CHAPTER II. THE CBO INCOME TAX MODEL

This chapter describes CBO's revenue forecasting model for the individual income tax and how it is used. This model was developed for CBO's use in making five-year forecasts of federal budget revenues based on current tax policy. These forecasts are considered by the Congress in developing concurrent resolutions on the budget.

OVERVIEW

The model is designed to account explicitly for the effects of important current developments affecting income tax revenues. These include:

- Cyclical swings in aggregate income;
- "Bracket creep," the movement of taxpayers' incomes upward through the progressive tax bracket structure as a consequence of inflation and productivity growth;
- Changes in statutory tax bracket rates, such as those enacted as part of the Economic Recovery Tax Act of 1981 (ERTA);
- Indexation of statutory tax brackets, personal exemptions, and the standard deduction, which was also enacted as part of ERTA to take effect in 1985.

Revenue forecasts by this model are based upon--that is, they take as given, or "exogenous"--forecasts by CBO's Fiscal Analysis Division of macroeconomic variables, such as real GNP, the levels of wages and prices, employment, and other variables.[1] Similarly, values for all statutory tax provisions are specified outside the model.

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1 After a preliminary revenue forecast is made by the Tax Analysis Division, the Fiscal Analysis Division reviews its forecast of GNP, taxable personal income, and other National Income and Product Accounts variables in light of the revenue forecast to ensure that the two are consistent. If necessary, revisions are made in the economic figures. This process of adjustment of the economic forecast to the revenue projection is sometimes repeated several times.

The model itself consists of four parts. The first develops a forecast of the tax base--the narrow Internal Revenue Service "Taxable Income" measure--from the forecast of the broader taxable personal income aggregate in the National Income and Product Accounts (NIPA).[2] This part represents the effects of exemptions and deductions in shielding personal income from taxation and accounts for definitional differences between the tax base and NIPA personal income. The second part derives a weighted-average tax rate that applies to the tax base. This involves predicting the way in which the tax base is spread over the structure of statutory tax brackets and combining this prediction with detailed information on statutory tax rates. The third part of the model represents the derivation of tax liabilities by combining the tax base from the first part with the weighted-average tax rate derived in the second part. Since tax liabilities differ from individual income tax revenues collected by the government because of the timing of tax collections and other factors, the final part of the model adjusts the liability forecast for these factors, yielding a forecast of federal revenues.

This model, while quite detailed and complex, is intended to account directly only for economic and policy developments with major consequences for tax revenues. Tax policy measures with smaller revenue implications must be analyzed separately and their revenue consequences added to the projections of the main model. Examples of measures that currently must be handled separately are changes in capital gains tax provisions and changes in Individual Retirement Account and Keogh plan provisions, among others. Over time, these specific items become incorporated in the estimation of the tax base, but at any point in time recently legislated tax provisions with smaller revenue effects are handled separately.

Each of the four main parts of the model is estimated on the basis of historical data, and is described below in turn. All logs are natural logs.

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2 Taxable personal income (TPY) consists of wage and salary disbursements, personal interest income, personal dividend income, rental income of persons, and farm and nonfarm proprietors' incomes. Equivalently, TPY can be computed as personal income minus government transfer payments and other labor income plus personal contributions for social insurance. Since transfers are excluded and personal contributions for social insurance are included, TPY is the same as Pechman's "adjusted personal income". See "Responsiveness of the Federal Personal Income Tax to Changes in Income," p. 415.

PART 1: FORECAST OF THE TAX BASE FROM TAXABLE PERSONAL INCOME

Approach Used in Earlier Studies

In computing tax liabilities, each taxpayer first subtracts from adjusted gross income a set of "exclusions": one or more personal exemptions and either a "standard" deduction ("zero bracket amount") or a set of itemized deductions. What remains is taxable income, or the "tax base" for that taxpayer.

