60	92.07	91.99	92.43	92.73	93.07	93.34
13	101.09	99.50	99.51	100.04	100.40	100.79	101.09
14	110.41	108.59	108.58	109.14	109.47	109.89	110.18
15	122.32	120.63	120.57	121.32	121.69	122.18	122.50
16	137.36	135.45	135.17	136.02	136.36	136.95	137.30
17	156.82	154.16	153.89	154.82	154.96	155.55	155.81
18	186.71	182.42	181.81	183.14	183.15	183.65	183.68
19	247.68	245.50	244.18	247.88	248.41	249.76	249.95
20	16.20	18.38	18.34	17.91	18.02	17.88	17.80
Disposable personal income per capita mean (in thousands):							
	6.29	11.27	12.44	13.64	16.09	19.93	20.08

The numbers are indexes (mean=100) of the cutoff income between ventiles. entile 20 has that group's share of all income.

TABLE 4.7 - RATIO OF POST-TAX TO PRE-TAX INCOME INDEXES - PERSONAL INCOME.

	1986	1988	1988	1991	1991	1995	1995
	----	BASE	REFORM	BASE	REFORM	BASE	REFORM
Ventile							
1	1.1459	1.1465	1.1399	1.1498	1.1485	1.1609	1.1548
2	1.1464	1.1463	1.1401	1.1500	1.1486	1.1614	1.1554
3	1.1414	1.1412	1.1393	1.1436	1.1465	1.1533	1.1522
4	1.1282	1.1279	1.1329	1.1292	1.1379	1.1364	1.1403
5	1.1112	1.1106	1.1177	1.1120	1.1190	1.1177	1.1198
6	1.0962	1.0955	1.0972	1.0969	1.0973	1.1018	1.0983
7	1.0842	1.0833	1.0791	1.0846	1.0805	1.0890	1.0818
8	1.0709	1.0697	1.0638	1.0705	1.0651	1.0740	1.0662
9	1.0580	1.0563	1.0506	1.0571	1.0522	1.0598	1.0530
10	1.0470	1.0454	1.0403	1.0458	1.0415	1.0478	1.0417
11	1.0359	1.0338	1.0295	1.0340	1.0302	1.0350	1.0293
12	1.0264	1.0240	1.0203	1.0241	1.0204	1.0246	1.0191
13	1.0169	1.0142	1.0109	1.0137	1.0104	1.0136	1.0090
14	1.0070	1.0042	1.0012	1.0035	1.0005	1.0025	0.9992
15	0.9986	0.9957	0.9927	0.9951	0.9928	0.9939	0.9922
16	0.9890	0.9860	0.9840	0.9874	0.9841	0.9839	0.9832
17	0.9762	0.9734	0.9736	0.9722	0.9717	0.9698	0.9690
18	0.9562	0.9555	0.9579	0.9548	0.9560	0.9523	0.9535
19	0.9328	0.9345	0.9398	0.9347	0.9399	0.9331	0.9399
20	0.9133	0.9175	0.9244	0.9183	0.9247	0.9175	0.9272

CHAPTER 5

SIMULATION OF A TAX REFORM PROPOSAL.

During the past few years, a consensus developed around the belief that the federal income tax code needed reform. Tax reformers argued that the code was far too complex, requiring too much time to prepare the returns; the code was unfair in that people earning similar incomes can end up paying quite different amounts of taxes; the high marginal tax rates acted as a disincentive for persons to work; and the many special provisions tended to distort the allocation of resources, thereby keeping the economy from operating efficiently.

While tax reform will arguably confer benefits upon the economy in each of the four areas outlined above, changes will occur in more easily observed, but no simpler to predict, areas of the economy. This chapter will use the model constructed in the previous chapters to simulate the major effects of a tax reform proposal. The benefits of simpler returns, horizontal equity, higher work incentives, and fewer allocational distortions are not explicitly modeled. However, this chapter will explore the likely effects of tax reform on two of the most important and visible areas of the economy; the size and distribution of the personal income tax burden, and the effects of tax reform on equipment investment by businesses.

The method employed fits in closely with the structure and capabilities of the model. The model is well-suited for simulating the major provisions of the tax reform plans which have gained the most support recently from legislators. In addition to the personal tax model which is the main topic of this thesis, the major provisions of the changes in the corporate tax laws will also be simulated.

Since the personal income tax model has already been described in detail, it is only necessary to describe how the built-in flexibility of that model is used for the simulation. The focus of the corporate tax reform analysis is its effects on equipment investment. Therefore, a brief description of the investment model is required and provided in appendix "A" to this chapter.

The purpose of this exercise is to estimate the effects of the major provisions of the tax reform plan that goes into effect in 1987. Because the tax reform proposal has major changes in both the personal and corporate tax laws, both of these must be simulated together to present a reasonable picture of the plan's likely overall effects. The tax reform simulation is meant to capture the spirit of the specific plan passed by the Joint Committee on Taxation in August of 1986. The tax reform package is lengthy and extremely detailed. Where possible, the exact provision will be simulated, but of course, the model does not have the capability of simulating many of the lesser provisions. This is true of both the personal and corporate proposals.

The simulation exercise will contrast forecasts of the U.S. economy under both current law and the tax reform proposal. The strengths of the model will be highlighted. In particular, forecasts of the level and distribution of income tax collections will be forecast under both plans. Business responses to tax-induced changes in investment incentives will be discussed. Finally, the combination of these changes will affect the macro economy in specific ways, in both the intermediate and long runs.

The Tax Reform Plan.

There have been at least a half-dozen serious proposals for tax reform. They have varied considerably in detail, but they all have centered around three prevailing themes: a simpler tax code which promotes horizontal equity, a broader tax base, and lower marginal rates.

The tax reform plan is much simpler, at least on the personal side. While the fact that the plan features fewer brackets does not appreciably simplify the calculation of taxes, there are other more simplifying characteristics of the plan. There will be fewer exclusions, adjustments, credits and deductions allowable which will make for simpler returns and a lower accounting and preparation burden. Complications such as income averaging will be repealed, and because of the higher standard deduction ($5,000 for joint returns), fewer taxpayers will benefit from itemization of their deductions. Tax shelters will be significantly curtailed. The two tax brackets are 15% and 28% bracket. The zero bracket amount will be incorporated back into the standard deduction.

The corporate returns will retain their current structure for the most part. Only the rates will change. The most notable exceptions, however, are the repeal of the investment tax credit (ITC), the deductibility of only 80% of certain business expenses, and the change in the depreciation schedules of some capital investments.

The tax base will be made much broader, especially for the personal income tax. Exclusions such as 60% of long term capital gains will be eliminated. Adjustments such as IRA contributions and certain tax shelter losses will be significantly curtailed. Certain tax credits such as the ITC and the political contributions credit will be repealed. Several deductions, such as non-mortgage interest and state and local sales taxes will be disallowed. On the corporate side, besides elimination of the ITC, travel and entertainment expense deductions will be limited to 80%, and the amount of tax liablility to which tax credits may be applied will be cut back.

The base expansion not only makes for simpler tax returns, but more importantly, it makes room for reductions in marginal tax rates in a revenue neutral plan. The top personal rate will be lowered from 50% to 28%, while the corporate rate is lowered from 46% to 34%. The personal rate of 28% is a bit misleading, however, because the benefits of the 15% rate on low income and personal exemptions are phased out over a large range of personal income. Higher income families in the phase-out range will face effective marginal rates of about 33% on average. See table 5.1 for a summary of the main provisions of the tax reform plan which were simulated, and how they compare to the current law.

Putting the Tax Reform Provisions in the Model.

1. The Rates.

This section will describe how the provisions of the tax reform proposal are simulated within the framework of the model. Changes in the rate schedule, the standard deduction, and the personal exemption amount are exactly what the model was designed to simulate. Because of the work that went into the design of the model in Chapters 2 and 3, this part of the simulation is simple. The tax rate schedules are read directly into the model as data. The same is true for the standard deduction amount since it can be incorporated directly into the schedule. The personal exemption amounts are also read in as data. These items are read from an exogenous data file which contains their values for each year of the forecast. Note that differences in the rate schedules and standard deductions for single and married taxpayers are fully taken into account since the model estimates income distributions and tax liabilities for each household size. Households of size greater than one are assumed to file joint returns.

The model also takes into account changes in the earned income credit (EIC), and the indexing provisions. The EIC test is applied to all income of household sizes three or more. This is because the model cannot distinguish between earned and nonearned income. The parameters of the EIC, which include the maximum amount, the income range over which it applies and the phase-in and phase-out rates, are all fed in as data. Indexing is modeled automatically by saving the inflation rate in the previous year's GNP deflator and applying it to both the tax bracket boundaries (including the zero-bracket amount) and the personal exemption amount. The indexing switch in the model can be turned on at any year in the forecast, and there is a separate switch for the tax brackets and the personal exemption amount.

2. Accounting for Tax Base Expansion Under Tax Reform.

The tax reform proposal seeks to change the definition of the income tax base, or AGI. The following items which are currently exempt will be included in the tax base: The dividend exclusion, capital gains, IRA deductions, moving expenses, the deduction for working married couples, and unemployment compensation. Together, these items totaled 3.9% of personal income in 1982, according to SOI. The base was expanded in the simulation by adding that amount to the value of AGI determined by the model. The new value of AGI was then used for the calculations. The procedure used assumes implicitly that the additions to the tax base are distributed in the same way as the old AGI. This turns out to be a reasonable assumption for most of these items. However, capital gains are distributed heavily toward the upper incomes. This is partially offset by the inclusion of unemployment compensation, which accrues primarily to the lower incomes.

According to SOI, the relative magnitude of each item in 1982 was as follows:

	($bill.)	%of PI	
Dividend Exclusion	1.9	0.1	
Capital Gains (excluded)	51.6	1.9	
Unemp. Compensation (excl.)	12.7	0.5	
IRA Deductions if AGI<50K	25.6	1.0	(adjusted for inflation)
Moving expense	3.7	0.1	
Marriage Deduction	9.0	0.3	
Total	104.5	3.9	

3. The Conversion from Standard to Effective Tax Under Tax Reform.

Itemized deductions and tax credits affect the relation between standard and effective tax rates. The tax reform plan eliminates all credits and many deductions. Because of this, and the fact that the standard deduction is raised by the plan, substantially fewer taxpayers will find it advantageous to itemize. Using data from 1982 tax returns, a new relationship between standard and effective taxes, reflecting these changes was estimated for each ventile.

The tax reform proposal will alter the relationship between standard and effective taxes in three important ways. First, the tax reform proposal will eliminate about 25% of amount of what were previously allowable deductions. The statistics from SOI indicate that itemized deductions are distributed remarkably like the income distribution itself for those who itemize. The deductions account for about 22-25% of AGI for those who itemize in all of the reported income groups. Overall, deductions account for about 15% of AGI. Second, the zero bracket amount rises from $2300 and $3400 for single and joint returns to $3000 and $5000 under the proposal, which raises the lower bound for the amount of deductions necessary to benefit from itemizing. Finally, almost all tax credits are eliminated. These credits account for about 3% of tax liability.

The procedure which estimates the change in the ratio of effective-to-standard tax liabilities per ventile is outlined in the steps below. Simply put, the procedure estimates the tax value of deductions under the new plan for the different income groups and uses those amounts as the differences between standard and effective taxes.

1. The number of returns, the "standard tax" under tax reform, and the average per household AGI (base definition) were saved from a run of the tax model with the reform proposal's tax rate schedule. Values for each of these three items were saved for each household size in each ventile for 1988.

2. The total deductions for each of the 120 groups (6 household sizes in each of the 20 ventiles) were then estimated based on the percentages reported in 1982 SOI, table 1.2. For household incomes of $20 thousand or less, 8.6% of AGI is taken in itemized deductions; 13.2% for AGI of $20-25 thousand; 15.1% for $25-30; 17.6% $30-40; 20% for $40-50; and 21% for AGI above $50 thousand per household. The resulting figures were then reduced by 25% to account for the fewer

deductions allowed under tax reform.

3. Next, the effective tax for each group under the new plan (NTAX) was calculated as the standard tax (ST) minus the marginal rate (MR, either 15%, 28%, or 33% depending on the group's average AGI) times the deductions estimated in step 2 (DED) minus the zero bracket amount (ZBA); NTAX = ST - (MR*(DED-ZBA)) when $(DED-ZBA)^+$.

4. The difference between the new tax and the standard tax was calculated where the new tax was less than the base. This represents the savings per household from itemization under tax reform.

5. The taxes and savings from itemization under tax reform per ventile were calculated by aggregating the household sizes in each ventile; The per household taxes and savings were multiplied by the number of returns for each group (calculated as population per group divided by household size).

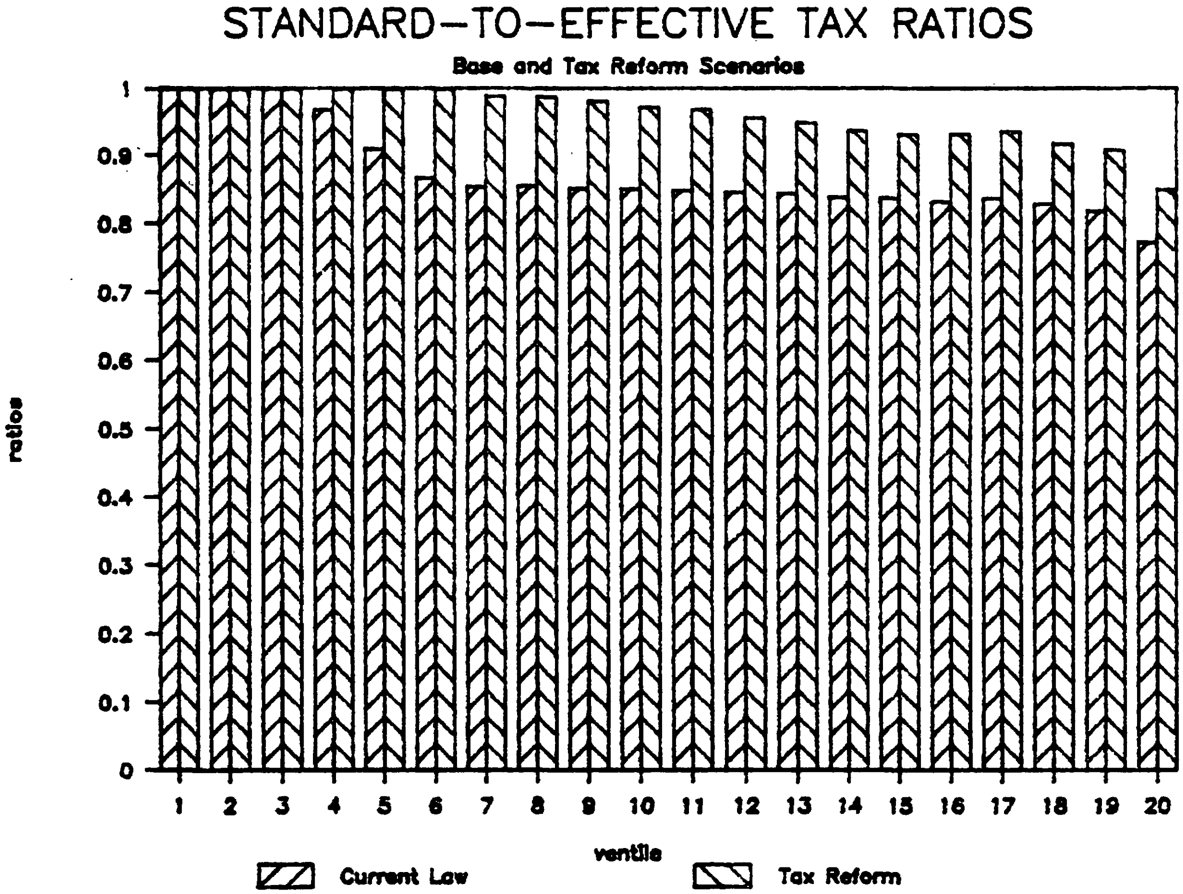
6. The saving from itemization as a share of standard taxes for each ventile represents the standard-to-effective tax ratios used for the tax reform simulation.

Figure 5.1 shows the factors used for converting standard tax rates to effective tax rates for both the base and the tax reform proposal. The numbers are shown in table 5.2.

Simulating Corporate Tax Reform.

The proposal for reforming the corporate income tax will undoubtedly affect the way businesses make their investment decisions. The current law is considered inequitable by many because effective tax rates vary widely among industries. The proposed changes are designed to help eliminate these inequities, and to remove many of the existing

FIGURE 5.1


STANDARD-TO-EFFECTIVE TAX RATIOS
Base and Tax Reform Scenarios
ratios
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
ventile
Current Law
Tax Reform

distortions in investment incentives. Removal of these distortions will supposedly allow the economy to operate more efficiently.

This section is an attempt to analyze and simulate the effects of the proposed changes in the corporate tax law on equipment investment. The scope of the study is limited to equipment investment only, and does not address investment in structures under the new tax proposal, although there may be significant macroeconomic effects due to the new treatment of certain commercial structures which previously served as tax shelters.

The entire tax reform package contains three major separate pieces which will affect equipment investment. The plan proposes to (1) lower the basic corporate tax rate from 46% to 34%, (2) eliminate the investment tax credit, and (3) change allowable depreciation schedules to slightly longer tax lives with more accelerated write-offs. Each of these will be more thoroughly discussed in turn, outlining the change, and its likely effects on investment.

Tax changes directly affect investment through changes in the cost of capital. The cost of capital is the return that an investment earns in order to be profitable. It is the return an asset must yield in order to pay taxes, recoup real depreciation, and cover the interest costs of financing its purchase. Naturally, a higher cost of capital will tend to depress investment incentives. The interindustry model determines investment, employment and energy use simultaneously, with investment being determined by each industry's output and its relative cost of capital. See appendix "A" for a more detailed and technical discussion of the determination of investment in the model, and appendix "B" for a description and derivation of the cost of capital formula.

The formula for capital cost is:

5.1) $$UCC = P(r + dep) * (1 - T*Z - C)/(1 - T)$$

The model forecasts investment for 55 industries based on costs of capital, labor and energy, as well as industry output. A different cost of capital is calculated for each industry. This cost of capital formula is used in the model as the price of capital equipment facing firms. It assumes 100% debt financing. The user cost will vary among investing industries in the model only because P, which is the price of the equipment bought, and the economic depreciation, dep, will vary. Each industry is assumed to use the same discount rate r, and each faces the same tax rate T and investment tax credit, C. Economic depreciation and the tax depreciation, Z will depend on the type of equipment bought. These simulations take this into account when estimating the economic depreciation, but not for the tax depreciation. The present value of the depreciation write-off is calculated assuming that all industries invest in equipment that has economy-wide average tax lives. The capital flow data show this to be a reasonable assumption.

The first piece of proposed legislation is the reduction of the top corporate tax rate from 46% to 34%. This change will have two effects on the cost of capital, each in an opposite direction. The lower tax rate will act to increase the overall after-tax return on capital, thus lowering the cost of capital. However, a lower tax rate will reduce the tax savings from deductions, particularly the depreciation deduction, which enters the cost of capital formula. The first effect dominates, ceteris paribus, so the net effect of the rate reduction is to lower the cost of capital. From a base of current law, changing only the corporate tax rate would lower the cost of capital by around 4% for all industries. Although this change will help stimulate investment, it will actually not have much effect on revenue, because deductions of business expenses will be significantly curtailed, thus increasing the corporate income tax base. The accounting changes which increase the tax base will have little or no effect on investment because they have no bearing on the marginal cost of capital.

The piece of the proposal with the biggest negative impact on investment is the repeal of the investment tax credit. The credit is a reduction of tax bills by 10% of the price of qualified equipment. It appears with a negative sign in the cost of capital formula. Elimination of the credit significantly raises the cost of capital. Although the tax credit is legislated to be ten percent, few studies use that rate as the true effective rate in the aggregate. This study is no exception. There are several reasons to believe the proper value to apply in cost of capital calculations is substantially lower.

To begin with, the law states that if the ITC is claimed, the equipment's basis for depreciation must be lowered by half the amount of the ITC. This means that the firm's depreciation stream will be 5% less each period. The amount it costs the firm in taxes is the tax rate times 5%, discounted over the depreciation schedule. The firm is given an option of reducing its ITC by two percentage points (to 8%) or taking the basis reduction, which works out to about 1.85% for the average equipment of a firm in the 46% tax bracket.

Equipment which can be written off in three years is only eligible for a 6% ITC (4% in lieu of basis reduction). The equipment, which includes autos, light trucks and research and equipment for experimentation makes up over 10% of all equipment purchases. Adjustment for this lowers the effective ITC by another .4%.

Numerous types of equipment are not eligible at all for the ITC. Such equipment includes most property used for long-term lodging, child care, tax-exempt, and government organizations, property used outside the country, and frequently replaced livestock. If equipment is sold or disposed of before its tax life expires, the firm must repay the ITC taken. Finally, the limit on the ITC is $25 thousand per year per firm, plus 85% of the firm's tax liability over that amount. It is tempting to ignore this limitation because the ITC can be carried back 3 years and forward 15 years, but many firms with little or no tax liability may go bankrupt before they can claim the whole ITC. Firms probably consider this in their investment decisions. It is estimated that this last group of provisions will subtract 1% from the aggregate effective ITC rate. Therefore the calculations and simulations use 6.7% as the effective investment tax credit rate, not the legislated rate of 10%. This may be the main reason the results from this study are different from other studies which adopt the same approach. If the elimination of the investment tax credit were the only change in the tax law, the cost of capital would increase by about 12%.

The tax reform package proposes to make the tax depreciation schedule more accelerated. Instead of the current 150% declining balance method of depreciation, the proposal will allow the faster double declining balance method. The current law has three classes of equipment with tax lives of three, five and ten years. Automobiles, light trucks and research and experimentation equipment fall into the three-year category, while except for a small group, the remainder fall into the five-year class. The faster depreciation will dampen the rise in the cost of capital due to the repeal of the ITC.

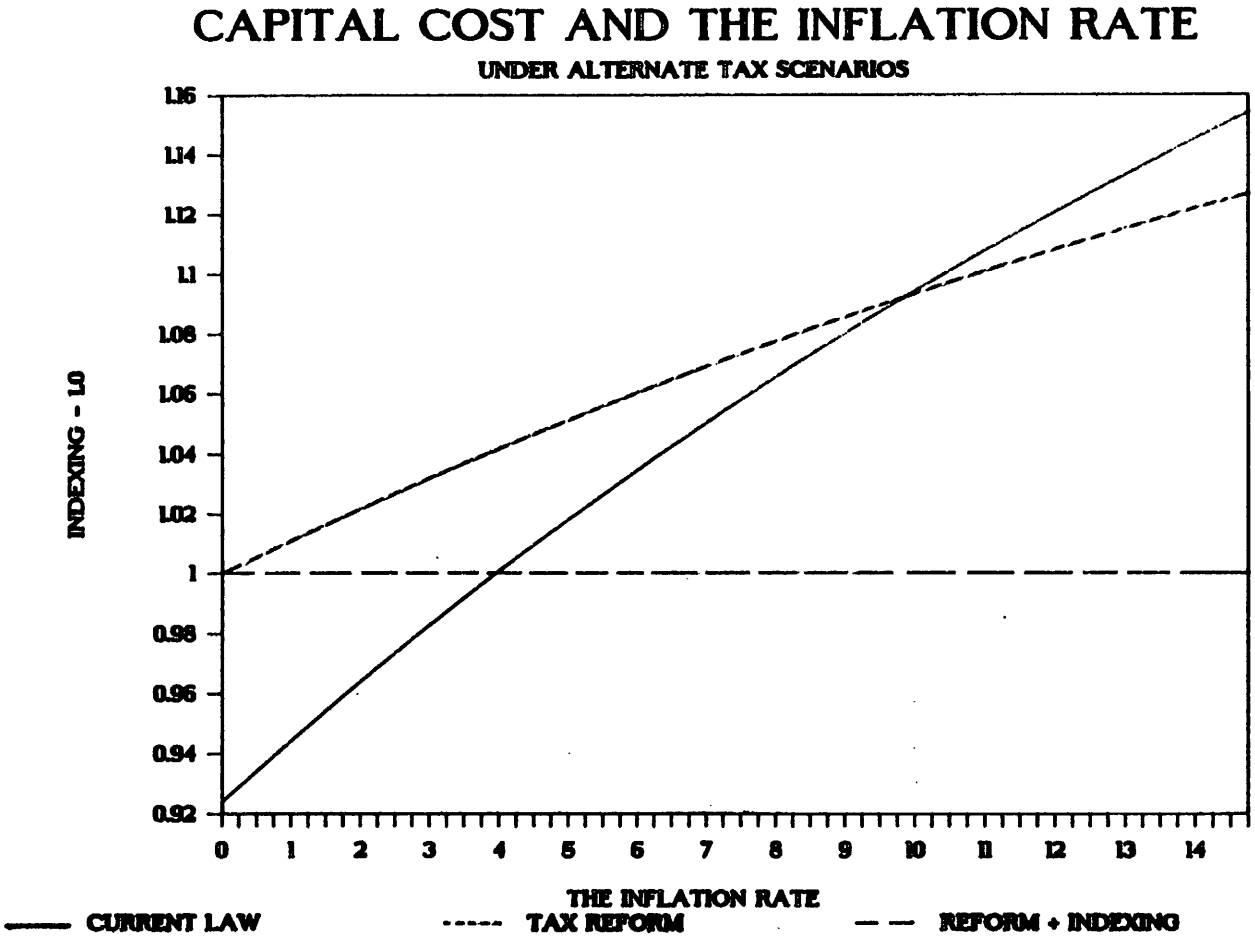
The tax proposal will lengthen the tax lives of certain classes of equipment. What was previously three-year equipment becomes five-year, and what was five-year, stays at five-year equipment. The tax lives of what was previously ten-year equipment gets lowered to seven. Other tax-life categories are added to the schedule for investments which are nonbuilding structures like sewage treatment plants, barns, and certain utility facilities. In the aggregate, and as far as equipment only is concerned, the effect will be small, and so it is ignored in the simulation. In a careful industry analysis, it would be possible, using available capital flow data, to construct an average service life for each industry, and calculate the present value of the depreciation deduction in that manner. For this simulation, however, it is assumed all industries average equipment tax life is five years under both plans. If shifting from 150% to double declining balance were the only change in the tax law it would lower the cost of capital by about 1.5%. The present value of depreciation of a five year piece of equipment costing one dollar under current law would be .796, while it would be .816 under tax reform with double-declining balance if both the expected real rate of return and expected inflation rate were 4%.

A most equitable major piece of tax reform was deleted from the tax reform proposal. That was the provision of indexation of the depreciable tax basis of capital purchases to inflation. Under current law, the depreciation allowed is based on the original purchase price of the equipment, without regard to current replacement cost. Indexation would have allowed the depreciable basis to be increased each year by the change in the price level over the previous year. The impact could be modeled in the capital cost framework by discounting the depreciation stream by the real, or inflation-adjusted interest rate instead of the nominal rate. Using this lower discount rate will raise the present value of the depreciation and thus lower the cost of capital. The higher the inflation rate, the more valuable to business this part of the tax law would be.

One very important point about this analysis is that the cost of capital under current law and the tax reform proposal is very sensitive to inflation. This is because the real present value of the depreciation stream, if it is not indexed, will decline as inflation rises, thus raising the cost of capital. Figure 5.2 illustrates how important inflation projections are to this analysis. It shows capital costs under current law, the tax reform proposal and the reform proposal including indexation. For every percentage point the inflation rate rises, the cost of capital under current law and reform increases by almost two percentage points. The cost of capital would be invariant to inflation if depreciation were indexed. The indexing provision alone, if it were enacted, would lower capital costs by about 7% if inflation were 4%. The inflation rate at which tax reform with indexing and the current law yield the same cost of capital is just over 4%. The inflation sensitivity of capital costs without indexing is a crucial point to consider when evaluating the effects of tax reform.

Table 5.3 shows the percentage change in capital cost from enacting various combinations of the pieces of the tax reform package. Shown are the impacts of tax changes on the cost of capital assuming no other

FIGURE 5.2


CAPITAL COST AND THE INFLATION RATE
UNDER ALTERNATE TAX SCENARIOS
INDEXING - 1.0
1.16
1.14
1.12
1.1
1.08
1.06
1.04
1.02
1
0.98
0.96
0.94
0.92
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
THE INFLATION RATE
CURRENT LAW
TAX REFORM
REFORM + INDEXING

changes or feedback effects in the economy. The overall package increases the cost of capital by 4.3% if expected inflation is 4% and the real rate of return is 4%.

Provisions not Modeled.

Of course there are many provisions in the tax reform package that are not modeled. It will be useful to list the most important ones here, starting with those on the personal income tax side.

1. The distribution of the base expansion is assumed to be like the distribution of the old definition of AGI. That is, the model can only forecast the distribution of the old definition of AGI, because that is what the equations have been historically estimated to forecast. Once those distributions are forecast, the estimated discrepancy between the old AGI and new AGI is added to each group's share of income in proportion to their share of old AGI. While it is true that this method can lead to distortions because certain income such as capital gains and income from defunct tax shelters accrues at the upper end of the income distribution, other items which tax reform adds to the definition of AGI, such as unemployment compensation and the elimination of the marriage deduction, accrue more toward the lower end, thus offsetting somewhat the potential distortion.

2. It should be pointed out that this model is not able to simulate many of the individual behavioral repsonses to tax reform that may occur at the microeconomic level. In particular, the tax reform package will alter the after-tax price of many items, particularly those items which are currently deductible, but will not be under the new plan. Those items may become less attractive. When these incentives

are discussed, it is often thought that resources will shift into the expenditures that are still deductible, and thus any static revenue prediction of tax reform will be overestimated. What is not usually mentioned is that with the lower tax rates, there is less incentive to alter puchases for tax avoidance purposes. Thus the price effects argument may be overstated. Nonetheless, these effects, if they exist, are not simulated. The deductions estimated for tax reform, which are reflected in the predicted relation between standard and effective tax rates, are based on the static analysis of historical data described above. Price-type effects could be estimated separately with the proper data, however, and incorporated into the forecast. But this simulation is static with regard to the individual price-type responses.

3. On the corporate side, the income tax is not modeled in enough detail to provide accurate revenue projection. Therefore revenues had to be taken from the joint committee's static estimates. The plan was passed under the assumption that it would be revenue neutral over the first five years. Since the plan results in a personal tax cut, the corporate revenue increase is fixed to be equal to the cut in personal taxes. The cut in personal taxes was estimated with a separate, completely static simulation of the personal income tax model. The simulation, which was designed to reflect the Joint Committee static method, used only the income distribution and tax model. Revenue estimates were compared under current law and tax reform assuming the same level of GNP and personal income. The difference in the estimates was then fed in as the difference in corporate revenue for the dynamic simulation with the complete model. This gave the macro simulation the property of static revenue neutrality that the legislators mandated.

4. Under current law, 46% of business expenses are paid by the federal government because they are deductible. Under the new plan, the subsidy would be reduced to 34%. For business meals and entertainment expenses, the subsidy would only be 80% of that, or about 27%. The effect of these changes would seem to reduce these expenses, but the magnitude, if any, is unknown. If they were estimated separately, they could be incorporated into the simulation by making the appropriate changes in the intermediate coefficient matrix. Also the research and development credit will be reduced from 25 to 20%. No effort has been made to take these effects into account for the current simulation.

5. Investment in structures is being treated differently under tax reform. Tax lives will be lengthened from 19 to 31.5 years. Unlike equipment investment, the investment in structures is not modeled in a user cost framework. The result of repeated experiments here was that business construction depended on output and interest rates, but not on any price or tax parameters. There is some disagreement with this view among economists, particularly regarding tax sheltering and commercial structures.

The Results of the Simulation.

The overall plan was designed by the Joint Committee on Taxation to be revenue neutral. This simulation was designed to capture that spirit, however, with a dynamic forecasting model. The personal tax model was first simulated alone in a pure static framework, using the income and other variables exogenous to the pure income tax calculation from a base run of the complete model. The difference in revenue calculated in this manner was then added to the corporate income tax revenue forecast while the complete dynamic simulation was being done. Alternatively, the model could have been adjusted to be revenue neutral in the dynamic simulation, but this would not have been an appropriate scenario.

The scenario that was run, then, is revenue neutral in a static simulation, but not in a dynamic one. When the tax burden is shifted from the personal income tax to the corporate tax, aggregate spending is affected. In particular aggregate spending will increase with dollar for dollar shifts in this manner, thus stimulating the economy, increasing income and tax revenue. The stimulus occurs in the simulation because personal consumption is more responsive to changes in income than business spending. When personal taxes are cut, about 93% of the extra disposable income is spent. When corporate taxes rise, corporate spending falls, but not as much as 93% of the tax hike. In particular, dividend payouts, especially in the short and intermediate term, are historically not as sensitive to profits as PCE is to disposable personal income. Profits, and retained earnings act as a buffer for corporate spending. The result is more aggregate spending and economy-wide stimulus. This effect outweighs the depressing effect that higher capital costs have on equipment investment (to be discussed later).

The static simulation results year by year are shown in table 5.4. Once the tax reform plan goes into full effect, (it will be phased-in during 1987) personal tax revenue will fall by about 6% per year, about $20 billion in 1988. For the first five years, the tax cut would be about 5% according to the static simulation. Shifting that amount of taxes from persons to corporations is not neutral with respect to overall economic activity, as explained above. The revenue estimates from the full dynamic simulation show less of a tax cut, reflecting the stronger economy's higher incomes.

TABLE 5.4
SIMULATED PERSONAL INCOME TAX REVENUE.
(Billions of Current Dollars)

	BASE	TAX REFORM (static)	TAX REFORM (dymnamic)
1986	363.4	363.4	363.4
1987	388.0	386.1	387.7
1988	406.2	382.8	385.8
1989	431.8	407.8	411.8
1990	468.3	442.6	445.9
1991	518.0	487.8	492.0
1992	564.8	530.6	536.4
1993	606.8	570.0	576.7
1994	652.1	611.9	620.1
1995	700.6	656.2	665.9

Also of interest is the effect of tax reform on the income elasticity of revenue. Using static simulation, where only aggregate personal income is changed, the current law yields an elasticity of 1.73. Under tax reform, the elasticity would be 1.69. The lower elasticity is due to the slightly less progressive rate structure. These estimates are the results of experiments with the model which raised personal income, and transfer payments both 10%. The multiplier would be slightly lower for smaller increases because of progressivity.

The tables at the end of this section show the results of the simulations in terms of the distribution of the tax burden. The simulation takes into account the phase-in of the tax rates in 1987 while assuming the new relation of standard and effective tax rates for that year and beyond. The results show income per ventile, and cutoff incomes using the new expanded AGI, the tax rates and tax liabilities, and the after-tax income distribution.

Table 5.5 shows how adjusted gross income is distributed among the twenty ventiles under each scenario for 1988 ,1991 and 1995. The table shows AGI both before and after all personal taxes. Remember that the definition of AGI is broader under tax reform than under current law.

Table 5.6 shows the cutoff point between ventiles in thousands of dollars per capita. Again, the definition of AGI varies across scenarios. There is no cutoff calculated for the top ventile because that number would represent the per capita AGI of the country's highest earner for that year, a meaningless statistic.

Table 5.7 shows the tax rates, both standard and effective. These tax rates are average rates, not the marginal rates which appear in the tax schedules. Again the rates are applied to different income bases according to the definition of AGI. Note that the standard and effective tax rates are equal for the lowest six ventiles under the tax reform proposal. This is because households in these groups will not benefit from itemization.

The most interesting table is table 5.8 because it shows the amounts of federal income tax liability for each ventile. The tax reform plan shows a reduction in personal income tax liabilities from the current law. In 1988, the plan shows a tax cut of about 5%. The ventiles which enjoy larger tax reductions than the overall average for each plan are marked with an asterisk. The bottom 5 or 6 ventiles get a bigger than average tax cut in percentage terms, except the lowest ventile, which pays no tax under either plan, and therefore gets no tax cut at all. The top 2 ventiles also receive more than the proportional tax cut. In fact, in dollar terms for 1988, the top 10% of taxpayers get about one-half of the total tax cut. So the people at the bottom and the top get the biggest percentage tax cuts, while no groups will pay higher taxes. This could be one reason for tax reform's political support.

Table 5.9 shows the indexes of after-tax disposable personal income by ventile. These numbers come from the static simulation. The dynamic simulation showed variation in the ventile cutoff incomes which was due not only to the change in the tax law, but also changes in the economic variables which determine the income distribution. Recall from Chapter 2 that the income distribution depends on the unemployment rate, the share of income in interest and dividends, the inflation rate and time. The first two of these variables changed enough in the dynamic simulation as to overwhelm the effect that tax reform had on the ventile borders. An inspection of the values in table 5.9 shows that the pure effect of tax reform on the distribution of personal income is small relative to the total amount of personal income. However, recall from table 4.7 that the effect of the overall tax system on the income distribution is quite significant.

In table 5.9, it is clear which ventiles benefit in relative as opposed to absolute terms. The numbers represent the percent of the overall average per capita after-tax income received by the highest person in the ventile. Note that the lowest ventiles were hurt in relative terms. That is not because the tax proposal raises their taxes, but because they pay either no taxes, in which case they receive no tax cut, or they pay so little in taxes that when their taxes are cut, it amounts to so few dollars that they are made relatively worse off when other groups enjoy a more substantial tax cut.

The changes may seem small, but they are calculated correctly. Take the values for the twentieth ventile which is the group most affected by tax reform in 1988. The difference in tax liablility between the base and reform scenario is about $6 billion. That amounts to only about .0018 of total disposable personal income ($3340 billion). Six billion dollars in a ventile translates to about $500 per person, which is 3.6% of $13,800, which is overall per capita income for 1988. However, the indexes are constructed to measure the relative position of persons. If all persons got an across-the-board increase in their disposable incomes in percentage terms, the indexes would not change. For the indexes to change, there must be shifts in the relative positions of people. That is why the pure tax-induced changes in the indexes in the static tax reform simulation are small even though the tax cut is significant.

Except for the very lowest ventiles, the tax reform proposal will make the low income groups better off both absolutely and relatively. This is because of the doubling of the personal exemption amount, and substantial increase in the standard deduction. The middle and upper middle income groups will benefit in absolute terms, but enjoy a smaller tax cut than the other groups, and therefore are made relatively worse off. The upper two income groups are made better off because of the lower marginal tax rates.

The results of this simulation indicate that the tax proposal will not alter the distribution of federal income tax liability very much. The difference is that the tax system becomes somewhat less progressive at the upper end, but more progressive at the lower end.

Because of the small relative shift in the shape of the income distribution as measured by the indexes, the proposed version of tax reform is not a particularly illuminating scenario under which to demonstrate the considerable abilities of the consumption model. For this reason no more will be said, other than to point out that the model does provide some useful evidence; namely, that changes in the distribution of tax liability under tax reform will be small enough to ignore when analyzing the proposal's effect on the goods distribution of consumption.

The effect on investment behavior is shown in tables 5.10 and 5.11. Table 5.10 shows the change in user cost by industry. The units of the user cost of capital are irrelevant, but not the percentage changes. The units depend on a weighted price index of the new capital goods purchased by the industries. The costs are comparable between the runs as the overall price deflators are not affected by tax reform according to the model. Table 5.11 shows capital equipment purchases in constant dollars by industry. The 5% rise in after-tax capital costs results in about a 2.5% decline in equipment purchases.

The overall macro effects as projected by the INFORUM model are summarized in table 5.12. Note that aggregate consumption increases, but not by 94% (1 minus the savings rate) of the tax cut. This is because dividends are part of income, and those were cut back somewhat by the higher corporate tax. Note that the percent fall in dividends is quite large (17.5) by 1995. Dividends are estimated in the model primarily on the basis of after-tax corporate profits with a smoothing lag structure. The large fall reflects the large (over 25%) percentage increase in corporate tax revenue that the simulation generates. The rise in consumption is also tempered by a rise in the savings rate. Since the savings rate is a negative function of the unemployment rate, among other things, the stronger economy and lower unemployment rate act to dampen the rise in consumption. Inflation was not affected by the proposal, and interest rates rose only slightly.

It would appear that in drafting the proposal, the analysts succeeded in coming up with simpler tax laws which will not drastically alter the distribution of the tax burden. A major criticism of the current system, besides its complexity and high marginal rates, is that it is horizontally inequitable. A person's tax bill depends not so much on the quantity of income he or she receives, but on the form of his or her income and the items it is spent on. Although this is one area which cannot be addressed by this study, it is hoped that this legislation will go a long way in correcting these inequities. In so doing, there will naturally be individual winners and losers in each group, but it does not appear that any income group as a whole will lose much. The other main result of this simulation exercise is that while the tax reform legislation will redistribute resources from investment-oriented industries and activities to those more oriented toward consumption, there will be virtually no impact on the overall growth of the economy.

TABLE 5.1

A SUMMARY OF THE TAX REFORM PLAN.

I. The tax rates:

These rates apply to AGI less personal exemption and standard deduction.
15% -- on individual AGI up to 17,850; joint AGI up to $29,750.
28% -- on AGI in excess of $17,850 and $29,750.

II. Exemptions, deductions, and phase-outs:

The personal exemption amount is $1,900 in 1987 and $2,000 thereafter, indexed to inflation. The standard deduction is $3,000 for single, and $5,000 for married filing joint.

There will be a phase-out of the benefits to high income earners of the 15% rate on a portion of their income. The phase-out occurs between $43,150 and $89,560 for singles, and between $71,900 and $149,250 for joint returns.

In addition, the personal exemption will be phased out at a rate of five percent for adjusted gross incomes between $89,560 and $129,560 for single and over $145,320 for joint returns. Both these phase-outs raise the effective marginal tax rate to 33% over their ranges.

III. Deductions:

The retained deductions include:
1) first and second home mortgage interest.
2) state and local income and property taxes.
3) charitable contributions.
4) medical expenses exceeding 10% of AGI.
5) child care expenses.

The repealed deductions include:
1) consumer interest payments.
2) investment interest if more than investment income.
3) state and local sales tax.
4) medical expenses less than 7.5
5) miscellaneous deductions such as union dues and employee business expenses under 2% of AGI.

TABLE 5.1 (continued)

IV. Other items changed:

1) IRA deductions severly limited.
2) two-earner deduction repealed.
3) political contributions credit repealed.
4) income averaging repealed.
5) capital gains exclusion repealed.
6) unemployment insurance exclusion repealed.
7) real estate related tax shelters severly limited.
8) moving expenses treated as miscellaneous deductions.
9) Earned Income Credit expanded.

V. Major changes in the business tax provisions of the tax reform plan:

1) Investment Tax credit repealed.

2) Depreciation service lives lengthened marginally for equipment, significantly for real estate and structures. This effect is offset by double declining balance instead of 150% for equipment.

3) Top corporate tax rate lowered from 46% to 34%. Income up to $75,000 subject to lower rates, but phased-out so that companies earning more than $350,000 will pay a flat rate of 34%.

4) Limited business expense deductions, particularly for travel and entertainment.

5) Maximum tax rate of 28% on corporate capital gains.

6) Alternative minimum tax added for corporations.

7) Research purchases tax credit reduced from 25 to 20%.

TABLE 5.2

STANDARD-TO-EFFECTIVE TAX RATIOS - BASE AND REFORM.

Ventile	Current Law	Tax Reform
1	1.00000	1.00000
2	1.00000	1.00000
3	1.00000	1.00000
4	0.96940	1.00000
5	0.91004	1.00000
6	0.86870	1.00000
7	0.85577	0.98979
8	0.85658	0.98849
9	0.85305	0.98232
10	0.85236	0.97363
11	0.84995	0.97024
12	0.84741	0.95704
13	0.84505	0.94917
14	0.83944	0.93714
15	0.83810	0.93146
16	0.83339	0.93215
17	0.83769	0.93588
18	0.82915	0.91731
19	0.81852	0.90862
20	0.77384	0.85088

TABLE 5.3

PERCENT CHANGE IN AGGREGATE CAPITAL COST FROM CURRENT LAW BASE *

T -- Change in the corporate tax rate from 46% to 34%.
C -- Change in the effective investment tax credit from 6.7% to 0.
Z -- Accelerate depreciation from 150 to 200% declining balance.
I -- Indexing the depreciation basis to inflation (assumed to be 4%).

Change	nominal i = 8%	nominal i = 6%
T only	-4.4	-3.1
C only	11.8	12.3
Z only	-1.6	-1.3
I only	-7.6	-8.6
T & C	5.3	6.9
T & Z	-5.4	-3.9
T & I	-9.0	-8.3
T, C & I	0.7	1.8
T, Z & I	-9.5	-8.6
C & Z	10.2	10.9
C & I	4.3	3.7
C, Z & I	3.3	3.2
Z & I	-8.5	-9.1
T,C,Z,&I	0.1	1.5
The entire tax reform proposal (T, C, & Z)	+4.3	+6.1
The entire proposal if expected inflation is 5%. (See Figure 5.2)	+3.5	+5.2

* The calculations assume that expected inflation is 4%, thus the first column assumes the ex ante real rate of return to be 4%, and the second column assumes a real rate of 2%.

TABLE 5.5
DISTRIBUTION OF AGI. (billion $)

Pre-Tax Ventile	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
1	11.28	11.89	12.66	14.32	15.21	17.62	18.80
2	23.53	25.60	27.17	31.14	33.02	39.68	42.22
3	32.51	35.65	37.81	43.49	46.12	55.98	59.54
4	40.98	45.28	47.97	54.95	58.21	71.02	75.48
5	49.38	54.66	57.89	66.59	70.55	86.21	91.58
6	57.31	63.58	67.33	77.43	82.02	100.51	106.77
7	65.21	72.68	76.93	88.50	93.72	115.20	122.34
8	73.43	81.82	86.60	99.64	105.53	129.94	137.98
9	81.56	90.95	96.26	110.93	117.47	144.68	153.61
10	90.13	100.86	106.71	123.02	130.26	160.74	170.63
11	99.52	111.36	117.84	135.82	143.82	177.47	188.42
12	109.12	122.13	129.22	148.95	157.70	194.98	206.98
13	120.23	134.79	142.56	164.51	174.18	215.66	228.90
14	133.26	149.44	158.17	182.25	192.98	238.60	253.25
15	147.95	166.10	175.65	202.66	214.55	265.59	281.87
16	167.22	187.96	198.78	229.17	242.61	300.05	318.44
17	191.47	214.69	227.13	261.26	276.66	342.17	363.19
18	225.49	253.32	267.91	308.42	326.58	403.46	428.27
19	282.16	316.34	334.58	384.60	407.41	501.51	532.51
20	463.36	496.18	532.35	605.97	647.86	773.84	827.23
Total	2465.09	2735.29	2901.52	3333.59	3536.47	4334.92	4608.01

AFTER-TAX AGI.

Ventile							
1	10.06	10.53	11.32	12.74	13.65	15.63	16.83
2	21.61	23.48	25.27	28.46	30.77	36.17	39.36
3	29.88	32.65	35.72	39.53	43.42	50.65	55.65
4	37.04	40.82	44.75	49.20	53.92	63.22	69.21
5	44.05	48.64	52.94	58.86	63.68	75.75	82.02
6	50.57	55.96	60.10	67.75	72.61	87.39	93.85
7	56.97	63.32	67.72	76.59	81.89	99.02	106.12
8	63.43	70.43	75.30	85.09	91.03	110.14	118.21
9	69.55	77.29	82.74	93.59	100.32	121.13	130.19
10	76.21	84.98	91.07	102.83	110.30	133.16	143.47
11	83.29	92.78	99.58	112.13	120.57	145.15	156.30
12	90.36	100.72	108.31	121.82	130.93	157.87	170.30
13	98.90	110.35	118.51	133.34	143.52	172.98	186.79
14	108.25	120.72	130.17	145.70	157.12	188.66	204.12
15	119.17	133.21	143.32	160.83	173.51	208.27	226.06
16	133.29	148.94	160.50	179.70	194.44	232.87	253.24
17	150.66	168.12	182.05	202.09	219.35	261.62	284.94
18	174.34	194.85	211.57	234.23	254.45	302.51	329.32
19	210.70	236.68	258.48	284.77	312.02	367.50	404.51
20	317.21	340.16	382.04	409.34	460.18	516.84	583.60
Total	1945.47	2154.55	2341.38	2598.48	2827.57	3346.41	3653.97

TABLE 5.6
UPPER LIMITS FOR PER CAPITA AGI. (thousand $)

Pre-Tax Ventile	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
1	1.59	1.68	1.78	1.97	2.09	2.41	2.56
2	2.45	2.63	2.79	3.10	3.29	3.84	4.08
3	3.20	3.45	3.66	4.07	4.32	5.06	5.38
4	3.94	4.26	4.52	5.03	5.33	6.28	6.68
5	4.65	5.05	5.34	5.95	6.31	7.45	7.92
6	5.34	5.80	6.14	6.86	7.26	8.60	9.13
7	6.04	6.59	6.97	7.78	8.24	9.78	10.38
8	6.75	7.37	7.80	8.70	9.22	10.94	11.62
9	7.47	8.17	8.64	9.66	10.23	12.17	12.92
10	8.26	9.05	9.57	10.70	11.33	13.49	14.32
11	9.09	9.95	10.53	11.77	12.46	14.84	15.76
12	9.97	10.93	11.56	12.93	13.69	16.33	17.34
13	11.04	12.11	12.81	14.33	15.17	18.11	19.22
14	12.22	13.40	14.18	15.85	16.78	20.03	21.26
15	13.71	15.07	15.94	17.82	18.86	22.52	23.90
16	15.54	17.08	18.06	20.19	21.37	25.51	27.07
17	18.04	19.82	20.96	23.39	24.77	29.53	31.35
18	21.89	24.03	25.42	28.33	30.01	35.66	37.86
19	29.09	31.88	33.72	37.62	39.88	47.31	50.27
Limits for Disposable AGI.							
1	1.44	1.51	1.63	1.78	1.92	2.17	2.35
2	2.25	2.41	2.61	2.83	3.08	3.49	3.81
3	2.92	3.14	3.43	3.67	4.03	4.54	4.98
4	3.54	3.82	4.17	4.48	4.88	5.56	6.05
5	4.13	4.47	4.83	5.24	5.64	6.51	7.02
6	4.69	5.08	5.45	5.97	6.39	7.44	7.98
7	5.25	5.71	6.10	6.69	7.16	8.35	8.95
8	5.80	6.30	6.74	7.39	7.91	9.22	9.90
9	6.35	6.91	7.40	8.11	8.70	10.14	10.91
10	6.95	7.58	8.13	8.89	9.55	11.11	11.96
11	7.57	8.25	8.86	9.67	10.39	12.08	13.02
12	8.23	8.98	9.65	10.53	11.33	13.17	14.21
13	9.02	9.85	10.60	11.54	12.43	14.42	15.59
14	9.89	10.79	11.63	12.63	13.62	15.78	17.09
15	10.98	12.01	12.94	14.06	15.19	17.57	19.09
16	12.32	13.46	14.54	15.73	17.04	19.66	21.39
17	14.08	15.39	16.69	17.95	19.48	22.38	24.37
18	16.66	18.25	19.88	21.27	23.20	26.47	28.96
19	21.21	23.21	25.48	27.08	29.86	33.64	37.29

TABLE 5.7
TAX RATES. (Percent)

"Standard Deduction" Tax Rates

Ventile	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.65	0.63	0.00	1.05	0.00	1.28	0.00
3	2.37	2.57	0.50	3.25	0.86	3.62	1.43
4	4.43	4.58	2.07	5.15	2.67	5.63	3.46
5	6.23	6.41	3.98	6.99	4.98	7.48	5.57
6	7.69	7.87	5.94	8.39	6.57	8.92	7.09
7	8.79	9.01	7.15	9.59	7.72	10.16	8.24
8	9.94	10.20	8.21	10.88	8.79	11.50	9.28
9	11.09	11.36	9.13	11.97	9.60	12.59	10.15
10	11.90	12.17	9.81	12.83	10.38	13.55	10.88
11	12.85	13.20	10.61	13.95	11.19	14.70	11.93
12	13.75	14.07	11.35	14.74	12.03	15.54	12.67
13	14.40	14.76	12.09	15.57	12.73	16.39	13.41
14	15.54	15.97	13.00	16.79	13.77	17.65	14.48
15	16.23	16.56	13.69	17.39	14.33	18.32	14.92
16	17.18	17.63	14.45	18.45	14.98	19.24	15.52
17	18.12	18.48	14.92	19.42	15.68	20.30	16.41
18	19.70	20.09	16.31	21.06	17.25	22.02	18.15
19	22.63	22.48	18.01	23.26	18.62	24.03	19.18
20	30.19	30.05	24.16	31.11	24.87	31.91	25.32
Effective Tax Rates							
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.65	0.63	0.00	1.05	0.00	1.28	0.00
3	2.37	2.57	0.50	3.25	0.86	3.62	1.43
4	4.29	4.44	2.07	5.00	2.67	5.46	3.46
5	5.67	5.83	3.98	6.37	4.98	6.81	5.57
6	6.68	6.83	5.94	7.29	6.57	7.75	7.09
7	7.52	7.71	7.07	8.21	7.64	8.70	8.15
8	8.51	8.74	8.11	9.32	8.69	9.85	9.18
9	9.46	9.69	8.97	10.21	9.43	10.74	9.97
10	10.14	10.37	9.55	10.94	10.10	11.55	10.59
11	10.92	11.22	10.29	11.85	10.85	12.49	11.57
12	11.66	11.92	10.86	12.49	11.52	13.17	12.12
13	12.17	12.48	11.47	13.16	12.08	13.85	12.73
14	13.04	13.41	12.18	14.10	12.91	14.82	13.57
15	13.60	13.88	12.75	14.58	13.35	15.35	13.90
16	14.32	14.69	13.47	15.38	13.96	16.04	14.46
17	15.18	15.48	13.97	16.27	14.68	17.01	15.35
18	16.34	16.65	14.96	17.46	15.82	18.26	16.65
19	18.53	18.40	16.37	19.04	16.92	19.67	17.43
20	23.37	23.25	20.56	24.08	21.16	24.69	21.54

TABLE 5.8

FEDERAL INCOME TAX LIABILITY. (billion $)

	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
Ventile							
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.15	0.16	0.00*	0.33	0.00*	0.51	0.00*
3	0.77	0.92	0.19*	1.41	0.40*	2.03	0.85*
4	1.76	2.01	0.99*	2.75	1.56*	3.88	2.62*
5	2.80	3.19	2.30*	4.24	3.51*	5.87	5.10*
6	3.83	4.35	4.00*	5.64	5.39	7.79	7.57
7	4.91	5.60	5.44	7.26	7.16	10.02	9.97
8	6.25	7.15	7.03	9.29	9.17	12.80	12.66
9	7.71	8.81	8.63	11.32	11.08	15.54	15.32
10	9.14	10.46	10.19	13.45	13.16	18.57	18.07
11	10.87	12.50	12.13	16.10	15.61	22.17	21.80
12	12.72	14.56	14.04	18.61	18.16	25.67	25.10
13	14.63	16.82	16.36	21.64	21.04	29.88	29.13
14	17.38	20.03	19.27	25.69	24.91	35.36	34.37
15	20.12	23.06	22.40	29.54	28.63	40.77	39.17
16	23.94	27.61	26.77	35.24	33.87	48.12	46.06
17	29.06	33.23	31.72	42.50	40.61	58.19	55.76
18	36.84	42.19	40.07	53.85	51.68	73.66	71.32
19	52.27	58.22	54.76*	73.23	68.93*	98.65	92.80*
20	108.27	115.37	109.46*	145.90	137.10*	191.09	178.22*
Total	363.41	406.24	385.75	518.00	491.97	700.57	665.88

* - Denotes groups which receive a larger tax cut than the overall average in percentage terms.

TABLE 5.9

INDEX OF VENTILE LIMITS FOR DISPOSABLE PERSONAL INCOME.
(From a "Static" Simulation of the Model)

Ventile	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
1	20.109	20.204	20.077	19.611	19.492	19.490	19.372
2	35.497	35.446	35.395	34.624	34.621	34.264	34.244
3	53.418	53.426	53.282	52.101	52.016	51.616	51.514
4	54.234	54.178	54.383*	53.160	53.402*	52.705	52.850*
5	56.445	56.431	56.752*	55.723	55.936*	55.431	55.522*
6	60.090	60.114	60.170*	59.672	59.551	59.576	59.374
7	64.947	65.090	64.796	64.858	64.462	64.950	64.496
8	69.261	69.447	69.042	69.376	68.894	69.602	69.084
9	74.058	74.273	73.819	74.294	73.814	74.598	74.091
10	79.567	79.886	79.445	80.051	79.588	80.453	79.976
11	85.166	85.571	85.181	85.826	85.409	86.309	85.838
12	92.012	92.461	92.131	92.819	92.431	93.400	92.963
13	99.557	100.104	99.743	100.538	100.121	101.199	100.768
14	108.633	109.224	108.842	109.649	109.229	110.340	109.950
15	120.645	121.444	121.006	121.939	121.566	122.734	122.499
16	135.271	136.205	135.852	136.724	136.500	137.657	137.544
17	154.037	155.082	155.037	155.456	155.359	156.315	156.172
18	182.027	183.551	183.983*	183.911	184.195*	184.484	184.657*
19	244.477	248.858	250.283*	250.091	251.670*	252.149	253.903*
20	18.344	17.906	18.053*	17.982	18.158*	17.720	17.919*

Disposable personal income per capita mean (in $thousands):

12.44 13.64 13.78 16.09 16.27 20.08 20.36

The numbers are indexes (mean=100) of the cutoff income between the ventile shown and the next ventile. Ventile 20 has that group's share of all income.

* Denotes groups made relatively better off by tax reform.

TABLE 5.10

USER COST OF CAPITAL BY INDUSTRY.

	BASE	BASE	REFORM	BASE	REFORM	BASE	REFORM
	1986	1988	1988	1991	1991	1995	1995
Industry	----	----	----	----	----	----	----
1 Agriculture	385.51	390.93	412.07	427.88	450.20	500.63	526.73
2 Crude oil & gas	443.84	447.64	471.77	484.20	509.36	549.05	577.34
3 Mining	492.71	499.49	526.43	545.52	573.93	636.28	669.37
4 Construction	511.95	520.62	548.71	572.24	602.04	672.10	706.98
5 Food, tobacco	424.03	428.57	451.62	465.54	489.76	537.10	564.90
6 Textiles	393.18	396.27	417.67	428.36	450.73	492.57	518.25
7 Knitting	382.59	384.75	405.57	414.52	436.21	474.15	498.94
8 Apparel&textile	407.08	409.03	431.04	439.98	462.86	499.31	525.12
9 Paper	389.12	393.22	414.30	425.96	448.05	490.31	515.62
10 Printing	421.56	423.56	446.41	454.91	478.65	516.19	542.97
11 Ag. fertilizer	387.98	393.81	414.86	428.60	450.79	497.50	523.16
12 Other chemicals	390.02	393.98	415.11	425.46	447.56	487.90	513.14
13 Petrol refining	391.70	394.88	416.06	426.17	448.28	486.30	511.40
14 Rubber, plastic	385.34	386.76	407.66	414.92	436.61	471.72	496.34
15 Shoes, Leather	417.61	416.22	438.68	442.54	465.62	492.57	518.05
16 Lumber	444.21	450.98	475.28	494.89	520.64	579.06	609.01
17 Furniture	424.30	427.82	450.89	463.75	487.91	532.82	560.44
18 Stone,clay,glas	413.10	416.49	438.94	450.54	474.02	517.34	544.22
19 Iron & steel	385.76	389.09	409.97	420.55	442.36	482.78	507.76
20 Non-fer metals	383.60	387.34	408.08	419.63	441.34	483.31	508.24
21 Metal products	404.99	407.67	429.67	440.51	463.47	504.81	531.04
22 Engine, turbine	390.29	387.49	408.40	408.92	430.23	450.54	473.82
23 Ag. machinery	382.21	381.05	401.63	404.63	425.74	451.27	474.69
25 Metalworkg mach	379.03	379.59	400.12	406.29	427.53	460.02	484.04
27 Spec ind mach	388.12	388.80	409.79	416.22	437.94	470.72	495.23
28 Mis n-elec mach	388.38	387.79	408.72	412.83	434.36	462.22	486.21
29 Computrs,office	379.10	379.42	399.77	405.40	426.40	456.24	479.74
30 Servic ind mach	394.21	394.45	415.74	421.36	443.34	474.63	499.32
31 Comm, elec comp	375.41	375.37	395.48	400.18	420.89	448.78	471.87
32 Elec app,distrb	377.41	378.19	398.47	404.72	425.69	457.12	480.71
33 Household appl	400.49	402.94	424.63	434.37	456.98	496.82	522.67
34 Elec light,wire	376.05	377.31	397.59	404.75	425.77	459.66	483.49
35 TV,radio,phono	371.38	370.49	390.33	393.53	413.88	438.28	460.79

TABLE 5.10 (continued)

USER COST OF CAPITAL BY INDUSTRY.

Industry	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
36 Motor vehicles	377.72	378.99	399.51	407.22	428.52	464.74	489.10
37 Aerospace	375.18	372.34	392.41	392.32	412.75	431.44	453.73
38 Ships & boats	387.62	388.52	409.41	415.95	437.58	469.38	493.71
39 Other transp eq	387.90	388.88	409.80	416.38	438.03	469.94	494.31
40 Instruments	401.48	400.77	422.40	426.72	448.95	476.79	501.44
41 Misc mfg.	407.26	408.58	430.65	438.86	461.76	497.92	523.80
42 Railroads	320.59	325.37	342.91	357.89	376.62	419.44	441.49
43 Air transport	538.62	548.98	578.65	611.54	643.76	727.20	766.26
44 Truckg,oth trns	445.36	452.11	476.55	499.10	525.25	585.76	616.55
45 Communic serv	386.42	392.79	413.39	429.07	450.89	501.25	526.53
46 Elec utilities	394.87	400.65	422.01	438.35	460.93	511.97	538.17
47 Gas,water,sewer	416.63	422.13	444.85	457.97	481.91	531.47	559.28
48 Whl & ret trade	489.63	495.13	521.74	539.43	567.47	622.24	654.30
49 Finance & ins	419.13	412.90	435.23	430.53	453.03	463.14	486.94
50 Real estate	419.21	427.04	449.93	470.19	494.63	553.65	582.32
51 Hotels, repairs	475.52	483.22	509.12	530.15	557.75	621.03	653.19
52 Business serv	426.74	422.65	445.47	444.44	467.62	484.67	509.59
53 Auto repair	495.13	503.69	530.85	555.82	584.72	652.00	685.62
54 Movies,amusemts	424.05	430.61	453.75	472.57	497.23	554.53	583.36
55 Medic,educ,npo	441.35	449.07	473.07	489.95	515.38	572.56	602.23

TABLE 5.11
EQUIPMENT INVESTMENT BY INDUSTRY.
(billions of 77$)

Industry	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
All industries	210.08	205.78	200.52	232.43	224.40	254.81	243.66
Ag, min, const	45.63	42.69	41.10	46.82	44.86	52.20	49.71
1 Agriculture	10.53	11.04	10.80	12.99	12.71	14.05	13.66
2 Crude oil & gas	3.75	3.91	3.75	4.68	4.41	5.82	5.40
3 Mining	6.27	6.18	5.87	6.78	6.36	7.26	6.73
4 Construction	25.08	21.56	20.68	22.37	21.39	25.06	23.92
Non-durable goods	29.41	25.87	25.28	28.51	27.66	31.26	30.02
5 Food, tobacco	5.47	5.26	5.12	5.80	5.60	6.74	6.46
6 Textiles	1.29	1.24	1.22	1.37	1.31	1.22	1.16
7 Knitting	0.23	0.19	0.20	0.21	0.21	0.18	0.18
8 Apparel&textile	0.42	0.38	0.38	0.52	0.52	0.49	0.48
9 Paper	4.55	4.06	3.97	4.44	4.34	4.90	4.72
10 Printing	2.49	2.35	2.26	2.54	2.42	2.79	2.62
11 Ag. fertilizer	1.29	1.06	0.99	0.81	0.73	0.90	0.78
12 Other chemicals	8.70	6.73	6.65	7.48	7.38	8.31	8.14
13 Petrol refining	3.00	2.83	2.75	3.19	3.05	3.69	3.47
14 Rubber, plastic	1.78	1.63	1.60	2.02	1.97	1.95	1.90
15 Shoes & leather	0.18	0.13	0.13	0.12	0.12	0.11	0.11
Durable Goods	30.79	28.73	27.95	34.87	33.75	38.38	36.88
16 Lumber	1.59	1.56	1.49	1.55	1.47	1.63	1.52
17 Furniture	0.34	0.33	0.33	0.41	0.40	0.39	0.38
18 Stone,clay,glass	1.74	1.82	1.78	2.11	2.04	2.17	2.08
19 Iron & steel	3.20	2.35	2.28	2.43	2.33	2.47	2.36
20 Non-ferr metals	1.15	0.94	0.93	1.14	1.14	1.40	1.39
21 Metal products	2.35	2.35	2.29	2.72	2.63	2.73	2.62
22 Engine,turbine	0.49	0.45	0.43	0.56	0.53	0.60	0.57
23 Ag. machinery	0.34	0.41	0.40	0.40	0.39	0.47	0.45
25 Metalworkg mach	0.64	0.58	0.56	0.70	0.68	0.75	0.71
27 Spec ind mach	0.29	0.21	0.20	0.26	0.25	0.25	0.24
28 Misc n-elec mach	2.73	2.38	2.23	2.70	2.51	2.74	2.47
29 Computers,office	2.12	2.38	2.29	3.57	3.42	4.95	4.71
30 Service ind mach	0.38	0.30	0.29	0.34	0.34	0.31	0.31
31 Comm, elec comp	3.14	3.17	3.08	4.37	4.23	5.00	4.79
32 Elec appl, distb	0.74	0.66	0.64	0.79	0.78	0.81	0.80
33 Household appl	0.31	0.28	0.28	0.30	0.30	0.27	0.27
34 Elec light, wire	0.63	0.63	0.61	0.76	0.73	0.77	0.74
35 TV, radio, phono	0.08	0.12	0.13	0.19	0.19	0.17	0.17
36 Motor vehicles	5.38	4.57	4.56	5.87	5.82	6.50	6.46
37 Aerospace	1.48	1.29	1.27	1.48	1.44	1.53	1.48
38 Ships & boats	0.05	0.26	0.24	0.24	0.22	0.28	0.25
39 Other transp eq	0.11	0.12	0.12	0.15	0.14	0.15	0.14
40 Instruments	1.12	1.15	1.10	1.37	1.31	1.60	1.51
41 Misc Mfg	0.39	0.41	0.41	0.46	0.46	0.45	0.45

TABLE 5.11 (continued)

EQUIPMENT INVESTMENT BY INDUSTRY.
(billions of 77$)

Industry	BASE 1986	BASE 1988	REFORM 1988	BASE 1991	REFORM 1991	BASE 1995	REFORM 1995
Transportation	12.99	13.17	12.99	15.48	15.03	15.39	14.74
42 Railroads	4.46	4.28	4.19	5.33	5.11	4.88	4.61
43 Air transport	3.99	4.16	4.20	4.97	4.98	5.12	5.14
44 Truckg, oth tran	4.54	4.74	4.59	5.19	4.95	5.39	4.99
Utilities	29.55	31.81	31.52	36.65	35.97	41.25	40.25
45 Communic servic	18.39	20.92	20.73	24.37	23.87	27.14	26.38
46 Elec utilities	7.40	7.31	7.30	8.49	8.46	10.05	10.02
47 Gas, water, sewer	3.76	3.57	3.48	3.80	3.64	4.06	3.85
48 Whl & ret trade	30.12	29.13	27.99	31.28	29.58	32.41	29.95
Fin, ins, real est	11.70	11.99	11.85	12.98	12.70	14.30	13.83
49 Finance & ins	6.68	6.85	6.74	7.42	7.19	8.17	7.80
50 Real estate	5.01	5.14	5.11	5.56	5.51	6.13	6.04
Services	19.04	21.19	20.71	24.40	23.47	27.83	26.52
51 Hotels, repair	2.86	2.86	2.82	2.98	2.90	3.15	3.01
52 Business service	6.11	7.00	6.84	8.61	8.29	10.77	10.23
53 Auto repair	2.32	2.35	2.27	2.79	2.64	3.11	2.92
54 Movies, amusemts	1.94	2.40	2.29	2.61	2.44	2.77	2.57
55 Medic, educ, npo	5.81	6.58	6.50	7.42	7.21	8.04	7.80
Miscellaneous	0.85	1.20	1.14	1.42	1.39	1.80	1.76
56 Personal autos	9.50	9.47	9.47	9.77	9.77	9.92	9.92
57 Sales of used eq	-8.65	-8.27	-8.33	-8.35	-8.38	-8.13	-8.16

TABLE 5.12

THE IMPACT OF TAX REFORM ON SELECTED ECONOMIC VARIABLES.
(Changes in percentages and billion dollars)

Economic Variable	1988		1995	
	pct. ch.	$ ch.	pct.ch.	$ ch.
Gross national product (72$)	+ 0.3	+ 6.1	+ 0.3	+ 5.5
Personal consumption (72$)	+ 0.8	+ 9.5	+ 0.9	+ 13.5
Equipment investment (72$)	- 2.6	- 3.7	- 4.4	- 7.9
Structures (72$)	+ 0.4	+ 0.6	+ 0.1	+ 0.2
Inventory change (72$)	+ 0.2	+ 0.0	- 2.7	- 0.3
Exports (72$)	+ 0.1	+ 0.2	+ 0.2	+ 0.4
Imports (72$)	+ 0.3	+ 0.5	+ 0.2	+ 0.4
Government (72$)	+ 0.0	+ 0.0	+ 0.0	+ 0.0
Unemployment rate (pct.)	- 0.3	---	- 0.3	---
Inflation (GNP Deflator) (pct.)	+ 0.0	---	+ 0.0	---
AAA bond yield (basis points)	+ 2	---	+ 27	---
10 year T-bond yld.(basis points)	+ 3	---	+ 14	---
Savings rate (pct. of disp. inc.)	+ 0.4	---	+ 0.4	---
Labor productivity (index)	+ 0.0	---	+ 0.0	---
Cost of capital (avg.index)	+ 5.4	---	+ 5.2	---
Fed. personal tax revenue (cu$)	- 5.0	-20.5	- 5.0	- 34.7
Disposable personal income (cu$)	+ 1.0	+35.1	+ 1.4	+ 72.6
Corporate profits after tax (cu$)	- 5.0	-12.2	- 1.0	- 3.5
Personal dividend income (cu$)	- 5.8	- 5.2	-17.5	- 20.6

APPENDIX A

THE INFORUM INVESTMENT EQUATIONS.

The INFORUM investment equations have been estimated for 53 industries as part of a joint estimation of investment, employment and energy demand within the framework of a Generalized Leontief Cost Function, (GLCF), also known as the Diewert function. The GLCF was chosen because of its flexibility, and the fact that factor demand equations, such as that for investment, can be derived directly. Joint estimation imposes consistency upon the behavior of factor demands. Thus, if the investment equation for an industry indicates that an increase in the price of labor relative to capital will stimulate investment, the employment equation for that industry will indicate that this same price change will reduce the demand for labor. The equations assume that once investments have been made, businessmen cannot instantly adjust the size of their capital stock to changes in relative prices. For instance, if the relative cost of capital rises, the existing capital stock will not be reduced all at once, but old investment goods will be allowed to depreciate, and new investment in capital can be curtailed. However, investment will respond fairly rapidly to changes in output, since this implies a need for expansion of capacity. This approach results in a set of investment equations that are more sensitive to changes in output in the short run, but that reflect trends in relative prices in the long run (the time it takes to replace old equipment).

The theory underlying these investment equations assumes a well-behaved (twice differentiable, continuous and concave) production function in which output(Q) in each industry can be expressed as a function of the capital stock(K), labor inputs(L) and energy inputs(E):

$$(A.1)\ Q = F(K,\ L,\ E)$$

Associated with this production function is a twice continuous, linearly homogeneous, monotonic and concave cost function. We use the cost function referred to above as the Generalized Leontief Cost Function (GLCF). Microeconomic theory states that from this cost function we can derive a set of factor demand functions for capital, labor and energy. In this framework, factor demands are based on output, relative prices of the three inputs, and a time trend for each input representing productivity growth. The expression for the demand for capital in year t arising from the GLCF is:

$$(A.2)\ K_t = e^{-a_K t} * Q * \{b_{KL}(P_L/P_K)^{.5} + b_{KE}(P_E/P_K)^{.5} + b_{KK}\}$$

where: e = the base of natural logarithms

a_K = time trend for capital productivity

P_L = the price of labor, the wage level

P_K = the price of capital, or cost of capital

P_E = the price of energy

Q = output

b_{Kj} = parameters to be estimated, for j=K, L, E

The b_{Kj}'s determine the degree of complementarity or substitutibility among inputs. If b_{KL} is positive, then capital and labor are substitutes. If b_{KE} is negative, then capital and energy are complements. The time trend, a_K, accounts for all other factors that affect the level of capital required, and which move slowly over time. The form in which output enters the equation imposes constant returns to scale. This means that if the time trend were zero, and relative prices didn't change, a 1% increase in output would be associated with a 1% increases in the optimal capital stock.

The equation determines the optimal capital stock for each industry, based on outputs and relative prices. This demand for an optimal capital stock then translates into a demand for investment, depending on how the current capital stock compares to what is optimal. Total or gross investment can be viewed as consisting of two parts, net investment and replacement investment. Net investment is the net increase or decrease (almost always an increase) in the capital stock and is considered new investment. Replacement investment is funded out of depreciation, and replaces lost capacity due to worn out or obsolete equipment. Capacity is defined here as the ability to produce output, assuming the optimal capital-output ratio. So if the price of labor relative to capital rises, implying an increase in the optimal capital-output ratio, then more capital is required to replace the same amount of lost capacity than if prices had remained constant. It is through this process that relative prices affect the size of the capital stock. The price of capital is determined by the cost of capital formula defined and explained in the text.

Equations for investment, employment and energy demand have been estimated jointly for 55 industries comprising the U.S. economy. Table A.1 displays a summary of the estimated parameters, in the form of price elasticities and elasticities of substitution. The own-price elasticity of capital is displayed in the 1st column. A value of -.335 in AGRICULTURE(1) means that all else equal, a 1% increase in the price of capital will result in a .335% decrease in the optimal capital stock desired by firms (or farms) in the agricultural sector. The 2nd and 3rd columns show the elasticity of capital with respect to prices of labor and energy. A 1% increase in wages relative to the cost of capital in the agriculture sector will result in a .345% increase in the optimal capital stock, and a 1% increase in the price of energy will result in a .010% decrease. In other words, labor and capital are substitutes in this industry, whereas energy and capital are slightly complementary. A quick perusal of the table will indicate that industries vary widely in their responses to changes in the price of capital, labor and energy. CRUDE PETROLEUM(2), MINING(3) and SHIPS AND BOATS(38) show a marked response to the cost of capital and labor, whereas HOUSEHOLD APPLIANCES(33), MOTOR VEHICLES(36) and ELECTRIC UTILITIES(46) show very little response. Most sectors show capital and energy as slight complements. In AGRICULTURAL FERTILIZERS(11), ENGINES & TURBINES(22) and AIR TRANSPORT(43) complementarity is more pronounced, while in STONE, CLAY & GLASS(18) and PETROLEUM REFINING(13), capital and energy are substitutes.

Table A.1 shows the estimated elasticities of investment with respect to the cost of capital and the cross-price elasticities with respect to labor and energy. The last column shows the change in investment by industry between the base and tax reform complete dynamic model simulation.

TABLE A.1

PRICE ELASTICITIES AND SIMULATION RESULTS.

INDUSTRY	PK	PKL	PKE	INVSTMT in '95 bil 77$	% CH. from Cur. Law
1 AGRICULTURE	-0.335	0.345	-0.010	13.66	- 2.8
2 CRUDE PETROLEUM	-0.669	0.674	-0.006	5.40	- 7.2
3 MINING	-0.610	0.707	-0.097	6.73	- 7.3
4 CONSTRUCTION	-0.541	0.519	0.022	23.92	- 4.5
5 FOOD, TOBACCO	-0.539	0.458	0.081	6.46	- 4.2
6 TEXTILES	-0.640	0.638	0.001	1.16	- 4.9
7 KNITTING, HOSIERY	-0.366	0.089	0.277	0.18	- 0.0
8 APPAREL	-0.295	0.322	-0.028	0.48	- 2.0
9 PAPER	-0.274	0.203	0.071	4.72	- 3.7
10 PRINTING	-0.557	0.581	-0.023	2.62	- 6.1
11 AGRI. FERTILIZER	-0.699	0.860	-0.161	0.78	-13.3
12 OTHER CHEMICALS	-0.198	0.163	0.035	8.14	- 2.0
13 PETRO. REFINING	-0.440	0.254	0.186	3.47	- 6.0
14 RUBBER & PLASTIC	-0.244	0.269	-0.025	1.90	- 2.6
15 FOOTWEAR & LEATHER	-0.366	0.398	-0.033	0.11	- 0.0
16 LUMBER	-0.582	0.570	0.012	1.52	- 6.7
17 FURNITURE	-0.168	0.188	-0.021	0.38	- 2.6
18 STONE, CLAY & GLASS	-0.291	0.157	0.134	2.08	- 4.1
19 IRON & STEEL	-0.272	0.376	-0.104	2.36	- 4.5
22 ENGINES & TURBINES	-0.319	0.441	-0.122	0.57	- 5.0
23 AGRI. MACHINERY	-0.204	0.241	-0.038	0.45	- 4.3
25 METALWORKING MACHIN	-0.251	0.279	-0.028	0.71	- 5.3
27 SPECIAL INDUSTRY	-0.221	0.247	-0.025	0.24	- 4.0
28 MISC. NONELEC. MACH	-0.558	0.576	-0.018	2.47	- 9.9
29 COMPUTERS	-0.284	0.334	-0.049	4.71	- 4.8
30 SERVICE IND MACH	-0.025	0.108	-0.083	0.31	- 0.0
31 COMMUNICATIONS MACH	-0.174	0.181	-0.007	4.79	- 4.2
32 HEAVY ELECTRICAL	-0.000	0.012	-0.012	0.80	- 1.2
33 HOUSEHOLD APPLIANCES	0.000	0.028	-0.028	0.27	0.0
34 ELEC. LIGHT & WIR	-0.251	0.276	-0.025	0.74	- 3.9
35 RADIO, T.V. RECEIVER	0.000	0.087	-0.087	0.17	0.0
36 MOTOR VEHICLES	-0.000	0.000	0.000	6.46	- 0.6
37 AEROSPACE	-0.160	0.170	-0.011	1.48	- 3.3
38 SHIPS & BOATS	-0.693	0.687	0.006	0.25	-10.7
39 OTHER TRANS. EQUIP	-0.262	0.281	-0.020	0.14	- 6.7
40 INSTRUMENTS	-0.372	0.435	-0.062	1.51	- 5.6
41 MISC. MFG.	-0.195	0.214	-0.019	0.45	- 0.0

TABLE A.1 (continued)

INDUSTRY	PK	PKL	PKE	INVSTMNT in '95 bil 77$	% CH. from CUR. LAW
42 RAILROADS	-0.202	0.191	0.011	4.61	- 5.5
43 AIR TRANSPORT	0.000	0.132	-0.132	5.14	0.4
44 TRUCKING & OTHER	-0.453	0.404	0.049	4.99	- 7.4
45 COMMUNICATIONS SERV	-0.055	0.054	0.001	26.38	- 2.8
46 ELECTRIC UTILITIES	-0.003	0.001	0.002	10.02	- 0.3
47 GAS, WATER & SANIT	-0.415	0.292	0.124	3.85	- 5.2
48 WHOLESALE & RETAIL	-0.461	0.663	-0.202	29.95	- 7.6
49 FINANCE, INSURANCE	-0.380	0.417	-0.036	7.80	- 4.5
50 REAL ESTATE	-0.201	0.223	-0.023	6.04	- 1.5
51 HOTELS & REPAIRS	-0.389	0.580	-0.191	3.01	- 4.4
52 BUSINESS SERVICE	-0.341	0.440	-0.098	10.23	- 5.0
53 AUTO REPAIR & RENTAL	-0.287	0.336	-0.049	2.92	- 6.1
54 MOVIES & AMUSEMENTS	-0.400	0.505	-0.106	2.57	- 7.2
55 MEDICAL & ED. SERV	-0.058	0.092	-0.034	7.80	- 3.0
TOTAL				243.66	- 4.4

APPENDIX B

THE USER COST OF CAPITAL.

Tax changes directly affect investment through changes in the user cost of capital. The user cost of capital is the return that an investment must earn in order to be profitable; it is the minimum return an asset must yield in order to pay taxes, recoup real depreciation, and cover the interest costs of financing its purchase. Naturally, a higher user cost of capital will tend to depress investment incentives. A profit-maximizing competitive firm will continue to invest until its marginal return to capital is equal to the user cost.

In a tax-free world, the user cost of an infinite lived asset would be the asset's price, P, times the expected market real rate of return, r, which represents the real financing cost of the asset.

$$Pr$$

Of course, actual capital assets decline in value over time, so to recoup this decline in value, the depreciation rate, d, times the price must be added to the user cost leaving:

$$UCC = P(r + d)$$

Now, suppose that a subsidy of C times the price were awarded to the investor. This would have the same effect as lowering the price of the asset ,and therefore the entire user cost by C percent, resulting in the formula:

$$UCC = P(r + d)(1 - C)$$

Think of C as the subsidy provided by the investment tax credit. In the real world, the tax credit can only be applied against tax liabilities, so now the effects of taxes on the user cost of capital must be introduced.

A tax on corporate profits certainly will increase the return an asset must generate in order to pay for itself. If the expenditure on the asset is included in profits, (i. e. not deductible) the user cost must increase by a factor of $1/(1 - T)$, where T is the corporate tax rate. At a tax rate of fifty percent, the before tax rate of return must double in order to pay the taxes. If there is no deductibility, the user cost formula is:

$$UCC = P(r + d)(1 - C)/(1 - T)$$

If the initial expenditure on the asset is fully deductible, the amount of taxes saved is the tax rate times the asset price, so the user cost would be reduced accordingly. Under full deductibility, the formula is:

$$UCC = P(r + d)(1 - C - T)/(1 - T)$$

If half the asset purchase were deductible the tax rate term in the numerator would be multiplied by .5. In the actual corporate tax code the deduction for the purchase is taken in the form of depreciation deductions. Although the full purchase price is eventually deductible, the present discounted value of the deductions is less than the purchase price because it is spread out over the "tax life" of the asset. The present values of the depreciation deductions vary greatly according to the asset's tax life and the discount rate used. Under current law, depreciation is based on historical costs which have not been adjusted for inflation, meaning that the expected nominal interest rate is appropriate for discount, and therefore the expected inflation rate will also greatly affect the present value of depreciation deductions. The present value of the depreciation stream is some fraction, Z, of the original purchase price of the asset, so Z should be multiplied by the tax rate T in the numerator, yielding the final form of the user cost formula:

$$UCC = P(r + d)(1 - TZ - C)/(1 - T)$$

The user cost varies among investing industries because the price of the equipment bought and the economic depreciation varies. Each industry is assumed to perceive the same market rate of return and each faces the same tax rate and investment tax credit. Economic depreciation and the tax depreciation depend on the type of equipment bought. The model simulations take into account the differing values for economic depreciation, but not the tax depreciation. The present value of the depreciation deduction is calculated assuming that all industries invest in equipment that has economy-wide average tax lives. The capital flow data show that this is a reasonable assumption.

Appendix C.

The CES Income Distribution Model.

This appendix describes the work done in fitting a constant elasticity of substitution (CES) function to the Lorenz curve of income distribution. This procedure is identical to the one described in the text up to the point of defining the function in equation 2.5 of Chapter 2. The CES function is depicted below in equation C.1. Kakwani and Podder show that the necessary restrictions of the Lorenz curve are met with the CES production function. Think of T as the "output" and S and ($\sqrt{2}$ - S) as the "factors". The function takes the form:

C.1) $$T = a(dS^{-p}+ (1-d)(\sqrt{2}-S)^{-p})^{-v/p}$$

The parameters are a, d, v, and p, and all must be positive, with 0 <= d <= 1. Their interpretations are analogous to those in the production function literature, and will be discussed later.

Estimation Procedure.

The estimations are done as before, in the cross section with grouped data. One curve is estimated for each household size and each year for which there are data. The data set includes 16 years, 1966 and 1968-1982, and six household sizes, one through five and six and over. There are 96 (6x16) curves estimated in all. The estimation is done as suggested by Kmenta: The equation C.1 is expressed in log form, then a Taylor series expansion of Log T is done around p=0, and the terms which contain p to a power greater than 1 are dropped. The resulting form is a linear approximation of the CES function and is estimated with ordinary least squares. The equation estimated is of the form:

C.2) $$\text{Ln } T = b1 + b2\text{Ln}S + b3\ \text{Ln}(\sqrt{2}-S) + b4(\text{Ln}S - \text{Ln}(\sqrt{2}-S))^2$$

where antilog b1 = a; b2/(b2+b3) = d;

b2+b3 = v; and -2b4(b2+b3)/b2b3 = p.

(See Kmenta p.463)

The data presented in SOI are the amount of AGI and number of people in each income category. The data were adjusted so that there were 21 income categories for each year, so i varies from 1 to 21. Let agi_{thn} and r_{thn} be the amount of income and people in income category n, where the categories, n, are in ascending order according to income. AGI and R are total income and population for each household size. y_{thi} and x_{thi} are the percent cumulations of income and population. As before -

C.3) $$y_{thi} = \sum_{n=1}^{i} agi_{thn}/AGI_{th}$$

C.4) $$x_{thi} = \sum_{n=1}^{i} r_{thn}/R_{th}$$

The 21 S's and T's are generated by applying the x's and y's to the Lorenz curve transformation described in equations M.1 and M.2 from the mathematical appendix. They are used in the regression equation C.2 to estimate the parameters a, d, v & p. The number of data points reported per year varies from 18 to 31 (subscript n) according to the published detail. The observations were consolidated so that each year's data were divided into the same 21 income groups. For example, the data for 1979 thru 1981 have an income group for every thousand dollars between the ten and twenty thousand levels, while the groups for the other years are defined every five thousand dollars over that interval. The data were consolidated because the parameter estimates were affected by the number and distribution of the observations used. Standardizing the data increases confidence that variations in the estimated parameters reflect changes in the income distribution, rather than changes in the grouping of the data. The data were grouped according to the following group boundaries in thousand of dollars: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 50, 100, 200, 500, one million, and one million and over. Note that these numbers are not indexed to inflation. This means that there were more people in the lower groups in the earlier years, and more people in the upper groups in the later years. There is no inherent bias with this because the Lorenz curve is defined in percentage terms. Its just that the data points to which the curves are fit tend to move along the curve as the different years are estimated. Table C.1 shows the results of the estimations of equation C.2.

Once the parameters of the CES function have been estimated, the functional relationship between T and S is defined for each curve. However, the Lorenz curve must be defined in terms of a relationship between x and y. Due to the nature of the CES function and the Lorenz curve transformation, one cannot construct a function relating x to y. It must be solved numerically. This is done by setting up a sufficiently detailed grid relating chosen values of x to the corresponding values of y. Then to get the y corresponding to any x, a linear interpolation is performed between the points established in the grid. The grid was constructed by taking fifty equally spaced values of S (points along the line of equal distribution), and evaluating the function to get the corresponding values of T. The corresponding values for x and y are then easily gotten by equations M.3 and M.4. The segments of the curve between the enumerated points are assumed to be linear. Linear interpolations are performed to obtain the specific points needed. For example, if the desired valuation of x is one-fourth of the way between two values for x established in the grid, then the value for y is taken to be one-fourth of the way between the two grid values for y. The size of fifty for the grid was chosen because it is large enough to give a very good approximation of the curvature of the Lorenz curve despite the use of linear interpolation. Experimentation with more detailed grids of size 100 and 200 did not change the results appreciably.

How well does this function really fit the income distribution data? Table C.1 shows that the parameter estimating equations fit the data very well. However, one must remember that these are the equations relating T to S. Table C.2 shows the results of taking the parameter estimates and constructing Lorenz curves. Then, the points along the horizontal axis, that is, the percentage population points were matched up to points at equally spaced intervals of 5% of the total, and the corresponding percent income points on the vertical axis were found. The first column shows the horizontal coordinates, and the next two columns show the actual and estimated vertical coordinates. The fits appear to be quite good when viewed this way. There is almost never a miss of over one percent, and the miss is usually smallest around the middle where most of the people are.

The third and fourth columns of table C.2 show the same data, but the cumulative percentages of income are converted to dollars of income per interval. The estimation is subtracted from the actual amount and shown as the percent residual in the last column per table. The residuals in dollar terms sum to zero by construction. At first glance, one might not be impressed with the relative size of the residuals. Particularly near the tails of the income distribution, the residuals are sometimes quite large in relation to income. Table C.2 shows the fit for the years 1966, 1970, 1975 and 1981. These years were chosen because of their chronological spacing only, and may be regarded as a representative sample of the procedure's fit for all years.

Unfortunately, the actual data are not reported in the ventile form. To convert the IRS reported data to ventiles in table C.2, a linear interpolation had to be done. The method used was equivalent to assuming that the persons in each interval were uniformly distributed over it, and then the persons were cumulated progressively to form the ventiles. The estimates, however, are results of the estimation procedure described above. In other words, they are derived from the grid constructed with the estimated CES parameters.

Within the Lorenz curve framework, there are many different types of functions which could be used to relate T to S. For example, a Cobb-Douglas function has all the desirable properties of the CES with one less parameter. That form was first estimated, but the CES was found to fit better. The Linear approximation of the CES function which was used in the estimation is identical to the estimation form of the Cobb-Douglas, but has included the substitution term. The substitution parameter was significant in improving the performance of the CES function.

There may be other functional forms which do as well as the CES function. Plotting T against S must yield an inverted U-shaped curve where the slope is never greater than forty five degrees. The obvious function to try to fit to data like this is a polynomial. A second degree polynomial was first tried, but a third degree polynomial fit the data much better.

The alternative was of the form:

$$T = b1 + b2*S + b3*S^2 + b4*S^3$$

This specification is comparable to the CES function in that both estimate four parameters. The polynomial has the disadvantage of not restricting the ends of the estimated Lorenz curve to intersect (0,0) and (1,1), however, the estimated parameters come fairly close to the true end points. Overall, the fit was comparable to that of the CES function, but a careful examination of the residuals (estimated minus actual) of the noncumulated income in each IRS reported income interval reveals the superiority of the CES function.

The estimation of the cubic function yields high R-squared values, and estimates of b1 close to zero, indicating that the curve begins as it should, near the origin. The estimation of the cubic function and its reasonable fit to the data shows the flexibility of the approach taken for modeling the income distribution. There are, of course, many additional functional forms that could have been tried but were not. It would be worthwhile to continue trying different forms, but one should not judge the form by its ability to fit the data alone. The CES function has other desirable properties as well. 1) It is relatively easy to estimate its linear approximation with ordinary least squares. 2) The form assures that the estimated Lorenz curve has all the correct properties, such as always sloping upwards, and beginning and ending in the corners as it should. 3) The parameters of the CES funtion have economic interpretations. However, as we shall see, the interpretation sometimes are not independent of one another, and therefore there is some ambiguity. The deviations from base function used and presented in the text avoids these ambiguities in the interpretation of the parameters. In addition, it was judged to be more elegant and simple, and it fit the data better with fewer parameters and therefore was chosen over the CES form.

Interpretation of the Parameters of the CES Function.

The parameters of the CES function (equation 2) can now be interpreted. In the production function literature, the parameters have the following interpretation:

a is the efficiency parameter.

d is the distribution parameter.

v is the returns-to-scale parameter.

p is the substitution parameter.

In a CES production function, output corresponds to the length T, which is a measure of inequality, while the inputs capital and labor correspond to S and $\sqrt{2}$-S which is the position of point D along the line of equal distribution, that is, how far up the income scale the function is being evaluated.

Making general statements about the equality or lack of equality of a particular income distribution is hazardous. Only in a very few special cases can it be said without controversy that one distribution is "more equal" than another. A convention will be adopted here, regarding the use of the term "equality," with the realization that it may not conform to other notions of equality. From here on, an income distribution will be referred to as "more equal" over a certain range of income if the length of the construct "T" of the Lorenz curve is on average shorter over that income range.

The parameter "a" indicates the efficiency of the inputs in producing the output, so therefore, a ceteris paribus increase in "a" would result in a longer length T, that is, a more bowed Lorenz curve. The more bowed the curve, the less equal the income distribution. Of the coefficients estimated in the equations (3), only b1 affects the size of "a," since a = antilog b1.

The returns-to-scale parameter, v, also affects how much the curve bows out. Because v enters the CES function with a negative sign, the curve bows out less as v increases, and vice versa. As the sum of b2 and b3, v will increase when either of those coefficients increase. However, the parameters s and p also vary with b2 and b3, so their effect on the shape of the curve can be ambiguous with regard to the overall equality of the income distribution.

The distribution parameter, d, is a measure of skewness of the function. If d is greater than 1/2, the Lorenz curve is skewed towards (1,1), meaning that the upper end of the distribution is more unequal than the lower end. As shown in the table below, d varies directly with b2 and inversely with b3. Because both b2 and b3 affect the values of both d and v, their effects on the equality of the income distribution depend on the location in that distribution.

Finally, p, the substitution parameter would measure at what ratios capital and labor could be substituted for one another while keeping output constant. There is no direct analogy to this concept with the Lorenz curve since there can be no "isoquant" along which T is kept constant. However, changes in p do make differences in the shape of the

Lorenz curve. For example, as p increases (decreases), the distribution becomes more equal (unequal) at each end of the distribution, while not being affected much in the middle. The parameter p varies inversely with b2, b3, and b4.

$a = \text{antilog } b1 \qquad d = b2/(b2 + b3)$

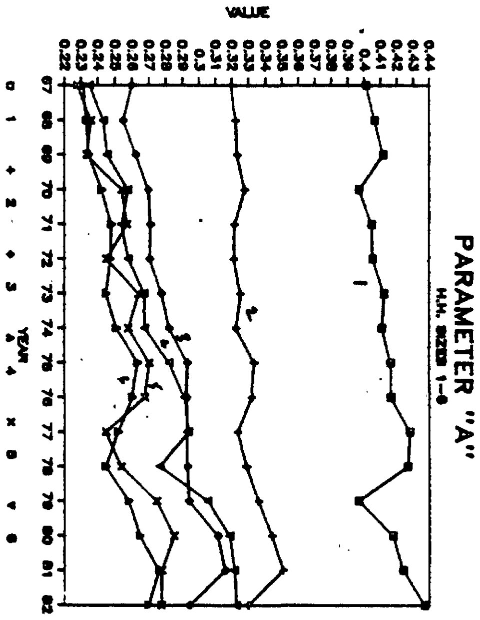
$v = b2 + b3 \qquad p = -2b4(b2 + b3)/b2b3$

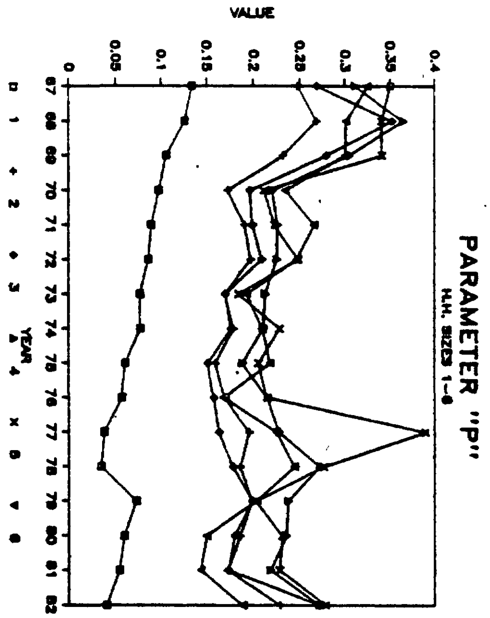
with respect to:	Partial Derivatives a	d	v	p
b1	$e^{b1}(+)$	0	0	0
b2	0	$b3/(b2+b3)^2(+)$	1	$2b4/b2^2(-)$
b3	0	$-b2/(b2+b3)^2(-)$	1	$2b4/b3^2(-)$
b4	0	0	0	$-2(b2+b3)/b2b3\ (-)$

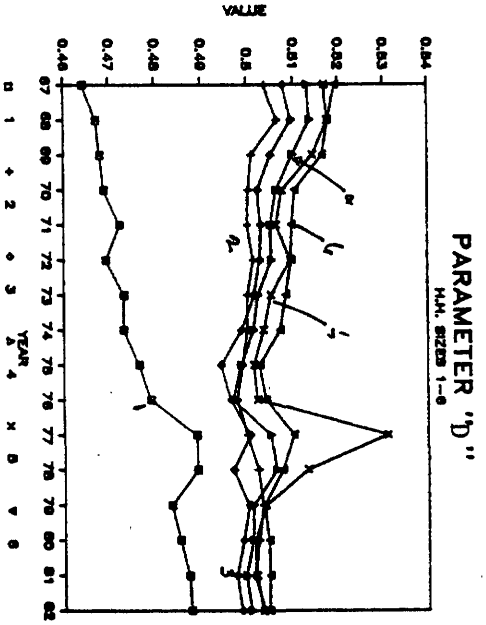
The parameters b1 thru b4 have been estimated for 16 years of data at 6 household sizes. Cyclical or secular changes in these numbers are of considerable interest because once they are converted into the CES function parameters they allow inferences about movements in the income distribution over time. Figures C.1 to C.4 show the historical pattern of change in those parameters. Parameter "a", while having been relatively trendless for household size two, has been rising, especially in the larger household sizes, indicating a trend towards more unequal distributions. The v parameter shows an upward trend for all household sizes, indicating that the trend evident from the efficiency parameter is somewhat offset. The movements in parameter "d" would seem to indicate that the small asymetry in the Lorenz curves is being diminished. The decline in parameter "p" means that the income distribution is getting less equal within both the top and bottom end of

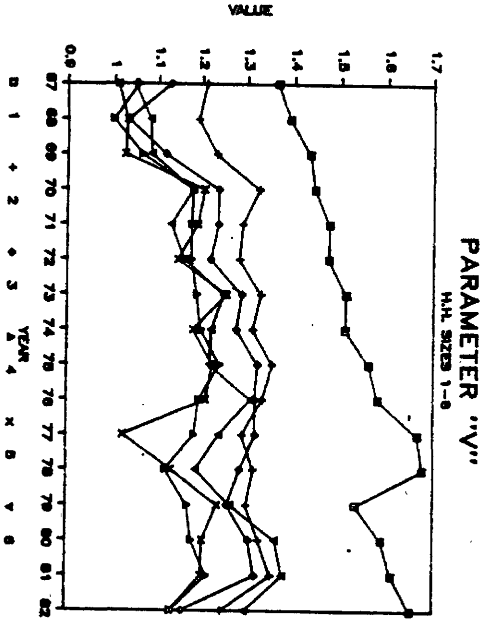
FIGURES C.1-4

TIME SERIES OF PARAMETERS A,D,V,AND P.









the income scale.

Because of the interaction of the four parameters on the shape of the curve, the trends in the parameters do not necessarily reflect unambiguous changes in the equality of the distribution. This especially holds true here, where the trends in "a" and "v" offset one another in terms of equality. Again, it is not easy to generalize about the equality of income distributions, but based on the same concepts discussed previously, some observations can be made. Enumerating the income distributions defined by the estimated parameters reveals that for household size one, AGI has been becoming more equally distributed over the sample period, especially at the bottom end. Household size two has also been getting more equal, but the trend is very small. The AGIs of the other household sizes have been getting slightly less equally distributed, however.

These time-series of parameters offer a special opportunity to study trends in the distribution of AGI. Of special interest is what affects the income distribution, and how it can be forecast. The most important determinants of income distribution are institutional in nature, and are very difficult, if not impossible to capture in an econometric model. It was hypothesized that some cyclical and secular economic variables have an effect on the Lorenz curve parameters. The variables thought to have an effect are the unemployment rate, the inflation rate, and the percent of personal income made up of interest and dividends.

A higher unemployment rate would be expected to make the income distribution more unequal. The people holding on to their jobs will continue earning their usual incomes, while those laid off will have significant income cuts. Furthermore, these effects will be most pronounced at the lower end of the income distribution because most layoffs occur at the low end of the wage scale, and the laid off person will most likely end up in the lower income ventiles. Thus, a higher unemployment rate would be expected to have a positive influence on the efficiency parameter and a negative influence on the other three. The regression results are shown in table C.3. The unemployment rate had the expected signs for parameter "a" except for household size two where the coefficient was nearly zero. The signs were correct on the distribution parameter except for household size one. The signs were all as expected for the substitution parameter. However, the signs were not as expected for the returns-to-scale parameter, offsetting the effect from the efficiency parameter.

The percent of income mede up of interest and dividends is measured in the aggregate, not according to income ventile. So, while it is true that some lower income households, such as those headed by retirees, have a large share of their income from assets, the aggregate nature of the variable means that it is measuring income which is accruing primarily to households in the upper ventiles. Thus, an increase in this variable will tend to exacerbate the inequality of the income distribution as a whole. The influence on parameter a should be positive, and on parameter v, it should be negative. These signs are indeed the results of the regression equations, except for parameter v, household sizes one and six. More income in the form of interest and dividends will tend to make the lower end of the distributions more equal, since it brings up the income of retirees more to the levels of the working poor. At the same time the upper end will be made more unequal as the high asset dominated incomes pull further away from high earned incomes. Therefore the expected sign for this variable on parameter d is positive, as the distribution becomes more skewed towards the upper end, while for parameter p, there is no a priori expectation, as the two ends are changing in opposite direction in terms of their equality. All the estimated coefficients for parameter s have the expected sign, while parameter p has one zero, four positive, and one negative coefficient.

The inflation rate is expected to influence the distribution of income because, due to institutional factors, some incomes are fixed, or not tied in any way to the general price level. These incomes will tend to fall behind in inflationary periods, making the distribution more skewed (assuming that persons on fixed incomes also occupy the lower end of the distribution). While it is true that the distribution would also become more skewed in disinflationary periods, no such periods occurred during the sample . At a stable price level, fixed and indexed incomes will not change relative to each other, so a more equal distribution would be expected. Thus the expected influence on parameters a and v are positive and negative, respectively. They turned out to be positive for both (except for parameter a, household size 1). To the extent that fixed incomes are at the lower end of the distribution, one would expect the inflation rate to influence parameters s and p in a negative way. This turns out to be the case, with one statistically insignificant exception.

The expectations of the signs in general were pretty much borne out by the regressions, except for the signs on the returns-to-scale parameter, v. Only the share of income in dividends and interest influences v in the expected direction. Even the historical time-series are somewhat paradoxical in that "a" and v exhibit trends which send conflicting signals about changes in the overall equality of the income distribution.

The unemployment rate and inflation rate have both been rising over the sample period, and are most responsible for explaining the trends of the parameters. These results are not inconsistent with the conclusion drawn in Chapter 2, with the possible exception of the inflation rate which did not have a statistically significant effect on the parameters in the functional form used there. Again here, it is interesting to note the differences in income distribution among the various household sizes. Single person households seem to be the most diverse, while households of five seem to have the most uniform incomes.

TABLE C.1

ESTIMATION RESULTS OF THE CES INCOME DISTRIBUTION MODEL.

```
YEAR  1967   HH SIZE  1  : YEAR  1967    HH SIZE 2  : YEAR  1967    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9997 : RSQ 0. 9997 RBARSQ 0. 9996 : RSQ 0. 9998 RBARSQ 0. 9997
RHO 0. 5824 AAPE    0. 9773 : RHO 0. 6756 AAPE    0. 8384 : RHO 0. 6241 AAPE    0. 7295
B1 -0. 9131 T-STAT -31. 39 : B1 -1. 1401 T-STAT -47. 10 : B1 -1. 3477 T-STAT -61. 32
B2  0. 6338 T-STAT  17. 31 : B2  0. 6096 T-STAT  24. 83 : B2  0. 5729 T-STAT  28. 81
B3  0. 7312 T-STAT  26. 82 : B3  0. 6005 T-STAT  24. 03 : B3  0. 5552 T-STAT  27. 08
B4 -0. 0228 T-STAT  -6. 68 : B4 -0. 0375 T-STAT -11. 18 : B4 -0. 0379 T-STAT -15. 15

YEAR  1967   HH SIZE  4  : YEAR  1967    HH SIZE 5  : YEAR  1967    HH SIZE 6
RSQ 0. 9998 RBARSQ 0. 9997 : RSQ 0. 9993 RBARSQ 0. 9992 : RSQ 0. 9989 RBARSQ 0. 9987
RHO 0. 5662 AAPE    0. 6192 : RHO 0. 6736 AAPE    1. 0601 : RHO 0. 7160 AAPE    1. 4023
B1 -1. 4634 T-STAT -59. 90 : B1 -1. 4793 T-STAT -37. 01 : B1 -1. 4476 T-STAT -29. 31
B2  0. 5411 T-STAT  24. 90 : B2  0. 5219 T-STAT  14. 55 : B2  0. 5435 T-STAT  12. 49
B3  0. 5132 T-STAT  22. 74 : B3  0. 4873 T-STAT  12. 98 : B3  0. 5029 T-STAT  10. 98
B4 -0. 0409 T-STAT -15. 02 : B4 -0. 0442 T-STAT  -9. 64 : B4 -0. 0424 T-STAT  -7. 74

YEAR  1968   HH SIZE  1  : YEAR  1968    HH SIZE 2  : YEAR  1968    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9997 : RSQ 0. 9998 RBARSQ 0. 9997 : RSQ 0. 9999 RBARSQ 0. 9998
RHO 0. 6161 AAPE    1. 0615 : RHO 0. 6921 AAPE    0. 7039 : RHO 0. 5826 AAPE    0. 5173
B1 -0. 9001 T-STAT -30. 35 : B1 -1. 1321 T-STAT -50. 93 : B1 -1. 3675 T-STAT -73. 33
B2  0. 6497 T-STAT  17. 77 : B2  0. 6033 T-STAT  26. 03 : B2  0. 5250 T-STAT  28. 99
B3  0. 7408 T-STAT  26. 20 : B3  0. 5881 T-STAT  24. 78 : B3  0. 5055 T-STAT  27. 15
B4 -0. 0218 T-STAT  -6. 08 : B4 -0. 0400 T-STAT -12. 18 : B4 -0. 0453 T-STAT -18. 56

YEAR  1968   HH SIZE  4  : YEAR  1968    HH SIZE 5  : YEAR  1968    HH SIZE 6
RSQ 0. 9997 RBARSQ 0. 9997 : RSQ 0. 9989 RBARSQ 0. 9987 : RSQ 0. 9983 RBARSQ 0. 9980
RHO 0. 5864 AAPE    0. 5778 : RHO 0. 7552 AAPE    1. 3099 : RHO 0. 7828 AAPE    1. 6547
B1 -1. 4563 T-STAT -56. 31 : B1 -1. 4442 T-STAT -26. 46 : B1 -1. 4131 T-STAT -20. 87
B2  0. 5126 T-STAT  21. 29 : B2  0. 5325 T-STAT  10. 36 : B2  0. 5595 T-STAT   8. 80
B3  0. 4852 T-STAT  19. 60 : B3  0. 4962 T-STAT   9. 51 : B3  0. 5211 T-STAT   8. 05
B4 -0. 0455 T-STAT -14. 47 : B4 -0. 0437 T-STAT  -6. 55 : B4 -0. 0406 T-STAT  -4. 95

YEAR  1969   HH SIZE  1  : YEAR  1969    HH SIZE 2  : YEAR  1969    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9996 : RSQ 0. 9996 RBARSQ 0. 9996 : RSQ 0. 9998 RBARSQ 0. 9998
RHO 0. 6439 AAPE    1. 0965 : RHO 0. 7301 AAPE    0. 8282 : RHO 0. 7367 AAPE    0. 6008
B1 -0. 8875 T-STAT -29. 19 : B1 -1. 1294 T-STAT -39. 81 : B1 -1. 3381 T-STAT -61. 57
B2  0. 6710 T-STAT  18. 06 : B2  0. 6175 T-STAT  21. 09 : B2  0. 5637 T-STAT  27. 13
B3  0. 7625 T-STAT  25. 86 : B3  0. 6152 T-STAT  20. 41 : B3  0. 5527 T-STAT  25. 77
B4 -0. 0189 T-STAT  -4. 99 : B4 -0. 0357 T-STAT  -8. 61 : B4 -0. 0390 T-STAT -14. 06

YEAR  1969   HH SIZE  4  : YEAR  1969    HH SIZE 5  : YEAR  1969    HH SIZE 6
RSQ 0. 9999 RBARSQ 0. 9998 : RSQ 0. 9993 RBARSQ 0. 9992 : RSQ 0. 9990 RBARSQ 0. 9988
RHO 0. 4483 AAPE    0. 4131 : RHO 0. 7571 AAPE    1. 0431 : RHO 0. 7894 AAPE    1. 2610
B1 -1. 4496 T-STAT -72. 51 : B1 -1. 4550 T-STAT -32. 33 : B1 -1. 4047 T-STAT -25. 45
B2  0. 5418 T-STAT  29. 57 : B2  0. 5265 T-STAT  12. 61 : B2  0. 5598 T-STAT  10. 64
B3  0. 5209 T-STAT  27. 67 : B3  0. 4971 T-STAT  11. 48 : B3  0. 5241 T-STAT   9. 81
B4 -0. 0404 T-STAT -17. 16 : B4 -0. 0436 T-STAT  -7. 95 : B4 -0. 0406 T-STAT  -5. 89

YEAR  1970   HH SIZE  1  : YEAR  1970    HH SIZE 2  : YEAR  1970    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9996 : RSQ 0. 9998 RBARSQ 0. 9997 : RSQ 0. 9999 RBARSQ 0. 9998
RHO 0. 6530 AAPE    1. 1421 : RHO 0. 7147 AAPE    0. 7462 : RHO 0. 6732 AAPE    0. 5654
B1 -0. 9238 T-STAT -31. 48 : B1 -1. 1153 T-STAT -50. 19 : B1 -1. 3107 T-STAT -71. 13
B2  0. 6773 T-STAT  19. 81 : B2  0. 6634 T-STAT  30. 82 : B2  0. 6215 T-STAT  38. 05
B3  0. 7667 T-STAT  27. 96 : B3  0. 6628 T-STAT  29. 66 : B3  0. 6161 T-STAT  35. 92
B4 -0. 0175 T-STAT  -5. 16 : B4 -0. 0287 T-STAT  -9. 98 : B4 -0. 0303 T-STAT -14 70
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TABLE C.1 (continued)

```
YEAR  1970   HH SIZE  4  ! YEAR  1970    HH SIZE 5  ! YEAR  1970    HH SIZE 6
RSQ 0. 9999 RBARSQ 0. 9999 ! RSQ 0. 9998 RBARSQ 0. 9997 ! RSQ 0. 9995 RBARSQ 0. 9994
RHO 0. 5032 AAPE    0. 3734 ! RHO 0. 5850 AAPE    0. 6868 ! RHO 0. 6904 AAPE    0. 9193
B1 -1. 4176 T-STAT -88. 33 ! B1 -1. 3709 T-STAT -50. 98 ! B1 -1. 3567 T-STAT -34. 04
B2  0. 5969 T-STAT  44. 06 ! B2  0. 6119 T-STAT  26. 96 ! B2  0. 6014 T-STAT  16. 60
B3  0. 5822 T-STAT  40. 80 ! B3  0. 5939 T-STAT  24. 65 ! B3  0. 5771 T-STAT  15. 36
B4 -0. 0325 T-STAT -19. 69 ! B4 -0. 0319 T-STAT -11. 51 ! B4 -0. 0345 T-STAT  -7. 51

YEAR  1971   HH SIZE  1  ! YEAR  1971    HH SIZE 2  ! YEAR  1971    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9997 ! RSQ 0. 9998 RBARSQ 0. 9998 ! RSQ 0. 9999 RBARSQ 0. 9998
RHO 0. 6727 AAPE    1. 1168 ! RHO 0. 7103 AAPE    0. 6622 ! RHO 0. 7064 AAPE    0. 5297
B1 -0. 9045 T-STAT -33. 02 ! B1 -1. 1341 T-STAT -52. 96 ! B1 -1. 3063 T-STAT -70. 24
B2  0. 6972 T-STAT  22. 15 ! B2  0. 6453 T-STAT  30. 65 ! B2  0. 6219 T-STAT  36. 83
B3  0. 7787 T-STAT  30. 31 ! B3  0. 6454 T-STAT  29. 35 ! B3  0. 6147 T-STAT  34. 80
B4 -0. 0164 T-STAT  -5. 16 ! B4 -0. 0308 T-STAT -10. 66 ! B4 -0. 0308 T-STAT -14. 20

YEAR  1971   HH SIZE  4  ! YEAR  1971    HH SIZE 5  ! YEAR  1971    HH SIZE 6
RSQ 0. 9999 RBARSQ 0. 9999 ! RSQ 0. 9998 RBARSQ 0. 9997 ! RSQ 0. 9994 RBARSQ 0. 9993
RHO 0. 4479 AAPE    0. 3337 ! RHO 0. 5858 AAPE    0. 5932 ! RHO 0. 7630 AAPE    0. 9530
B1 -1. 3947 T-STAT -99. 55 ! B1 -1. 3586 T-STAT -54. 74 ! B1 -1. 3715 T-STAT -33. 16
B2  0. 5935 T-STAT  48. 64 ! B2  0. 6026 T-STAT  27. 72 ! B2  0. 5753 T-STAT  15. 05
B3  0. 5820 T-STAT  45. 45 ! B3  0. 5879 T-STAT  25. 52 ! B3  0. 5537 T-STAT  13. 83
B4 -0. 0332 T-STAT -21. 80 ! B4 -0. 0331 T-STAT -12. 05 ! B4 -0. 0375 T-STAT  -7. 45

YEAR  1972   HH SIZE  1  ! YEAR  1972    HH SIZE 2  ! YEAR  1972    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9997 ! RSQ 0. 9998 RBARSQ 0. 9998 ! RSQ 0. 9998 RBARSQ 0. 9998
RHO 0. 6433 AAPE    1. 0987 ! RHO 0. 7288 AAPE    0. 6340 ! RHO 0. 7061 AAPE    0. 5718
B1 -0. 9030 T-STAT -32. 70 ! B1 -1. 1355 T-STAT -52. 79 ! B1 -1. 3083 T-STAT -62. 43
B2  0. 6920 T-STAT  21. 91 ! B2  0. 6434 T-STAT  29. 90 ! B2  0. 6132 T-STAT  32. 12
B3  0. 7823 T-STAT  29. 58 ! B3  0. 6400 T-STAT  28. 45 ! B3  0. 6066 T-STAT  30. 32
B4 -0. 0158 T-STAT  -4. 75 ! B4 -0. 0317 T-STAT -10. 54 ! B4 -0. 0319 T-STAT -12. 90

YEAR  1972   HH SIZE  4  ! YEAR  1972    HH SIZE 5  ! YEAR  1972    HH SIZE 6
RSQ 0. 9999 RBARSQ 0. 9999 ! RSQ 0. 9997 RBARSQ 0. 9996 ! RSQ 0. 9995 RBARSQ 0. 9994
RHO 0. 4328 AAPE    0. 3353 ! RHO 0. 7042 AAPE    0. 7314 ! RHO 0. 7845 AAPE    0. 8918
B1 -1. 3971 T-STAT -93. 72 ! B1 -1. 4061 T-STAT -44. 11 ! B1 -1. 3557 T-STAT -33. 32
B2  0. 5941 T-STAT  46. 05 ! B2  0. 5832 T-STAT  20. 95 ! B2  0. 5910 T-STAT  15. 88
B3  0. 5820 T-STAT  42. 81 ! B3  0. 5617 T-STAT  19. 09 ! B3  0. 5690 T-STAT  14. 63
B4 -0. 0331 T-STAT -20. 49 ! B4 -0. 0355 T-STAT -10. 05 ! B4 -0. 0357 T-STAT  -7. 32

YEAR  1973   HH SIZE  1  ! YEAR  1973    HH SIZE 2  ! YEAR  1973    HH SIZE 3
RSQ 0. 9997 RBARSQ 0. 9997 ! RSQ 0. 9997 RBARSQ 0. 9997 ! RSQ 0. 9998 RBARSQ 0. 9998
RHO 0. 6548 AAPE    1. 0873 ! RHO 0. 7277 AAPE    0. 7887 ! RHO 0. 6527 AAPE    0. 6166
B1 -0. 8863 T-STAT -34. 21 ! B1 -1. 1234 T-STAT -45. 63 ! B1 -1. 2819 T-STAT -63. 31
B2  0. 7155 T-STAT  24. 57 ! B2  0. 6651 T-STAT  28. 17 ! B2  0. 6463 T-STAT  37. 14
B3  0. 7961 T-STAT  32. 69 ! B3  0. 6651 T-STAT  26. 77 ! B3  0. 6428 T-STAT  34. 76
B4 -0. 0145 T-STAT  -4. 84 ! B4 -0. 0283 T-STAT  -8. 90 ! B4 -0. 0274 T-STAT -12. 71

YEAR  1973   HH SIZE  4  ! YEAR  1973    HH SIZE 5  ! YEAR  1973    HH SIZE 6
RSQ 0. 9999 RBARSQ 0. 9999 ! RSQ 0. 9998 RBARSQ 0. 9997 ! RSQ 0. 9995 RBARSQ 0. 9994
RHO 0. 4308 AAPE    0. 3923 ! RHO 0. 5445 AAPE    0. 5797 ! RHO 0. 7912 AAPE    0. 9018
B1 -1. 4073 T-STAT -82. 52 ! B1 -1. 3329 T-STAT -51. 71 ! B1 -1. 3200 T-STAT -33. 22
B2  0. 5968 T-STAT  41. 93 ! B2  0. 6347 T-STAT  29. 22 ! B2  0. 6348 T-STAT  17. 92
B3  0. 5913 T-STAT  38. 81 ! B3  0. 6219 T-STAT  27. 51 ! B3  0. 6141 T-STAT  16. 49
B4 -0. 0315 T-STAT -17. 91 ! B4 -0. 0290 T-STAT -11. 07 ! B4 -0. 0301 T-STAT  -6. 64
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TABLE C.1 (continued)

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YEAR  1974   HH SIZE  1  ! YEAR  1974    HH SIZE 2  ! YEAR  1974    HH SIZE 3
RSQ 0.9997 RBARSQ 0.9997 ! RSQ 0.9998 RBARSQ 0.9997 ! RSQ 0.9997 RBARSQ 0.9997
RHO 0.6528 AAPE   1.0502 ! RHO 0.7177 AAPE   0.7683 ! RHO 0.7146 AAPE   0.8185
B1 -0.8894 T-STAT -34.73 ! B1 -1.1312 T-STAT -46.96 ! B1 -1.2651 T-STAT -48.53
B2  0.7143 T-STAT  25.19 ! B2  0.6564 T-STAT  28.17 ! B2  0.6370 T-STAT  27.82
B3  0.7953 T-STAT  32.58 ! B3  0.6566 T-STAT  26.65 ! B3  0.6405 T-STAT  26.13
B4 -0.0145 T-STAT  -4.78 ! B4 -0.0293 T-STAT  -9.22 ! B4 -0.0282 T-STAT  -9.61

YEAR  1974   HH SIZE  4  ! YEAR  1974    HH SIZE 5  ! YEAR  1974    HH SIZE 6
RSQ 0.9999 RBARSQ 0.9999 ! RSQ 0.9999 RBARSQ 0.9999 ! RSQ 0.9997 RBARSQ 0.9996
RHO 0.6034 AAPE   0.4839 ! RHO 0.4171 AAPE   0.3767 ! RHO 0.7003 AAPE   0.7333
B1 -1.3828 T-STAT -74.06 ! B1 -1.3556 T-STAT -72.31 ! B1 -1.3188 T-STAT -41.89
B2  0.6004 T-STAT  37.96 ! B2  0.5941 T-STAT  36.24 ! B2  0.6195 T-STAT  22.54
B3  0.5973 T-STAT  35.36 ! B3  0.5859 T-STAT  33.45 ! B3  0.6025 T-STAT  20.51
B4 -0.0315 T-STAT -15.93 ! B4 -0.0336 T-STAT -15.95 ! B4 -0.0320 T-STAT  -9.10

YEAR  1975   HH SIZE  1  ! YEAR  1975    HH SIZE 2  ! YEAR  1975    HH SIZE 3
RSQ 0.9997 RBARSQ 0.9996 ! RSQ 0.9996 RBARSQ 0.9996 ! RSQ 0.9997 RBARSQ 0.9996
RHO 0.6693 AAPE   1.1107 ! RHO 0.7643 AAPE   0.9555 ! RHO 0.7217 AAPE   0.9018
B1 -0.8758 T-STAT -31.17 ! B1 -1.0984 T-STAT -36.70 ! B1 -1.2269 T-STAT -44.39
B2  0.7432 T-STAT  24.30 ! B2  0.6757 T-STAT  23.11 ! B2  0.6543 T-STAT  27.50
B3  0.8163 T-STAT  29.80 ! B3  0.6788 T-STAT  21.91 ! B3  0.6693 T-STAT  25.95
B4 -0.0119 T-STAT  -3.43 ! B4 -0.0271 T-STAT  -6.73 ! B4 -0.0251 T-STAT  -8.25

YEAR  1975   HH SIZE  4  ! YEAR  1975    HH SIZE 5  ! YEAR  1975    HH SIZE 6
RSQ 0.9998 RBARSQ 0.9998 ! RSQ 0.9998 RBARSQ 0.9998 ! RSQ 0.9999 RBARSQ 0.9999
RHO 0.6916 AAPE   0.6356 ! RHO 0.4727 AAPE   0.5261 ! RHO 0.3500 AAPE   0.3151
B1 -1.3340 T-STAT -58.05 ! B1 -1.3084 T-STAT -62.78 ! B1 -1.2650 T-STAT -71.81
B2  0.6187 T-STAT  31.29 ! B2  0.6142 T-STAT  34.37 ! B2  0.6123 T-STAT  38.26
B3  0.6222 T-STAT  29.07 ! B3  0.6108 T-STAT  31.83 ! B3  0.6061 T-STAT  35.41
B4 -0.0293 T-STAT -11.56 ! B4 -0.0315 T-STAT -13.96 ! B4 -0.0332 T-STAT -15.66

YEAR  1976   HH SIZE  1  ! YEAR  1976    HH SIZE 2  ! YEAR  1976    HH SIZE 3
RSQ 0.9997 RBARSQ 0.9996 ! RSQ 0.9996 RBARSQ 0.9995 ! RSQ 0.9996 RBARSQ 0.9995
RHO 0.6751 AAPE   1.1106 ! RHO 0.7672 AAPE   0.9663 ! RHO 0.7687 AAPE   0.9484
B1 -0.8761 T-STAT -32.02 ! B1 -1.1037 T-STAT -34.00 ! B1 -1.2295 T-STAT -38.85
B2  0.7565 T-STAT  26.13 ! B2  0.6642 T-STAT  20.75 ! B2  0.6546 T-STAT  23.57
B3  0.8225 T-STAT  31.07 ! B3  0.6701 T-STAT  19.72 ! B3  0.6640 T-STAT  22.15
B4 -0.0112 T-STAT  -3.39 ! B4 -0.0283 T-STAT  -6.33 ! B4 -0.0260 T-STAT  -7.26

YEAR  1976   HH SIZE  4  ! YEAR  1976    HH SIZE 5  ! YEAR  1976    HH SIZE 6
RSQ 0.9997 RBARSQ 0.9996 ! RSQ 0.9999 RBARSQ 0.9999 ! RSQ 0.9999 RBARSQ 0.9998
RHO 0.7859 AAPE   0.7442 ! RHO 0.3666 AAPE   0.4550 ! RHO 0.4301 AAPE   0.4280
B1 -1.3473 T-STAT -46.42 ! B1 -1.3188 T-STAT -71.90 ! B1 -1.2335 T-STAT -61.99
B2  0.5933 T-STAT  23.26 ! B2  0.6076 T-STAT  37.98 ! B2  0.6597 T-STAT  37.70
B3  0.6007 T-STAT  21.88 ! B3  0.6024 T-STAT  35.21 ! B3  0.6492 T-STAT  35.72
B4 -0.0320 T-STAT  -9.64 ! B4 -0.0324 T-STAT -15.82 ! B4 -0.0277 T-STAT -12.57

YEAR  1977   HH SIZE  1  ! YEAR  1977    HH SIZE 2  ! YEAR  1977    HH SIZE 3
RSQ 0.9993 RBARSQ 0.9992 ! RSQ 0.9994 RBARSQ 0.9993 ! RSQ 0.9993 RBARSQ 0.9991
RHO 0.4166 AAPE   1.4776 ! RHO 0.6250 AAPE   0.9937 ! RHO 0.7280 AAPE   1.1527
B1 -0.8489 T-STAT -20.35 ! B1 -1.1282 T-STAT -29.58 ! B1 -1.2274 T-STAT -28.94
B2  0.8144 T-STAT  18.37 ! B2  0.6452 T-STAT  16.86 ! B2  0.6602 T-STAT  17.45
B3  0.8511 T-STAT  20.77 ! B3  0.6454 T-STAT  15.85 ! B3  0.6590 T-STAT  15.97
B4 -0.0079 T-STAT  -1.53 ! B4 -0.0315 T-STAT  -5.75 ! B4 -0.0269 T-STAT  -5.34
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TABLE C.1 (continued)

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YEAR  1977   HH SIZE  4  ¦ YEAR  1977   HH SIZE 5  ¦ YEAR  1977   HH SIZE 6
RSQ 0.9998 RBARSQ 0.9997 ¦ RSQ 0.9984 RBARSQ 0.9981 ¦ RSQ 0.9997 RBARSQ 0.9997
RHO 0.5934 AAPE   0.6279 ¦ RHO 0.6532 AAPE   1.4338 ¦ RHO 0.4906 AAPE   0.6292
B1 -1.3790 T-STAT -52.79 ¦ B1 -1.4080 T-STAT -20.12 ¦ B1 -1.2248 T-STAT -44.22
B2  0.5976 T-STAT  26.71 ¦ B2  0.5426 T-STAT   8.99 ¦ B2  0.6324 T-STAT  25.03
B3  0.5859 T-STAT  24.53 ¦ B3  0.4793 T-STAT   7.52 ¦ B3  0.6077 T-STAT  22.28
B4 -0.0336 T-STAT -11.84 ¦ B4 -0.0495 T-STAT  -6.46 ¦ B4 -0.0347 T-STAT -10.19

YEAR  1978   HH SIZE  1  ¦ YEAR  1978   HH SIZE 2  ¦ YEAR  1978   HH SIZE 3
RSQ 0.9993 RBARSQ 0.9992 ¦ RSQ 0.9997 RBARSQ 0.9996 ¦ RSQ 0.9995 RBARSQ 0.9994
RHO 0.4494 AAPE   1.4484 ¦ RHO 0.5529 AAPE   0.8088 ¦ RHO 0.6686 AAPE   0.9702
B1 -0.8516 T-STAT -20.78 ¦ B1 -1.1119 T-STAT -37.38 ¦ B1 -1.2274 T-STAT -34.15
B2  0.8195 T-STAT  19.15 ¦ B2  0.6604 T-STAT  22.21 ¦ B2  0.6386 T-STAT  19.68
B3  0.8559 T-STAT  21.08 ¦ B3  0.6546 T-STAT  20.69 ¦ B3  0.6468 T-STAT  18.37
B4 -0.0072 T-STAT  -1.40 ¦ B4 -0.0306 T-STAT  -7.23 ¦ B4 -0.0286 T-STAT  -6.59

YEAR  1978   HH SIZE  4  ¦ YEAR  1978   HH SIZE 5  ¦ YEAR  1978   HH SIZE 6
RSQ 0.9995 RBARSQ 0.9994 ¦ RSQ 0.9998 RBARSQ 0.9997 ¦ RSQ 0.9998 RBARSQ 0.9998
RHO 0.7541 AAPE   0.8949 ¦ RHO 0.4318 AAPE   0.5939 ¦ RHO 0.1589 AAPE   0.4743
B1 -1.4081 T-STAT -36.80 ¦ B1 -1.3716 T-STAT -52.55 ¦ B1 -1.2856 T-STAT -61.66
B2  0.5658 T-STAT  17.16 ¦ B2  0.5801 T-STAT  25.94 ¦ B2  0.6022 T-STAT  32.50
B3  0.5518 T-STAT  15.56 ¦ B3  0.5504 T-STAT  23.12 ¦ B3  0.5847 T-STAT  29.98
B4 -0.0380 T-STAT  -8.88 ¦ B4 -0.0390 T-STAT -13.68 ¦ B4 -0.0362 T-STAT -15.02

YEAR  1979   HH SIZE  1  ¦ YEAR  1979   HH SIZE 2  ¦ YEAR  1979   HH SIZE 3
RSQ 0.9993 RBARSQ 0.9992 ¦ RSQ 0.9998 RBARSQ 0.9998 ¦ RSQ 0.9998 RBARSQ 0.9997
RHO 0.6186 AAPE   1.3151 ¦ RHO 0.5464 AAPE   0.5681 ¦ RHO 0.6573 AAPE   0.6566
B1 -0.9244 T-STAT -23.17 ¦ B1 -1.0913 T-STAT -49.64 ¦ B1 -1.2243 T-STAT -49.42
B2  0.7405 T-STAT  17.46 ¦ B2  0.6543 T-STAT  28.70 ¦ B2  0.6295 T-STAT  27.25
B3  0.7911 T-STAT  18.48 ¦ B3  0.6461 T-STAT  27.63 ¦ B3  0.6289 T-STAT  26.15
B4 -0.0140 T-STAT  -2.41 ¦ B4 -0.0323 T-STAT  -9.86 ¦ B4 -0.0313 T-STAT -10.15

YEAR  1979   HH SIZE  4  ¦ YEAR  1979   HH SIZE 5  ¦ YEAR  1979   HH SIZE 6
RSQ 0.9998 RBARSQ 0.9998 ¦ RSQ 0.9998 RBARSQ 0.9998 ¦ RSQ 0.9999 RBARSQ 0.9999
RHO 0.5923 AAPE   0.5433 ¦ RHO 0.2270 AAPE   0.4436 ¦ RHO 0.2379 AAPE   0.3581
B1 -1.3539 T-STAT -63.83 ¦ B1 -1.2923 T-STAT -65.53 ¦ B1 -1.1862 T-STAT -73.24
B2  0.5852 T-STAT  31.62 ¦ B2  0.6229 T-STAT  36.80 ¦ B2  0.6371 T-STAT  41.10
B3  0.5826 T-STAT  30.43 ¦ B3  0.6137 T-STAT  35.28 ¦ B3  0.6286 T-STAT  38.82
B4 -0.0346 T-STAT -14.63 ¦ B4 -0.0313 T-STAT -14.68 ¦ B4 -0.0321 T-STAT -14.97

YEAR  1980   HH SIZE  1  ¦ YEAR  1980   HH SIZE 2  ¦ YEAR  1980   HH SIZE 3
RSQ 0.9994 RBARSQ 0.9993 ¦ RSQ 0.9998 RBARSQ 0.9998 ¦ RSQ 0.9996 RBARSQ 0.9995
RHO 0.6453 AAPE   1.3041 ¦ RHO 0.5299 AAPE   0.5557 ¦ RHO 0.7227 AAPE   0.8587
B1 -0.8729 T-STAT -23.36 ¦ B1 -1.0671 T-STAT -49.20 ¦ B1 -1.1659 T-STAT -36.70
B2  0.7702 T-STAT  19.50 ¦ B2  0.6664 T-STAT  29.95 ¦ B2  0.6516 T-STAT  22.00
B3  0.8169 T-STAT  20.27 ¦ B3  0.6607 T-STAT  28.99 ¦ B3  0.6544 T-STAT  21.18
B4 -0.0119 T-STAT  -2.19 ¦ B4 -0.0309 T-STAT  -9.72 ¦ B4 -0.0294 T-STAT  -7.43

YEAR  1980   HH SIZE  4  ¦ YEAR  1980   HH SIZE 5  ¦ YEAR  1980   HH SIZE 6
RSQ 0.9998 RBARSQ 0.9997 ¦ RSQ 0.9999 RBARSQ 0.9999 ¦ RSQ 0.9998 RBARSQ 0.9998
RHO 0.6011 AAPE   0.6293 ¦ RHO 0.1003 AAPE   0.3651 ¦ RHO 0.4103 AAPE   0.4599
B1 -1.3283 T-STAT -54.79 ¦ B1 -1.2543 T-STAT -78.54 ¦ B1 -1.1433 T-STAT -54.66
B2  0.5905 T-STAT  28.44 ¦ B2  0.6034 T-STAT  41.60 ¦ B2  0.6871 T-STAT  36.14
B3  0.5881 T-STAT  27.67 ¦ B3  0.5998 T-STAT  40.00 ¦ B3  0.6751 T-STAT  35.18
B4 -0.0346 T-STAT -13.24 ¦ B4 -0.0347 T-STAT -18.01 ¦ B4 -0.0256 T-STAT -10.34
```

TABLE C.1 (continued)

```
YEAR  1981   HH SIZE  1  ¦ YEAR  1981    HH SIZE 2  ¦ YEAR  1981    HH SIZE 3
RSQ 0. 9995 RBARSQ 0. 9994 ¦ RSQ 0. 9998 RBARSQ 0. 9998 ¦ RSQ 0. 9995 RBARSQ 0. 9994
RHO 0. 6496 AAPE    1. 2166 ¦ RHO 0. 5296 AAPE    0. 5339 ¦ RHO 0. 7063 AAPE    0. 9334
B1 -0. 8582 T-STAT -23. 68 ¦ B1 -1. 0478 T-STAT -46. 14 ¦ B1 -1. 1519 T-STAT -30. 67
B2  0. 7845 T-STAT  20. 43 ¦ B2  0. 6786 T-STAT  29. 29 ¦ B2  0. 6563 T-STAT  18. 35
B3  0. 8257 T-STAT  20. 68 ¦ B3  0. 6751 T-STAT  28. 55 ¦ B3  0. 6628 T-STAT  17. 65
B4 -0. 0110 T-STAT  -2. 03 ¦ B4 -0. 0292 T-STAT  -8. 84 ¦ B4 -0. 0286 T-STAT  -5. 82

YEAR  1981   HH SIZE  4  ¦ YEAR  1981    HH SIZE 5  ¦ YEAR  1981    HH SIZE 6
RSQ 0. 9997 RBARSQ 0. 9996 ¦ RSQ 0. 9998 RBARSQ 0. 9998 ¦ RSQ 0. 9999 RBARSQ 0. 9998
RHO 0. 6515 AAPE    0. 6845 ¦ RHO 0. 2498 AAPE    0. 4485 ¦ RHO 0. 1237 AAPE    0. 4188
B1 -1. 2874 T-STAT -43. 14 ¦ B1 -1. 2804 T-STAT -63. 52 ¦ B1 -1. 1342 T-STAT -64. 86
B2  0. 6060 T-STAT  23. 13 ¦ B2  0. 6025 T-STAT  33. 85 ¦ B2  0. 6956 T-STAT  46. 70
B3  0. 6072 T-STAT  22. 57 ¦ B3  0. 5984 T-STAT  32. 66 ¦ B3  0. 6829 T-STAT  46. 35
B4 -0. 0331 T-STAT  -9. 79 ¦ B4 -0. 0342 T-STAT -14. 75 ¦ B4 -0. 0247 T-STAT -13. 43
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TABLE C.2
FIT OF THE CES INCOME DISTRIBUTION MODEL.

YEAR 1981 HOUSEHOLD SIZE 1

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00287	0.00082	1155.	328.	71.6
0.10000	0.00953	0.00783	2675.	2819	-5.4
0.15000	0.01770	0.01869	3285.	4364.	-32.8
0.20000	0.02994	0.03284	4919.	5690.	-15.7
0.25000	0.04492	0.05008	6024.	6931.	-15.1
0.30000	0.06262	0.07021	7113.	8090.	-13.7
0.35000	0.08466	0.09332	8859.	9290.	-4.9
0.40000	0.11063	0.11957	10438.	10552.	-1.1
0.45000	0.14059	0.14915	12044.	11890.	1.3
0.50000	0.17493	0.18229	13802	13319.	3.5
0.55000	0.21370	0.21935	15585.	14895	4.4
0.60000	0.25795	0.26070	17788	16623	6.6
0.65000	0.30770	0.30684	19995.	18547	7.2
0.70000	0.36347	0.35883	22417.	20897.	6.8
0.75000	0.42669	0.41746	25411.	23568.	7.3
0.80000	0.49797	0.48450	28653.	26946	6.0
0.85000	0.58002	0.56259	32980.	31387.	4.8
0.90000	0.67918	0.65606	39860.	37572.	5.7
0.95000	0.79460	0.77583	46393.	48144.	-3.8
1.00000	1.00000	1.00000	82561.	90105.	-9.1

YEAR 1981 HOUSEHOLD SIZE 2

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID. %
0.05000	0.00424	0.00408	2211.	2178	3.7
0.10000	0.01377	0.01359	4970.	4759	0.2
0.15000	0.02698	0.02734	6887.	7172.	-4.1
0.20000	0.04358	0.04436	8660.	8874.	-2.5
0.25000	0.06311	0.06460	10186.	10554.	-3.6
0.30000	0.08570	0.08785	11776.	12126.	-3.0
0.35000	0.11174	0.11403	13581.	13651.	-0.5
0.40000	0.14108	0.14319	15298.	15208.	0.6
0.45000	0.17390	0.17544	17119.	16020	1.7
0.50000	0.21084	0.21094	19262.	18512	3.9
0.55000	0.25182	0.24789	21374.	20312	5.0
0.60000	0.30008	0.29280	25167.	22377	11.1
0.65000	0.34885	0.33988	25431.	24549	3.5
0.70000	0.40551	0.39183	29546.	27092.	8.3
0.75000	0.46513	0.44940	31093.	30024	3.4
0.80000	0.53827	0.51411	38143.	33744.	11.5
0.85000	0.61316	0.58780	39054.	38430	1.6
0.90000	0.69660	0.67461	43511.	45268	-4.0
0.95000	0.80047	0.78355	54167	56010.	-4.9
1.00000	1.00000	1.00000	104053.	112878.	-8.5

YEAR 1981 HOUSEHOLD SIZE 3

ACTUAL % POP	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM. $ AGI	RESID %
0.05000	0.00481	0.00484	1461.	1470.	-0.6
0.10000	0.01544	0.01605	3227.	3404.	-5.5
0.15000	0.03002	0.03197	4426.	4834.	-9.2
0.20000	0.04826	0.05136	5538.	5887.	-6.3
0.25000	0.07016	0.07397	6648.	6862.	-3.2
0.30000	0.09587	0.09963	7805.	7792.	0.2
0.35000	0.12533	0.12831	8943.	8706.	2.7
0.40000	0.15836	0.15992	10027.	9598.	4.3
0.45000	0.19534	0.19461	11227.	10532.	6.2
0.50000	0.23771	0.23247	12863.	11492	10.7
0.55000	0.28399	0.27364	14050	12500.	11.0
0.60000	0.33027	0.31836	14050	13577	3.4
0.65000	0.38349	0.36722	16158.	14833.	8.2
0.70000	0.43998	0.42045	17150.	16159.	5.8
0.75000	0.50464	0.47911	19630.	17808.	9.3
0.80000	0.57585	0.54411	21617.	19733.	8.7
0.85000	0.64706	0.61729	21617.	22218.	-2.8
0.90000	0.72939	0.70194	24997.	25697.	-2.8
0.95000	0.82679	0.80628	29568.	31678.	-7.1
1.00000	1.00000	1.00000	52585.	58810.	-11.8

YEAR 1981 HOUSEHOLD SIZE 4

ACTUAL % POP.	ACTUAL % AGI	ESTIM. % AGI	ACTUAL $ AGI	ESTIM $ AGI	RESID %
0.05000	0.00616	0.00601	1966.	1919.	2.4
0.10000	0.01864	0.01916	3988.	4201.	-5.3
0.15000	0.03540	0.03751	5353.	5858.	-9.4
0.20000	0.05642	0.05949	6713.	7021.	-4.6
0.25000	0.08180	0.08475	8105	8068.	0.5
0.30000	0.11079	0.11306	9257.	9040	2.3
0.35000	0.14346	0.14428	10434.	9970.	4.4
0.40000	0.18149	0.17835	12145.	10082.	10.4
0.45000	0.22122	0.21528	12690.	11793	7.1
0.50000	0.26096	0.25511	12690.	12721	-0.2
0.55000	0.30928	0.29807	15433.	13720	11.1
0.60000	0.35793	0.34432	15537.	14771.	4.9
0.65000	0.40955	0.39408	16485.	15893.	3.6
0.70000	0.47067	0.44794	19523.	17201.	11.9
0.75000	0.53180	0.50641	19523.	18673.	4.4
0.80000	0.59293	0.57043	19523.	20446.	-4.7
0.85000	0.66262	0.64161	22256.	22732.	-2.1
0.90000	0.74092	0.72284	25005.	25941.	-3.7
0.95000	0.83641	0.82106	30498.	31371.	-2.9
1.00000	1.00000	1.00000	52244.	57146.	-9.4

TABLE C.2 (continued)

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           YEAR 1981     HOUSEHOLD SIZE 5          !           YEAR 1981    HOUSEHOLD SIZE 6
ACTUAL  ! ACTUAL!ESTIM   ! ACTUAL! ESTIM  !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM  !RESID
% POP.  ! % AGI ! % AGI  ! $ AGI ! $ AGI  !   %   !% POP   ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %
 -------!-------!--------!-------!--------!-------!--------!-------!--------!--------!--------!------
0 05000!0.00604!0.00592!   947. !   928 !   2.0!0.05000!0.00629!0.00631!   553. !   555 !  -0 3
0 10000!0.01898!0.01888!  2028 !  2032. !  -0.2!0.10000!0.01865!0.01841!  1087 !  1065 !   2.1
0 15000!0 03623!0.03699!  2706. !  2840 !  -5.0!0.15000!0 03511!0.03493!  1448. !  1453. !  -0 3
0 20000!0.05732!0.05873!  3306. !  3409. !  -3.1!0.20000!0 05506!0.05467!  1754 !  1735 !   1.1
0 25000!0 08272!0.08375!  3982 !  3922 !   1.5!0.25000!0 07824!0.07740!  2039 !  2000 !   1 9
0 30000!0 11194!0.11181!  4581. !  4399. !   4.0!0.30000!0.10465!0.10303!  2323. !  2254 !   3 0
0 35000!0.14440!0.14278!  5090. !  4855. !   4 6!0.35000!0 13452!0.13192!  2627 !  2505 !   4 6
0 40000!0 18226!0.17660!  5936 !  5303 !  10 7!0 40000!0 16791!0.16289!  2936 !  2759 !   6 0
0 45000!0.22136!0.21328!  6130. !  5751 !   6 2!0 45000!0.20676!0.19723!  3417 !  3020 !  11 6
0 50000!0.26057!0 25287!  6148. !  6207. !  -1 0!0.50000!0 24736!0.23466!  3570 !  3292 !   7 8
0 55000!0 30835!0.29555!  7491. !  6692 !  10 7!0.55000!0.28796!0.27537!  3570 !  3580 !  -0 3
0 60000!0 35613!0 34157!  7491 !  7214 !   3 7!0.60000!0 33674!0.31959!  4289 !  3889 !   9 3
0 65000!0 40640!0 39106!  7881 !  7760 !   1.5!0 65000!0.38653!0.36796!  4378 !  4253 !   2.9
0 70000!0.46661!0.44471!  9440. !  8411. !  10.9!0.70000!0.44367!0.42068!  5025 !  4637 !   7 7
0 75000!0.52683!0.50294!  9440. !  9129. !   3.3!0.75000!0.50646!0.47087!  5522. !  5116 !   7 3
0 80000!0 58704!0.56676!  9440. ! 10004. !  -6.0!0.80000!0.56925!0 54344!  5522. !  5679. !  -2.8
0 85000!0.65359!0.63778! 10434. ! 11135. !  -6.7!0.85000!0.63496!0.61627!  5779. !  6405. ! -10 8
0 90000!0 73028!0.71898! 12024. ! 12730 !  -5.9!0 90000!0.71491!0.70065!  7031. !  7420. !  -5.5
0 95000!0.82502!0.81731! 14854 ! 15416 !  -3.8!0.95000!0.81169!0.80496!  8511 !  9173. !  -7.8
1 00000!1 00000!1 00000! 27433 ! 28642 !  -4 4!1.00000!1.00000!1.00000! 16560 ! 17152 !  -3.6

           YEAR 1975     HOUSEHOLD SIZE 1          !           YEAR 1975    HOUSEHOLD SIZE 2
ACTUAL  ! ACTUAL!ESTIM   ! ACTUAL! ESTIM. !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM. !RESID
% PUP   ! % AGI ! % AGI  ! $ AGI ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   &
 -------!-------!--------!-------!--------!-------!--------!-------!--------!--------!--------!------
0 05000!0.00495!-.00209!   896 !  -378 ! 142 2!0.05000!0.00480!0.00446!  1263. !  1174. !   7.0
0 10000!0 00990!0.00350!   896. !  1012. ! -12.9!0.10000!0 01495!0.01496!  2669. !  2760 !  -3 4
0.15000!0 01786!0 01335!  1443. !  1785. ! -23.7!0.15000!0.02883!0.02994!  3653 !  3742. !  -7 9
0.20000!0.03072!0.02714!  2329. !  2499. !  -7.3!0.20000!0.04607!0.04829!  4535. !  4828. !  -6.5
0 25000!0.04357!0.04418!  2329. !  3086. ! -32.5!0.25000!0.06635!0.06980!  5335. !  5658. !  -6.1
0 30000!0.06127!0.06437!  3207. !  3658. ! -14.1!0.30000!0.09004!0.09445!  6232. !  6483 !  -4.0
0 35000!0.08273!0.08783!  3886. !  4250. !  -9.4!0.35000!0.11731!0.12201!  7175. !  7251. !  -1 1
0 40000!0 10605!0.11464!  4226. !  4857. ! -14.9!0.40000!0.14814!0.15253!  8109 !  8030 !   1 0
0.45000!0.13620!0.14488!  5460. !  5477. !  -0.3!0.45000!0.18264!0.18611!  9075 !  8831. !   2.7
0 50000!0 16983!0.17877!  6091. !  6139. !  -0.8!0.50000!0.22129!0.22290! 10167. !  9681. !   4 8
0 55000!0 20884!0.21674!  7067. !  6878. !   2.7!0.55000!0.26390!0.26319! 11209. ! 10598. !   5.4
0 60000!0.25413!0.25913!  8204. !  7678. !   6.4!0.60000!0.31073!0.30715! 12320. ! 11564. !   6 1
0 65000!0.30302!0.30637!  8855. !  8557. !   3.4!0.65000!0.36179!0.35521! 13433. ! 12642. !   5.9
0.70000!0.35910!0.35949! 10160. !  9622. !   5.3!0.70000!0.42212!0.40804! 15870. ! 13898. !  12.4
0 75000!0.42327!0.41928! 11623. ! 10831. !   6.8!0.75000!0.48522!0.46635! 16599. ! 15339. !   7.6
0.80000!0.49610!0.48742! 13194. ! 12344. !   6.4!0.80000!0.54831!0.53132! 16599. ! 17093 !  -3.0
0 85000!0.58037!0.56644! 15263. ! 14313. !   6.2!0.85000!0.62324!0.60497! 19710. ! 19374. !   1.7
0 90000!0 67735!0.66046! 17568. ! 17031. !   3.1!0.90000!0.70417!0.69077! 21290. ! 22571. !  -6.0
0 95000!0.79537!0.78024! 21379. ! 21698. !  -1.5!0.95000!0.80622!0.79740! 26848. ! 28051. !  -4.5
1 00000!1.00000!1.00000! 37067. ! 39807. !  -7.4!1.00000!1.00000!1.00000! 50976. ! 53298. !  -4.6
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TABLE C.2 (continued)

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              YEAR 1975     HOUSEHOLD SIZE 3          !           YEAR 1975    HOUSEHOLD SIZE 4
ACTUAL  ! ACTUAL!ESTIM.  ! ACTUAL! ESTIM. !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM. !RESID
% POP   ! % AGI ! % AGI  ! $ AGI ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %
--------!-------!--------!-------!--------!-------!--------!-------!--------!--------!--------!------
0 05000!0 00534!0 00551!    857. !    884  !  -3. 1!0 05000!0. 00686!0. 00704!   1201  !   1232. !  -2 6
0 10000!0. 01759!0 01826!   1966  !   2047. !  -4 1!0. 10000!0. 02116!0. 02162!   2504. !   2553. !  -2. 0
0 15000!0 03427!0 03605!   2677  !   2856  !  -6. 7!0. 15000!0. 03953!0. 04136!   3217. !   3456. !  -7 5
0 20000!0. 05453!0 05742!   3252. !   3428. !  -5 4!0. 20000!0. 06230!0. 06476!   3987  !   4098. !  -2. 8
0 25000!0. 07863!0 08202!   3867  !   3948. !  -2 1!0. 25000!0. 08886!0. 09138!   4650. !   4660. !  -0 2
0 30000!0. 10618!0. 10966!   4421. !   4436. !  -0. 3!0. 30000!0. 11886!0. 12096!   5253. !   5180. !   1. 4
0 35000!0. 13737!0 14024!   5006. !   4908  !   2. 0!0 35000!0. 15221!0. 15337!   5840  !   5675. !   2. 8
0 40000!0 17172!0. 17374!   5513. !   5376. !   2. 5!0. 40000!0. 18878!0. 18854!   6402. !   6158  !   3. 8
0 45000!0. 20953!0 21018!   6067. !   5848. !   3. 6!0. 45000!0. 22838!0. 22647!   6935. !   6641  !   4 2
0 50000!0. 25093!0. 24964!   6644. !   6333  !   4. 7!0. 50000!0 27066!0. 26729!   7402. !   7148. !   3 4
0 55000!0. 29508!0 27229!   7214  !   6845  !   5. 1!0. 55000!0. 32012!0. 31110!   8660  !   7670  !  11 4
0 60000!0. 34418!0 33850!   7752  !   7415. !   4. 3!0. 60000!0. 37144!0. 35798!   8987. !   8209. !   8 7
0 65000!0. 40184!0. 38836!   9253  !   8002. !  13. 5!0. 65000!0. 42276!0. 40841!   8987. !   8831  !   1 7
0 70000!0. 46005!0. 44261!   9342  !   8707  !   6. 8!0 70000!0. 47409!0. 46258!   8987. !   9484. !  -5 5
0 75000!0 51826!0. 50170!   9342. !   9483  !  -1. 5!0 75000!0. 53193!0. 52126!  10128  !  10275. !  -1. 5
0 80000!0. 58013!0 56667!   9931  !  10430  !  -5 0!0. 80000!0 59762!0. 58524!  11502. !  11203. !   2 6
0 85000!0 65506!0 63926!  12025  !  11646  !   3 2!0. 85000!0 66331!0. 65595!  11502  !  12380  !  -7 6
0 90000!0 73341!0. 72235!  12574  !  13335  !  -6. 1!0. 90000!0. 74237!0. 73599!  13844  !  14015. !  -1 2
0 95000!0 83138!0 82295!  15724. !  16144  !  -2 7!0. 95000!0. 84069!0. 83209!  17216  !  16027  !   2 3
1 00000!1. 00000!1. 00000!  27060. !  28414  !  -5. 0!1. 00000!1. 00000!1. 00000!  27894. !  29400  !  -5 4

              YEAR 1975     HOUSEHOLD SIZE 5          !           YEAR 1975    HOUSEHOLD SIZE 6
ACTUAL  ! ACTUAL!ESTIM   ! ACTUAL! ESTIM. !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM. !RESID
% POP   ! % AGI ! % AGI  ! $ AGI ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %
--------!-------!--------!-------!--------!-------!--------!-------!--------!--------!--------!------
0 05000!0 00672!0 00674!    665. !    667. !  -0. 3!0. 05000!0. 00616!0. 00598!    464  !    450. !   3 0
0 10000!0. 02019!0 02067!   1334. !   1380. !  -3. 4!0. 10000!0. 01996!0. 01885!   1039. !    969. !   6. 7
0 15000!0. 03845!0 03974!   1808  !   1888  !  -4. 4!0 15000!0. 03800!0. 03680!   1358. !   1351  !   0 5
0 20000!0 06122!0 06241!   2255. !   2245. !   0. 4!0. 20000!0. 06019!0. 05833!   1671. !   1621. !   3 0
0 25000!0. 08737!0. 08830!   2589. !   2564. !   1. 0!0. 25000!0. 08543!0. 08310!   1900. !   1865. !   1 8
0 30000!0. 11722!0. 11717!   2956  !   2859. !   3. 3!0. 30000!0. 11401!0. 11090!   2151  !   2093. !   2. 7
0 35000!0. 15012!0. 14890!   3258  !   3141. !   3. 6!0 35000!0. 14563!0. 14161!   2381. !   2312. !   2 9
0 40000!0. 18604!0. 18341!   3556. !   3418. !   3. 9!0. 40000!0. 18019!0. 17517!   2602. !   2527. !   2. 9
0 45000!0. 22474!0. 22072!   3832. !   3694. !   3. 6!0. 45000!0. 21778!0. 21160!   2830. !   2742. !   3 1
0. 50000!0 26796!0. 26088!   4280. !   3976. !   7. 1!0. 50000!0. 25828!0. 25095!   3049  !   2963. !   2 8
0 55000!0. 31648!0. 30415!   4805  !   4285. !  10. 8!0. 55000!0. 30478!0. 29339!   3501. !   3195. !   8. 7
0 60000!0. 36500!0 35056!   4805. !   4596. !   4. 3!0. 60000!0. 35466!0. 33922!   3755. !   3451. !   8. 1
0 65000!0. 41352!0 40050!   4805. !   4945. !  -2. 9!0. 65000!0. 40455!0. 38857!   3755. !   3714. !   1 1
0 70000!0. 46204!0. 45433!   4805. !   5331. ! -10. 9!0. 70000!0. 45443!0. 44211!   3755. !   4031. !  -7 3
0 75000!0. 52331!0. 51276!   6067. !   5785. !   4. 6!0. 75000!0. 50976!0. 50028!   4165. !   4379. !  -5. 1
0 80000!0. 58532!0. 57659!   6140. !   6321. !  -2. 9!0. 80000!0. 57385!0. 56410!   4825. !   4805. !   0. 4
0 85000!0 65158!0. 64738!   6561. !   7010. !  -6. 8!0. 85000!0. 63794!0. 63526!   4825. !   5356. ! -11 0
0 90000!0. 72769!0. 72791!   7536. !   7974. !  -5. 8!0. 90000!0. 71657!0. 71675!   5920  !   6135  !  -3 6
0 95000!0. 82901!0 82504!  10033. !   9617. !   4. 1!0. 95000!0. 81659!0. 81556!   7529. !   7438. !   1 2
1 00000!1. 00000!1. 00000!  16932  !  17325. !  -2. 3!1. 00000!1. 00000!1. 00000!  13807. !  13885. !  -0 6
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TABLE C.2 (continued)

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          YEAR 1970    HOUSEHOLD SIZE 1          !            YEAR 1970   HOUSEHOLD SIZE 2
ACTUAL  ! ACTUAL!ESTIM   ! ACTUAL.! ESTIM. !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM. !RESID
% POP   ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %
--------!-------!--------!--------!--------!-------!--------!-------!--------!--------!--------!-------
0 05000!0. 00424!-. 00439!   458 !   -474. ! 203. 6!0. 05000!0 00551!0. 00450!   909. !   742. !  18 3
0 10000!0. 00848!0. 00001!   458. !   475. !  -3. 8!0. 10000!0. 01552!0. 01510!  1649 !  1746 !  -5 9
0 15000!0 01782!0. 00916!  1010. !   988 !   2. 2!0. 15000!0. 02891!0. 03026!  2205. !  2498. ! -13. 3
0 20000!0. 02861!0. 02285!  1165. !  1480. ! -27. 0!0. 20000!0. 04692!0. 04882!  2969. !  3058. !  -3. 0
0 25000!0. 04675!0. 04002!  1960 !  1855. !   5. 4!0. 25000!0. 06788!0. 07056!  3453. !  3581. !  -3 7
0 30000!0 06490!0. 06063!  1960 !  2227. ! -13. 6!0. 30000!0 09113!0. 09542!  3830. !  4098 !  -7. 0
0 35000!0. 08304!0. 08482!  1960. !  2613. ! -33. 3!0. 35000!0. 11938!0. 12322!  4655. !  4580 !   1 6
0 40000!0. 10640!0. 11242!  2524. !  2982. ! -18. 2!0. 40000!0. 15080!0. 15397!  5178. !  5066 !   2. 1
0. 45000!0. 13662!0. 14357!  3264 !  3365. !  -3. 1!0. 45000!0. 18538!0. 18774!  5698. !  5565. !   2. 3
0 50000!0. 16683!0. 17843!  3264. !  3766. ! -15. 4!0. 50000!0. 22392!0. 22474!  6351. !  6096. !   4 0
0 55000!0. 20604!0. 21739!  4235 !  4210. !   0. 6!0. 55000!0. 26690!0. 26515!  7080. !  6659. !   6. 0
0 60000!0 24877!0. 26074!  4617. !  4683. !  -1. 4!0. 60000!0. 31388!0. 30918!  7742. !  7255. !   6. 3
0 65000!0. 30003!0. 30882!  5538. !  5195. !   6. 2!0. 65000!0. 36451!0. 35728!  8342. !  7925. !   5 0
0 70000!0. 35502!0. 36267!  5941. !  5817. !   2. 1!0. 70000!0. 41966!0. 41002!  9088. !  8691. !   4 4
0 75000!0. 42163!0. 42294!  7196. !  6511. !   9. 5!0. 75000!0. 48022!0. 46818!  9978. !  9583. !   4. 0
0. 80000!0. 49516!0. 49118!  7943. !  7372. !   7. 2!0. 80000!0. 54648!0. 53287! 10918 ! 10659. !   2. 4
0 85000!0. 57910!0. 56972!  9069. !  8484. !   6. 4!0. 85000!0. 62089!0. 60606! 12260 ! 12060. !   1. 6
0 90000!0. 67633!0. 66251! 10504 ! 10025. !   4. 6!0. 90000!0. 70846!0. 69118! 14430. ! 14026. !   2. 8
0 95000!0 79241!0. 77974! 12540. ! 12664. !  -1. 0!0. 95000!0. 80392!0. 79685! 15729 ! 17410. ! -10. 7
1 00000!1. 00000!1. 00000! 22426. ! 23795. !  -6. 1!1. 00000!1. 00000!1. 00000! 32308. ! 33473. !  -3. 6

          YEAR 1970    HOUSEHOLD SIZE 3          !            YEAR 1970   HOUSEHOLD SIZE 4
ACTUAL. ! ACTUAL!ESTIM.  ! ACTUAL! ESTIM.  !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM. !RESID
% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %
--------!-------!--------!--------!--------!-------!--------!-------!--------!--------!--------!-------
0 05000!0. 00749!0. 00703!   785. !   737. !   6. 1!0. 05000!0. 00888!0. 00868!  1018 !   995. !   2. 3
0 10000!0 02133!0. 02124!  1451. !  1489. !  -2. 7!0. 10000!0. 02531!0. 02501!  1884 !  1873. !   0. 4
0 15000!0. 03964!0. 04052!  1917 !  2019. !  -5. 3!0. 15000!0. 04640!0. 04632!  2419. !  2443. !  -1. 0
0 20000!0. 06129!0. 06339!  2269. !  2396. !  -5. 6!0. 20000!0. 07171!0. 07135!  2902. !  2870. !   1. 1
0 25000!0 08675!0. 08944!  2667. !  2729. !  -2. 3!0. 25000!0. 09989!0. 09950!  3232. !  3227. !   0 1
0 30000!0. 11613!0. 11844!  3079. !  3039. !   1. 3!0. 30000!0. 13100!0. 13048!  3566. !  3553. !   0. 4
0 35000!0. 14874!0. 15028!  3417. !  3335. !   2. 4!0. 35000!0. 16619!0. 16416!  4035. !  3861. !   4. 3
0 40000!0 18379!0. 18488!  3672 !  3625. !   1. 3!0. 40000!0. 20312!0. 20044!  4235 !  4160. !   1 8
0 45000!0. 22319!0. 22225!  4128. !  3916. !   5. 1!0. 45000!0. 24241!0. 23940!  4505 !  4468 !   0 8
0 50000!0 26531!0. 26248!  4413. !  4215. !   4. 5!0. 50000!0. 28512!0 28099!  4897 !  4769. !   2 6
0. 55000!0 30968!0. 30579!  4649. !  4537. !   2. 4!0. 55000!0. 32952!0. 32528!  5091 !  5078. !   0 3
0 60000!0 35832!0. 35222!  5096. !  4865 !   4. 5!0. 60000!0. 37706!0. 37255!  5451. !  5421 !   0 6
0 65000!0 41012!0. 40218!  5427 !  5235. !   3. 6!0. 65000!0. 42779!0. 42295!  5817 !  5779 !   0 7
0 70000!0. 46516!0. 45600!  5767. !  5638. !   2. 2!0. 70000!0. 48178!0. 47692!  6191. !  6188. !   0 0
0 75000!0. 52432!0. 51441!  6198 !  6120. !   1 3!0. 75000!0. 53930!0. 53487!  6595. !  6645 !  -0 8
0 80000!0 58856!0. 57821!  6730. !  6684 !   0. 7!0. 80000!0. 60458!0. 59771!  7486. !  7205. !   3 7
0 85000!0 66202!0 64893!  7697 !  7409. !   3. 7!0. 85000!0. 67529!0. 66676!  8108. !  7918 !   2 3
0 90000!0 74120!0 72932!  8296 !  8422 !  -1 5!0. 90000!0. 74600!0. 74450!  8108 !  8914 !  -9 9
0 95000!0 83045!0 82621!  9351. ! 10152 !  -8. 6!0. 95000!0 83437!0. 83706! 10133 ! 10614 !  -4 7
1 00000!1 00000!1 00000! 17764. ! 18208. !  -2. 5!1. 00000!1. 00000!1. 00000! 18991 ! 18683 !   1 6
```

TABLE C.2 (continued)

```
             YEAR 1970    HOUSEHOLD SIZE 5          !          YEAR 1970   HOUSEHOLD SIZE 6
ACTUAL  ! ACTUAL!ESTIM   ! ACTUAL.! ESTIM. !RESID. !ACTUAL  ! ACTUAL!ESTIM   !ACTUAL  ! ESTIM. !RESID
% POP   ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %
--------!-------!--------!--------!--------!-------!--------!-------!--------!--------!--------!------
0 05000!0.00888!0.00842!    655. !    621. !   5.2!0.05000!0.00944!0.00806!    644  !    550. !  14.6
0 10000!0.02481!0.02408!   1174. !   1154. !   1.7!0.10000!0.02596!0.02317!   1128. !   1032  !   8.5
0.15000!0 04537!0 04461!   1516. !   1514. !   0.1!0.15000!0.04727!0.04320!   1456  !   1367. !   6.1
0.20000!0.06991!0.06878!   1810. !   1781. !   1.6!0.20000!0.07215!0.06683!   1699. !   1614. !   5.0
0 25000!0 09786!0.09603!   2060  !   2010. !   2.4!0.25000!0.09949!0.09358!   1867  !   1827. !   2.2
0.30000!0.12872!0.12615!   2276. !   2220. !   2.4!0.30000!0.12980!0.12321!   2070. !   2023. !   2 3
0 35000!0 16207!0.15898!   2459. !   2421. !   1.6!0.35000!0.16364!0.15557!   2311. !   2210. !   4 4
0 40000!0 19910!0.19446!   2730. !   2616. !   4.2!0.40000!0.19923!0.19061!   2430. !   2392. !   1 5
0 45000!0.23807!0.23261!   2874. !   2813. !   2.1!0.45000!0.23780!0.22830!   2634. !   2574. !   2.3
0 50000!0 27929!0.27355!   3039. !   3018. !   0.7!0.50000!0.27870!0.26881!   2793. !   2766. !   1.0
0 55000!0 32396!0.31728!   3293. !   3225. !   2.1!0.55000!0 32135!0.31217!   2912. !   2761. !  -1 7
0 60000!0 37066!0.36401!   3444. !   3445. !  -0.1!0.60000!0.36784!0.35850!   3175  !   3164. !   0 3
0 65000!0 42001!0.41411!   3639  !   3694  !  -1.5!0.65000!0.41695!0.40827!   3354. !   3398. !  -1 3
0 70000!0.47303!0.46783!   3909  !   3961. !  -1.3!0.70000!0.46931!0.46163!   3576. !   3644. !  -1 9
0 75000!0.52972!0.52579!   4180. !   4274. !  -2.2!0.75000!0.52523!0.51940!   3818  !   3944. !  -3.3
0 80000!0.59640!0.58891!   4917  !   4654. !   5.3!0.80000!0.58782!0.58231!   4274. !   4296. !  -0 5
0 85000!0 66351!0.65851!   4948. !   5131. !  -3.7!0.85000!0.65685!0.65182!   4713  !   4746. !  -0.7
0 90000!0 73371!0.73716!   5176. !   5799. ! -12.0!0.90000!0.72587!0.73062!   4713. !   5381. ! -14.2
0.95000!0 82385!0.83155!   6646. !   6959. !  -4.7!0.95000!0.81552!0.82549!   6122. !   6478. !  -5 8
1.00000!1 00000!1.00000!  12988. !  12420. !   4.4!1.00000!1.00000!1.00000!  12597. !  11916. !   5 4

             YEAR 1966    HOUSEHOLD SIZE 1          !          YEAR 1966   HOUSEHOLD SIZE 2
ACTUAL  ! ACTUAL!ESTIM.  ! ACTUAL! ESTIM.  !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM. !RESID
% POP   ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI  !   %
--------!-------!--------!--------!--------!-------!--------!-------!--------!--------!--------!------
0 05000!0 00834!-.00650!    651. !   -507. ! 177.9!0.05000!0.00527!0.00376!    638  !    456. !  28.6
0 10000!0 01668!-.00396!    651  !    199. !  69.5!0 10000!0.01512!0.01366!   1194. !   1198. !  -0.4
0 15000!0 02503!0 00364!    651. !    593. !   8.9!0.15000!0 02832!0.02824!   1598  !   1765  ! -10.5
0 20000!0.03337!0.01583!    651. !    951. ! -46.1!0.20000!0.04464!0.04637!   1977  !   2195. ! -11 0
0 25000!0 04171!0.03170!    651. !   1238. ! -90.3!0.25000!0.06499!0.06783!   2464. !   2600. !  -5 5
0 30000!0 05923!0.05145!   1366. !   1541. ! -12.8!0.30000!0.08761!0.09248!   2739. !   2985. !  -9.0
0 35000!0 08245!0.07473!   1812  !   1816. !  -0.2!0.35000!0.11525!0.12010!   3347. !   3345. !   0.1
0 40000!0 10568!0.10155!   1812. !   2093. ! -15.5!0.40000!0.14490!0.15070!   3590. !   3705. !  -3 2
0 45000!0.12891!0.13204!   1812. !   2379. ! -31.3!0.45000!0.18140!0.18432!   4420. !   4071. !   7 9
0 50000!0.15714!0.16636!   2202  !   2677. ! -21.6!0.50000!0.21990!0.22109!   4662. !   4452. !   4 5
0.55000!0.19667!0.20473!   3084. !   2993. !   2.9!0.55000!0.26206!0.26129!   5104. !   4868. !   4.6
0.60000!0 23619!0.24761!   3084  !   3345. !  -8.5!0.60000!0.30852!0.30504!   5626  !   5298  !   5.8
0 65000!0 28513!0.29543!   3818. !   3731. !   2.3!0.65000!0.35843!0.35269!   6044  !   5770. !   4 5
0 70000!0 34049!0.34877!   4318. !   4163. !   3.6!0.70000!0.41350!0.40495!   6668  !   6328. !   5 1
0.75000!0 40401!0.40868!   4956. !   4672. !   5.7!0.75000!0.47370!0.46239!   7289  !   6955. !   4 6
0 80000!0 47539!0.47665!   5568. !   5303  !   4.8!0.80000!0.54493!0.52618!   8625. !   7724. !  10.5
0 85000!0 56151!0.55495!   6718  !   6108. !   9.1!0.85000!0.62258!0.59827!   9403  !   8730. !   7 2
0 90000!0.65902!0 64791!   7608. !   7252. !   4.7!0.90000!0.70024!0.68219!   9403  !  10161. !  -8 1
0 95000!0 77643!0.76550!   9159  !   9173. !  -0.2!0.95000!0.79266!0.78645!  11191  !  12624. ! -12.8
1 00000!1 00000!1.00000!  17441. !  18293. !  -4.9!1.00000!1.00000!1.00000!  25107. !  25858. !  -3 0
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TABLE C.2 (continued)

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          YEAR 1966    HOUSEHOLD SIZE 3         !             YEAR 1966   HOUSEHOLD SIZE 4
ACTUAL  ! ACTUAL!ESTIM   ! ACTUAL! ESTIM. !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM !RESID.
% POP   ! % AGI ! % AGI  ! $ AGI ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI !   %
--------!-------!--------!-------!--------!-------!--------!-------!--------!--------!-------!-------
0 05000!0 00766!0.00659!   597. !   513. !  14.0!0.05000!0.00949!0.00809!   790. !   673 !  14 8
0.10000!0.02125!0.02056!  1058. !  1087. !  -2.8!0.10000!0.02576!0.02424!  1354. !  1345. !   0.7
0 15000!0 03898!0.03980!  1380. !  1498. !  -8.6!0.15000!0.04667!0.04563!  1740. !  1780. !  -2 3
0 20000!0.05963!0.06273!  1608. !  1785. ! -11.0!0.20000!0.07094!0.07085!  2020. !  2099. !  -3 9
0 25000!0 08614!0.08892!  2064. !  2039. !   1.2!0.25000!0.10069!0.09925!  2477. !  2364. !   4 6
0 30000!0.11551!0.11810!  2286. !  2272. !   0.6!0.30000!0.13253!0.13053!  2650. !  2603. !   1.8
0 35000!0 14851!0.15011!  2569. !  2492. !   3.0!0.35000!0.16679!0.16448!  2852. !  2826. !   0.9
0 40000!0 18509!0.18486!  2847. !  2706. !   5.0!0.40000!0.20433!0.20100!  3124. !  3040. !   2 7
0 45000!0 22336!0.22234!  2980. !  2918  !   2.1!0.45000!0.24368!0.24014!  3275. !  3257. !   0.5
0.50000!0 26591!0.26261!  3312  !  3135  !   5.4!0.50000!0.28573!0.28181!  3500  !  3469. !   0 9
0 55000!0 31001!0 30585!  3434. !  3367. !   2.0!0.55000!0.33039!0.32608!  3717. !  3684  !   0.9
0 60000!0 35865!0.35211!  3786  !  3601. !   4.9!0.60000!0.37764!0.37320!  3932. !  3922. !   0 3
0 65000!0.40847!0.40176!  3879  !  3865. !   0.4!0.65000!0.42743!0.42328!  4144  !  4168. !  -0 6
0 70000!0.46355!0.45510!  4288. !  4153. !   3 2!0.70000!0.48558!0.47675!  4840. !  4451. !   8.0
0 75000!0 52491!0.51284!  4777. !  4495. !   5.9!0.75000!0.54839!0.53400!  5228. !  4765. !   8 8
0 80000!0.59508!0.57574!  5463. !  4897. !  10.4!0.80000!0.61120!0.59592!  5228  !  5154. !   1.4
0 85000!0 66525!0.64533!  5463. !  5417. !   0.8!0.85000!0.67401!0.66380!  5228. !  5649. !  -8 1
0.90000!0 73542!0.72437!  5463  !  6153. ! -12.6!0.90000!0.73749!0.73999!  5283  !  6342  ! -20.0
0 95000!0.82269!0.81962!  6794. !  7415. !  -9.1!0.95000!0.82661!0.83101!  7418  !  7575. !  -2.1
1 00000!1 00000!1.00000! 13803. ! 14042. !  -1.7!1.00000!1.00000!1.00000! 14431  ! 14065. !   2 5

          YEAR 1966    HOUSEHOLD SIZE 5         !             YEAR 1966   HOUSEHOLD SIZE 6
ACTUAL  ! ACTUAL!ESTIM.  ! ACTUAL! ESTIM. !RESID. !ACTUAL  ! ACTUAL!ESTIM.  !ACTUAL  ! ESTIM !RESID.
% POP   ! % AGI ! % AGI  ! $ AGI ! $ AGI  !   %   !% POP.  ! % AGI ! % AGI  ! $ AGI  ! $ AGI !   %
--------!-------!--------!-------!--------!-------!--------!-------!--------!--------!-------!-------
0 05000!0.00958!0.00789!   539. !   443. !  17.7!0.05000!0.01002!0.00830!   540. !   447. !  17.2
0 10000!0.02690!0.02404!   974. !   908. !   6.7!0.10000!0.02833!0.02434!   986. !   864. !  12.4
0 15000!0.04845!0.04550!  1211. !  1206. !   0.4!0.15000!0.05160!0.04546!  1254. !  1138. !   9.2
0 20000!0 07382!0.07080!  1426. !  1423. !   0.2!0.20000!0.07833!0.07034!  1440. !  1340. !   6 9
0 25000!0 10268!0.09930!  1623. !  1602. !   1.3!0.25000!0.10967!0.09835!  1689  !  1509. !  10.6
0 30000!0.13517!0.13066!  1827. !  1763. !   3.5!0.30000!0.14100!0.12920!  1689. !  1662. !   1 6
0 35000!0 16882!0.16469!  1892. !  1913  !  -1.1!0.35000!0.17492!0.16271!  1827. !  1805. !   1 2
0 40000!0 20686!0.20128!  2139. !  2057. !   3.8!0.40000!0.20991!0.19877!  1885. !  1943. !  -3 1
0 45000!0 24490!0.24044!  2139. !  2202. !  -3.0!0.45000!0.24915!0.23743!  2114. !  2083. !   1 5
0 50000!0.28720!0.28210!  2378. !  2342. !   1.5!0.50000!0.28852!0.27864!  2121. !  2221. !  -4 7
0 55000!0 33015!0.32630!  2415  !  2485. !  -2.9!0 55000!0.33279!0.32246!  2385. !  2361. !   1 0
0 60000!0 37732!0.37332!  2652. !  2643  !   0.3!0.60000!0.37707!0.36911!  2385  !  2513. !  -5.4
0 65000!0 42529!0.42324!  2697. !  2806  !  -4.1!0.65000!0.42631!0.41878!  2653  !  2677. !  -0 9
0 70000!0 48457!0.47648!  3333. !  2994  !  10.2!0 70000!0.47756!0.47183!  2761  !  2858. !  -3.5
0 75000!0 54507!0.53343!  3401. !  3202  !   5.9!0.75000!0.53967!0.52872!  3346  !  3065. !   8 4
0 80000!0.60557!0.59499!  3401. !  3461. !  -1.7!0.80000!0.60178!0.59041!  3346. !  3324. !   0 7
0 85000!0 66607!0.66240!  3401. !  3790. ! -11.4!0.85000!0.66389!0.65811!  3346. !  3647  !  -9.0
0 90000!0.73120!0.73805!  3662  !  4253. ! -16.2!0.90000!0.72600!0.73434!  3346. !  4107. ! -22 7
0 95000!0.81822!0.82839!  4892. !  5079. !  -3.8!0.95000!0.81210!0.82563!  4639. !  4919. !  -6 0
1 00000!1.00000!1.00000! 10220. !  9648. !   5.6!1.00000!1.00000!1.00000! 10124. !  9395. !   7 2
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TABLE C.3

REGRESSION RESULTS OF THE TIME-SERIES EQUATIONS FOR THE CES PARAMETERS.

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                     B1 IS THE INTERCEPT
                  B2 IS THE UNEMPLOYMENT RATE
         B3 IS THE PERCENT OF INCOME IN DIVIDENDS AND INTEREST

PARAM A      HH SIZE  1   | PARAM S      HH SIZE 1   | PARAM V      HH SIZE 1
RSQ 0.5151 RBARSQ 0.4405 | RSQ 0.6877 RBARSQ 0.6396 | RSQ 0.6643 RBARSQ 0.6127
RHO -.0105 AAPE   1.4679 | RHO 0.6280 AAPE   0.7181 | RHO 0.4700 AAPE   2.4371
B1  0.3723 T-STAT  23.28 | B1  0.4354 T-STAT  45.08 | B1  1.1771 T-STAT  10.66
B2  0.0031 T-STAT   1.65 | B2  0.0017 T-STAT   1.46 | B2  0.0340 T-STAT   2 63
B3  0.0018 T-STAT   0.99 | B3  0.0025 T-STAT   2.35 | B3  0.0115 T-STAT   0.94

PARAM P      HH SIZE  1   | PARAM A      HH SIZE 2   | PARAM S      HH SIZE 2
RSQ 0 6743 RBARSQ 0 6242 | RSQ 0 5975 RBARSQ 0.5355 | RSQ 0.4446 RBARSQ 0.3591
RHO 0 5139 AAPE  22 0978 | RHO 0 0715 AAPE   1.2434 | RHO -.0244 AAPE   0.2454
B1  0.1715 T-STAT   5 06 | B1  0.2835 T-STAT  25.86 | B1  0.4958 T-STAT 156 03
B2 -0.0124 T-STAT  -3 13 | B2 -0.0001 T-STAT  -0.10 | B2 -0.0012 T-STAT  -3 13
B3 -0.0016 T-STAT  -0.42 | B3  0.0037 T-STAT   3.01 | B3  0.0010 T-STAT   2.85

PARAM V      HH SIZE  2   | PARAM P      HH SIZE 2   | PARAM A      HH SIZE 3
RSQ 0.2988 RBARSQ 0.1909 | RSQ 0.3047 RBARSQ 0.1977 | RSQ 0.7566 RBARSQ 0.7192
RHO 0.2526 AAPE   2.5744 | RHO 0.2922 AAPE   9.6655 | RHO 0.4649 AAPE   2.3906
B1  1.2515 T-STAT  15.15 | B1  0.1909 T-STAT   3.69 | B1  0.1956 T-STAT  11.08
B2  0.0193 T-STAT   1.99 | B2 -0.0139 T-STAT  -2.29 | B2  0.0041 T-STAT   2.00
B3 -0.0059 T-STAT  -0 65 | B3  0.0072 T-STAT   1.25 | B3  0.0050 T-STAT   2.54

PARAM S      HH SIZE  3   | PARAM V      HH SIZE 3   | PARAM P      HH SIZE 3
RSQ 0.6666 RBARSQ 0.6153 | RSQ 0.3648 RBARSQ 0.2671 | RSQ 0.3232 RBARSQ 0.2191
RHO 0.2664 AAPE   0.3887 | RHO 0.3589 AAPE   4.4886 | RHO 0.3261 AAPE  15 6700
B1  0.5099 T-STAT 107 87 | B1  1.1705 T-STAT   8.41 | B1  0.1985 T-STAT   2.17
B2 -0.0021 T-STAT  -3.81 | B2  0 0386 T-STAT   2.37 | B2 -0.0256 T-STAT  -2.38
B3  0.0003 T-STAT   0.58 | B3 -0.0132 T-STAT  -0.85 | B3  0.0131 T-STAT   1.29

PARAM A      HH SIZE  4   | PARAM S      HH SIZE 4   | PARAM V      HH SIZE 4
RSQ 0.8875 RBARSQ 0.8702 | RSQ 0.6473 RBARSQ 0.5930 | RSQ 0.4654 RBARSQ 0.3832
RHO 0.0882 AAPE   1 3726 | RHO 0.2414 AAPE   0.4553 | RHO 0.3075 AAPE   3.3176
B1  0 1892 T-STAT  21.47 | B1  0.5158 T-STAT  88.47 | B1  1.1192 T-STAT  11.82
B2  0.0046 T-STAT   4 42 | B2 -0.0024 T-STAT  -3.52 | B2  0.0336 T-STAT   3.03
B3  0 0027 T-STAT   2.78 | B3  0.0002 T-STAT   0.36 | B3 -0.0135 T-STAT  -1.28

PARAM P      HH SIZE  4   | PARAM A      HH SIZE 5   | PARAM S      HH SIZE 5
RSQ 0.3995 RBARSQ 0.3071 | RSQ 0.6762 RBARSQ 0.6264 | RSQ 0.2014 RBARSQ 0 0785
RHO 0 3211 AAPE  11.1109 | RHO 0.2447 AAPE   3.1613 | RHO 0 1760 AAPE   0 9780
B1  0 2343 T-STAT   3 26 | B1  0.1821 T-STAT   9.32 | B1  0.5273 T-STAT  36.30
B2 -0.0238 T-STAT  -2 82 | B2  0.0044 T-STAT   1.94 | B2 -0 0013 T-STAT  -0.76
B3  0 0124 T-STAT   1.55 | B3  0.0039 T-STAT   1.78 | B3 -0.0009 T-STAT  -0.53
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TABLE C.3 (continued)

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PARAM V        HH SIZE  5  ! PARAM P        HH SIZE 5  ! PARAM A        HH SIZE 6
RSQ 0 1828 RBARSQ 0. 0571 ! RSQ 0. 1077 RBARSQ -. 0296 ! RSQ 0 8946 RBARSQ 0 8783
RHO 0 2619 AAPE    5. 4226 ! RHO 0. 2436 AAPE  18. 2604 ! RHO 0. 3092 AAPE    2. 6159
B1   1. 0592 T-STAT    6 97 ! B1   0. 2949 T-STAT    2. 49 ! B1   0. 1150 T-STAT    6 16
B2   0 0232 T-STAT    1. 30 ! B2 -0. 0145 T-STAT   -1. 05 ! B2   0. 0055 T-STAT    2. 51
B3 -0. 0040 T-STAT   -0. 24 ! B3   0. 0042 T-STAT    0. 32 ! B3   0. 0102 T-STAT    4 93

PARAM S        HH SIZE  6  ! PARAM V        HH SIZE 6  ! PARAM P        HH SIZE 6
RSQ 0 6765 RBARSQ 0 6267 ! PSQ 0 6980 RBARSQ 0. 6515 ! RSQ 0. 6066 RBARSQ 0 5461
RHO 0. 4737 AAPE    0. 4460 ! RHO 0. 1964 AAPE    3. 6634 ! RHO 0. 2150 AAPE  13. 4585
B1   0. 5242 T-STAT   88. 65 ! B1   0. 7513 T-STAT    6. 99 ! B1   0. 4434 T-STAT    6 67
B2 -0. 0023 T-STAT   -3. 35 ! B2   0. 0217 T-STAT    1. 72 ! B2 -0. 0136 T-STAT   -1. 75
B3 -0 0001 T-STAT   -0. 17 ! B3   0. 0261 T-STAT    2. 19 ! B3 -0. 0106 T-STAT   -1 44
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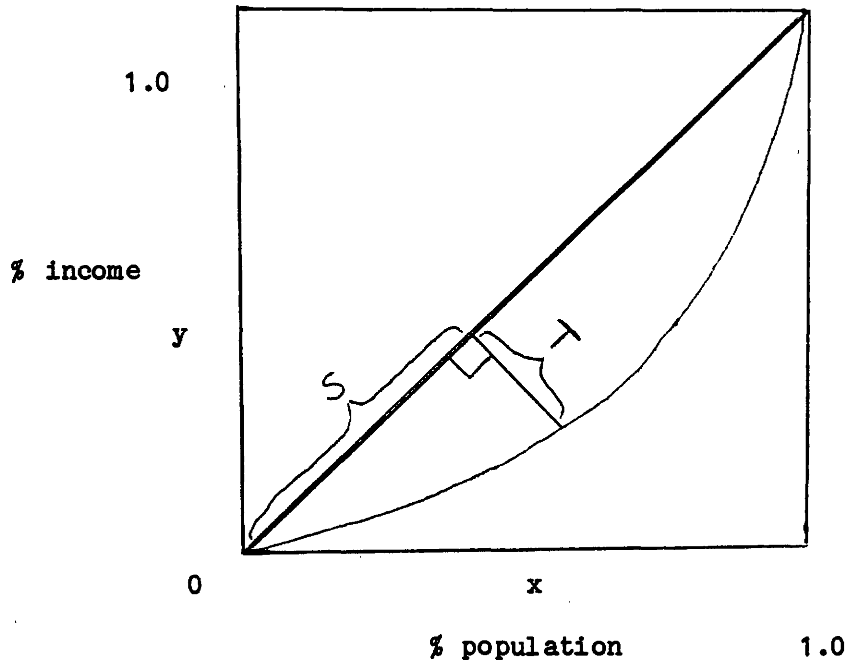
Mathematical Appendix.



The Lorenz curve is defined by a function T = f(S).

Basic geometry and algebra reveal that:

M.1) $S = (x + y)/\sqrt{2}$

M.2) $T = (x - y)/\sqrt{2}$

M.3) $x = (S + T)/\sqrt{2}$

M.4) $y = (S + T)/\sqrt{2}$

Equations M.1 - 4 are derived at the end of this appendix.

The Lorenz curve function for year t and household size h is

M.5) $T_{thi} = A_{th} * T81_{hi} + B_{th} * \{(S_{thi}{}^{1.5}(\sqrt{2} - S_{thi})^{.5}\}$

A_{th} and B_{th} are parameters which are estimated from historical observations on the income distribution. The third subscript on S and T, i, refers to the position along the x axis at which the function is evaluated. $T81_{hi}$ is the value of T in the 1981 Lorenz curve for household size h evaluated at position i.

The parameters A_{th} and B_{th} are obtained by regression estimation of equation M.5. The data for the estimation is obtained through the following process. First, the variable $T81_{hi}$ must be created, that is to say, the 1981 distribution must be defined. But to do this the observations of x_{thi} and y_{thi} must first be constructed. The raw data from Statistics of Income (SOI) are grouped. Each distribution has from 15 to 31 published observations (the j subscript) on the number of returns, r_{thj}, and on the amount of income, q_{thj}.

M.6) $$x_{thj} = \sum_{n=1}^{j} r_{thn}/R_{th}$$

M.7) $$y_{thj} = \sum_{n=1}^{j} q_{thn}/Q_{th}$$

R_{th} and Q_{th} are the total number of returns and income for year t, household size h. Linear interpolation is applied to get 40 values of yy_{thk} which correspond to 40 (k=1,40) values of xx_k chosen to be .025, .05, .075, ... 1.0. For example, if the value of xx_k chosen fell between x_{thj} and x_{thj+1}, then the value of yy_{thk} which corresponds to the value of xx_k would be

M.8) $$yy_{thk} = \{(xx_k - x_{thj})/(x_{thj+1} - x_{thj})\}*(y_{thj+1}-y_{thj}) + y_{thj}$$

These 40 values of of xx and yy for each year and household size are then used in equations M.1 and M.2 to obtain 40 corresponding values of S_{thk} and T_{thk}. The values of T which correspond to the 40 constructed points of xx_k for the year 1981 are called $T81_{hk}$. This constructing of xx and yy are necessary to get a whole time series of consistent data points used in estimating and forecasting the two parameters of the income distribution from equation M.5. This procedure is followed for all the years in the data sample (1966 through 1982, excluding 1967 because of lack of data) and values of S_{thk} and T_{thk} are similarly obtained. The values of T_{thk} are then used on the left-hand side of equation M.5, and the values of S_{thk} and $T81_{hk}$ are used on the right.

Equation M.5 is then estimated with ordinary least squares for each year and household size with the 40 observations to obtain the estimates of A_{th} and B_{th}. The results of these estimations are shown in table 2.1 of the text. Each parameter A, and B are cross-section estimates. Table 2.2 shows how well the estimated equations fit the interpolated grouped data from SOI. In order to save space, only the years 1966, 1970, 1975, and 1980 are shown. The fit for 1981 is perfect, by definition, since $A_{1981} = 1.0$ and $B_{1981} = 0.0$ for all six household sizes.

The cross-section estimates of the A and B parameters are then arranged in time-series. To forecast the income distribution in some future year, we need to forecast the value of this time-series. Equations are estimated in the form:

M.9) $A_h = c + d*UN + e*PCTINC + f*INFL + g*TIME$

M.10) $B_h = c + d*UN + e*PCTINC + f*INFL + g*TIME$

Where UN is the unemployment rate, PCTINC is the share of personal income that is made up of interest and dividends, INFL is the percentage change in the GNP deflator, and TIME is a linear time trend. The parameters estimated (c,d,e,f&g) are used with the forecasts of the economic variables to get forecasts of the parameters A and B. Equation M.5 indicates that if parameter A is greater than 1, the income distribution will be more unequal than it was in 1981. Also as parameter B increases, the more skewed the income distribution will be toward the right or upper end. The results of the estimations of equations M.9 and M.10 are shown in table 2.5 of the text and explained fully there.

What we have at this point is a means of forecasting A_{th} and B_{th}. We must next transform those into forecasts of y_{thg} which correspond to 50 grid values of x. The grids are necessary to combine the income distributions of the six household sizes into aggregate income distributions. The grids are created from the A_{th}'s and B_{th}'s numerically. Values of S_{hg}, T_{hg} and y_{hg} from the 1981 distribution are used. They are contained in a grid of 50 corresponding quadruplets which correspond to 50 equally spaced values of x_g. The 50 values of S_{hg} and $T81_{hg}$ are put in equation M.5 with the new forecast values of A_{th} and B_{th}. The result is 50 new values of T for each year and household size. These new T's and the S's (S_{81}) used to generate them are put into equations M.3 and M.4 to get new grids of values for x and y. These values of x are not equally spaced, however, so another linear interpolation is done, just as in equation M.8, to get the grid of quadruplets which correspond to the 50 equally spaced values of x_g for each household size in the forecast years.

Since the forecast values of x and y are in percentage terms, it is a simple matter to convert them to the number of people, X_{thg}, and dollar amount of income Y_{thg}, for year t, size h and grid cell g. The required pieces of data are the total population and income for each household size per year. The model determines both numbers in the aggregate, and the equations in tables 2.7 and 2.8 show how the aggregate is divided among the six household sizes. Let R_{th} be the number of people in household size h, year t, and Q_{th} be that group's AGI. X_{thg} and Y_{thg} are defined:

M.11) $$X_{thg} = (x_{thg} - x_{thg-1}) * R_{th} * H$$

M.12) $$Y_{thg} = (y_{thg} - y_{thg-1}) * Q_{th}$$

H = h, except when h = 6; Then H is the overall average household size of the six and over household size group.

Combining the Household Sizes.

The 6 household sizes are combined into a single overall 20 ventile distribution for each year. (Each ventile contains people from all 6 household sizes.) The grid values of x and y are converted into unit values by equations M.11 and M.12, and per capita incomes (PCI's) are calculated for each cell in each grid:

M.13) $$PCI_{thg} = Y_{thg} / X_{thg}$$

The cutoff PCI, (PCC) which defines the border between grid cell g and g+1 is obtained by:

M.14) $$PCC_{thg} = (PCI_{thg} + PCI_{thg+1})/2$$

The different household sizes are combined into a single distribution per year by an alogorithm where first, a guess is made at ventile i's cutoff PCI, $\widetilde{PCC}_{ti}$ (i = 1...20). If that guess falls between the grid's PCC_{thg} and PCC_{thg+1}, then the guess at ventile i's population from that household size and that year is arrived at by linear interpolation:

M.15) $$\widetilde{X}_{thi} = (\widetilde{PCC}_{ti} - PCC_{thg})/(PCC_{thg+1} - PCC_{thg}) * X_{thg} + \sum X_{thg-1}$$

The same interpolation is used to get the guess at the dollar income for ventile i, from household size h and year t, that is, $\widetilde{Y}_{thi}$. The same guess at $\widetilde{PCC}_{ti}$ is used for all six household sizes. Now the $\widetilde{X}_{thi}$'s are summed over h. If that sum is more than one-twentieth of that year's total population, the process is repeated with a lower inital guess at the per capita income cutoff, PCC_{ti}. If the sum is less than one-twentieth, a higher $\widetilde{PCC}_{ti}$ is tried. The process is repeated until the sum is within a specified range (100 persons) of the true ventile population. The resulting X_{thi}'s and Y_{thi}'s are shown in table 2.10 along with their sums over household sizes, X_{ti} and Y_{ti}. Note that the sums of X_{thi} over h, X_{ti}, are the same for all 20 ventiles in any given year. The final cutoff income, PCC_{ti} is saved for later use in constructing an index for the consumption model.

Estimating Federal Income Tax Liability.

Taxes are levied against household income, so an estimate of each household size's income in each ventile must be obtained. Average household incomes, AHI_{thi} are calculated:

M.16) $$AHI_{thi} = (Y_{thi}/X_{thi})*H$$

Next, "standard" tax liability is calculated as a function, TX_{thi}, of AGI_{thi}. The function is not estimated, but depends on parameters in the tax law. The standard tax rates are the rates which would apply to the average taxpayer in the {thi} group if that taxpayer took the standard deduction, and no other special tax credits or tax preferences.

M.17) $$STR_{thi} = TX_{thi}(AHI_{thi})/AHI_{thi}$$

These are calculated for both the history and the forecast. The historical values of standard tax rates are compared to the effective historical rates and a relation is established by regression analysis and used for the forecast. To establish this relationship, the historical actual taxes must be determined.

First, the actual income distribution for the history must be derived from the grouped SOI data. Interpolation is necessary to get the data to conform to the detailed ventile configuration as illustrated in table 2.10. Since we already have cross-section parameter estimates for each distribution in the history, it would be possible to derive the necessary detail in the same method as described above for the forecast, but that would result in distributions that correspond to the fitted, not the actual distribution. Since the purpose of analyzing the historical data is to establish the true relation between standard and actual taxes by ventile and household size, it is only appropriate to use the actual income distributions and not the fitted ones. These actual distributions in ventile and household size detail are obtained in the following manner.

The IRS reports AGI_{thj}, the number of exemptions other than age or blindness (EX_{thj}), and the taxes paid, (TAX_{thj}), for year t, household size h, and income group j. The cutoff, or upper income boundaries for each group are also reported, and here are converted to per capita incomes and denoted by SOI_{thj}. Cumulative percentage distributions are calculated as in equations M.6 & M.7, above, for exemptions, (ex_{thj}), and taxes (tax_{thj}). Next, a grid of size G (G=200) was constructed so that each cell contains AGI and taxes for 1/G of the population. This was accomplished by first, obtaining the cutoff per capita incomes $GPCC_{thg}$ and effective tax rates, GTR_{thg} at the upper border of each grid cell. This was done by linear interpolation: If the cumulative percent population for the g^{th} cell, g/G, falls between ex_{thj-1} and ex_{thj}, then

M.18) $$GPCC_{thg}=\{(g/G-ex_{thj-1})/(ex_{thj}-ex_{thj-1})\}*(SOI_{thj}-SOI_{thj-1})+SOI_{thj-1}$$

and

M.19) $$GTR_{thg}=\{(g/G-ex_{thj-1})/(ex_{thj}-ex_{thj-1})*$$

$$(TAX_{thj}-TAX_{thj-1})+TAX_{thj-1}\}/GPCC_{thg}$$

The upper border of the highest cell is, of course, not obtainable from the data. Fortunately, we are still able to to accurately assess the lower border and the dollar amounts of income and taxes in the highest cell, even when G=200. This is because the IRS reports its top income group as the one with households recieving over a million dollars in AGI. The number of returns in that group is less than .5% of the total returns for all the distributions in the sample. So even with the linear interpolation described above, it is possible to determine the average income and tax rates for the highest .005 of each distribution.

The next step is to fill out the rest of the grid cells, that is, to convert the upper limits of each cell's AGI and taxes to dollars of AGI and taxes in each grid cell. The dollars of income, $GAGI_{thg}$, and taxes $GTAX_{thg}$ are calculated as follows:

M.20) $$GAGI_{thg}=\{(GPCC_{thg-1}+GPCC_{thg})/2.0\}*1/G*\sum_{j=1}^{J}ex_{thj}$$

M.21) $$GTAX_{thg}=\{(GTR_{thg-1}+GTR_{thg})/2.0\}*GAGI_{thg}$$

Now the data are ready to be used to determine the historical ventile cutoff incomes. The household combining algorithm described above (equation M.15) for the forecast is applied to the history, using the historical grids just constructed. The result is not only income and exemptions for each of the 120 groups, but historical effective tax rates, (ETR_{thi}s) as well. Each group's average household income is calculated as in equation M.16, and the historical tax laws are applied to get the standard tax rates for each group as in equation M.17.

The reason 200 grid cells per distribution were necessary in the history was that the cell cutoff, or top per capita income border is used to determine the ventile per capita cutoff income. Because the top grid cell has no upper bound, linear interpolation is only possible if the ventile cutoff incomes are below the penultimate grid cell's upper bound. This was not the case in some of the historical distributions for grids of size 50 or 100, but a grid of size 200 was always sufficient. (Note that the top ventile's dollar income and taxes are calculated as residuals by subtracting the first 19 ventile amounts from the total dollar amount reported.

The AHI's are calculated as above, and applied to their year's tax laws. The tax laws in the past have, of course, varied over time, and every effort has been made to account for those changes which affect the calculation of standard taxes.

The actual or "effective" tax rates, ETR_{thi}'s, are obtained from the data by the interpolation method just described. Next, an equation which relates the standard tax rates to the effective tax rates must be estimated. The equations could have been estimated separately for each household size, but that would have required 120 equations. Instead, the six household sizes were aggregated into one, reducing the number of required equations to 20. Because the cutoff incomes, PCC_{ti}, are the same for all household sizes, the aggregation was accomplished by a simple income-weighted average:

M.22) $$STR_{ti}=\sum_{h=1}^{6}\{STR_{thi}* (Y_{thi}/(\sum_{h=1}^{6}Y_{thi}))\}$$

M.23) $$ETR_{ti}=\sum_{h=1}^{6}\{ETR_{thi}* (Y_{thi}/(\sum_{h=1}^{6}Y_{thi}))\}$$

At this point, the STR_{ti}'s and ETR_{ti}'s both exist for the history. The forecast STR_{ti}'s are obtained from the income distribution forecast and the future tax law assumptions. The forecast ETR_{ti}'s are obtained from the estimated results of regression equations which relate the historical standard and effective tax rates.

The ratios of effective to standard tax rates are assumed to change over time.

M.24) $$ETR_{ti}/STR_{ti}= a1_{ti} + a2_{ti} * TIME_{t}$$

The equations are estimated in nearly the equivalent form:

M.25) $$ETR_{ti}= a1_{ti} * STR_{ti} + a2_{ti} * TIME_{t} * STR_{ti}$$

The estimates of the $a1_{ti}$'s and $a2_{ti}$'s are used to forecast the standard-to-effective tax ratios. The estimated ratios (not the actual ratios) from 1982 are used for the base forecast. They are shown in the first column of table 3.2

The forecast income tax revenue for year t, ventile i is:

M.26) $$Tax_{ti}= ETR_{ti} * Y_{ti}$$

State and local income tax is calculated as an exogenous percentage of federal income taxes, and other taxes are calculated as percentages of personal income (the percentages are the average percentages over the 1980-1982 period). Disposable AGI is then calculated as:

M.27) $$DISAGI_{ti}= Y_{ti} - Tax_{ti} - \text{other taxes}_{ti}$$

Next, the per capita cutoff disposable AGI's, the $PCCD_{ti}$'s, must be estimated. This is done by estimating the effective tax rates on the cutoff incomes ,$CETR_{ti}$'s, by linear interpolation. If the cutoff income, PCC_{ti}, is two thirds of the way between the its surrounding ventiles' average AGI (denoted by $PCAGI_{ti}= AGI_{ti}/NEX/20$, where NEX is the total number of exemptions), then the cutoff tax rate will be two thirds of the way between the effective tax rates of its two surrounding ventiles:

M.28) $$CETR_{ti}=\{(PCC_{ti}-PCAGI_{ti})/(PCAGI_{ti+1}-PCAGI_{ti})\}*(ETR_{ti+1}-ETR_{ti})+ETR_{ti}$$

Then, $PCCD_{ti}$ can be calculated by multiplying the pre-tax cutoff AGI by one minus the tax rates. State and local income taxes are a fraction, RSLINC, of federal taxes, and the other taxes are a fraction, ROTH, of personal income.

M.29) $PCCD_{ti}= PCC_{ti}*\{1.0-((1+RSLINC)*CETR_{ti})\}-(ROTH*PCCPI_{ti})$

Where $PCCPI_{ti}$ is the per capita cutoff for Personal income derived below.

<u>Reconciliation to the Personal Income Definition of Income.</u>

The reconciliation items which are part of personal income but not AGI must now be added. The result of this last step is that the pre-tax and post-tax income distributions will be defined in terms of personal income instead of AGI. Let RI_{tr} be the 12 aggregate reconciliation items (r=1,12) and P_{ir} be the coefficients of the AGI-PI bridge. RF_{ti} is the flow of total reconciliation items to ventile i, and is defined as:

M.30) $$RF_{ti}= P_{ir}*RI_{tr}$$

That amount is added to disposable AGI to get disposable Personal Income.

M.31) $$DISPY_{ti}= DISAGI_{ti}+ RF_{ti}$$

The per capita reconciliation and per capita AGI are calculated as:

M.32) $$PCRF_{ti}= RF_{ti}/(NEX/20)$$

M.33 $$PCAGI_{ti}= AGI_{ti}/(NEX/20)$$

Then, the amount of per capita reconciliation at the ventile cutoff is is estimated by linear interpolation as the tax rates were before.

M.34) $$PCCRF_{ti}= \{(PCC_{ti}-PCAGI_{ti})/(PCAGI_{ti+1}-PCAGI_{ti})\}* (PCRF_{ti+1}-PCRF_{ti})+PCRF_{ti}$$

Then $PCCRF_{ti}$ is added to the per capita cutoffs for pre-tax AGI, PCC_{ti}, and post-tax AGI, $PCCD_{ti}$, to get the cutoffs for both pre-tax and post-tax personal income, $PCCPI_{ti}$ and $PCCPID_{ti}$.

Next, the nonfiler adjustment must be made. The adjustment can be expressed as follows where v_i^* denotes the adjusted cutoff income for ventile i, and v_i is the unadjusted cutoff income.

M.35) $v_2^*=.65v_2$

M.36) for i=3,6 $v_i^*=v_{i-1}-(.075(20-i)-1)*(v_{i-1}-v_{i-2})$

M.37) for i=7,19 $v_i^*=v_i-(.075(20-i))*(v_i-v_{i-1})$

The top ventile, which is the share of the total is increased by the appropriate factor (about 7%) to account for its having some people in it that were previously in the 19th ventile.

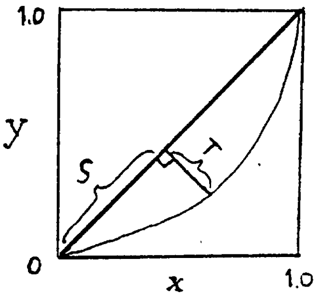
Finally, an index of the disposable personal income distribution must be constructed to be used in in the consumption model. The index $PCCDX_{ti}$ is defined as the cutoff per capita personal income divided by the average per capita personal income:

M.38) $PCCDX_{ti}= PCCPID_{ti}/(\sum_{i=1}^{20}DISPY_{ti}/POP)$

and the twentieth index number for year t is defined as:

M.39) $PCCDX_{t20}= DISPY_{t20}/\sum_{i=1}^{20}DISPY_{ti}$

Derivation of equations M.1 - M.4.



M.1) $S = (x + y)/\sqrt{2}$

M.2) $T = (x - y)/\sqrt{2}$

M.3) $x = (S + T)/\sqrt{2}$

M.4) $y = (S - T)/\sqrt{2}$

a) $x^2 + y^2 = S^2 + T^2$ (Pythagorean Theorem)

b) $T^2 = x^2 + y^2 - S^2$ (rearrangement of a)

c) $T^2 = (1-x)^2 + (1-y)^2 - (\sqrt{2}-S)^2$ (Pythagorean Theorem)

d) $x^2+y^2-S^2 = (1-x)^2 + (1-y)^2 - (\sqrt{2}-S)^2$ (combination of b & c)

e) $x^2+y^2-S^2 = 1-2x+x^2+1-2y+y^2-2+2\sqrt{2}S-S^2$ (expansion of d)

f) $0 = -x -y + \sqrt{2}S$ (cancellation of like terms in e)

g) Equation M.1: $S = (x + y)/\sqrt{2}$ (rearrangement of f)

h) $T^2 = x^2 + y^2 - x^2/2 - xy -y^2/2$ (sub eq. 1 for S^2 in b)

i) $T^2 = x^2/2 -xy +y^2/2$ (combine like terms in h)

j) $T^2 = (x^2 - 2xy + y^2)/2$ (factor out 2 in i)

k) $T^2 = \{(x-y)/\sqrt{2}\}^2$ (factor right side of j)

l) Equation M.2: $T = (x - y))/\sqrt{2}$ (square root of both sides of k)

m) $y = \sqrt{2}S - x$ (solve eq. 1 for y)

n) $y = x - \sqrt{2}T$ (solve eq. 2 for y)

o) $x - \sqrt{2}T = \sqrt{2}S - x$ (combine m and n)

p) Equation M.3: $x = (S + T)/\sqrt{2}$ (rearrange o and solve for x)

q) $x = \sqrt{2}S - y$ (solve eq. 1 for x)

r) $x = \sqrt{2}T + y$ (solve eq. 2 for x)

s) $\sqrt{2}T + y = \sqrt{2}S - y$ (combine q and r)

t) Equation M.4: $y = (S - T)/\sqrt{2}$ (rearrange s and solve for y)

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