Most tax models, including that of CBO, analyze this process at the aggregate level, relating the total tax base in the economy to total gross income as well as to variables accounting for changes in the relevant provisions of the tax law. This is simpler than analyzing the decisions of individual taxpayers or groups of taxpayers, and is still quite accurate.

As an additional simplifying step, proxy variables are often used for aggregate adjusted gross income, aggregate itemized deductions, and total tax returns. This procedure is used because none of these variables is normally predicted by formal economic forecasting procedures, and attempts to forecast them separately may not improve the accuracy of the overall analysis of the tax base.

Several earlier studies have used personal income from the NIPA as a proxy for adjusted gross income and total population as a proxy for total returns.[3] Itemized deductions, for their part, have been assumed to be proportional to aggregate gross income so no separate proxy variable is needed.[4] The earlier studies then predict the fraction of aggregate gross income that appears in the narrower aggregate tax base in terms of the levels of gross income per tax return, capital gains per return, the statutory personal exemption, and the statutory standard deduction (zero

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3 See "Income Sensitivity of a Simple Personal Income Tax," "The Responsiveness of Federal Personal Income Taxes to Income Change," and "Responsiveness of the Federal Individual Income Tax to Changes in Income."

4 In addition to the studies cited in footnote 3, this assumption is made in "The Elasticity of the U.S. Individual Income Tax: Its Calculation, Determinants, and Behavior." Other analysts have pointed out, however, that the assumption is sometimes violated in practice and that the behavior of the tax can be affected significantly. See David Greytak and Richard McHugh, "Inflation and the Individual Income Tax," Southern Economic Journal, 45 (1978).

bracket amount). Once the fraction of gross income appearing in the tax base has been determined, it is a simple matter to compute the predicted level of the tax base itself.

Each of the explanatory variables used in these studies should be expected a priori to have an identifiable qualitative effect on the ratio of the tax base to gross income. Other factors being equal, increases in either the personal exemption or standard deduction should reduce the ratio, while increases in gross income per return should increase it. This second effect should occur because increases in income per return may accrue largely to existing taxpayers and thus may not be as well protected from taxation by exemptions and deductions as increases that accrue to new taxpayers. A greater proportion of an income increase accruing to existing taxpayers should, therefore, enter the tax base.

Representation in the CBO Model

The CBO model, like earlier studies, generally follows the approach outlined above. Like most earlier treatments, for example, the model assumes aggregate itemized deductions to be proportional to gross income. The CBO approach departs from the earlier studies in important ways, however. In particular, the CBO model uses total employment instead of population as a proxy for total returns, and taxable personal income from the NIPA instead of personal income as a proxy for aggregate adjusted gross income. Employment, like population, is easily forecast; it is routinely included, in fact, in economic forecasts developed at CBO. Unlike population, however, employment varies over the business cycle. Since total tax returns also exhibit such variation, using employment rather than population prevents the model from overlooking important cyclical aspects in the behavior of returns, as is done in other studies.[5] Taxable

5 In particular, this treatment implies that changes in aggregate gross income that reflect price increases alone are taxed more heavily than are changes in aggregate real income. This is because changes in real income change employment and the number of tax returns. Income per return, therefore, changes less quickly when the income change is real than when it is purely nominal. The quantitative implications of this and other properties of the CBO model are described in Chapter IV.

personal income, similarly, is a closer proxy for adjusted gross income than is personal income, and is also routinely included in CBO economic forecasts.[6]

The estimated equation that results from all these considerations, using historical time-series data for 1954-1980, is

$$
\begin{aligned}
(1)\quad \log\left(\frac{Z}{TPY}\right) = {} & \underset{(-18.91)}{-2.16473} - \underset{(-10.35)}{.25983}\left(\log\left(\frac{TPY}{EMP}\right) - \log(ESTAT)\right) \\
& \underset{(-2.846)}{-.05442}\left(\log\left(\frac{TPY}{EMP}\right) - \log(SDSTAT)\right) \\
& \underset{(-2.054)}{-.03002}\log\left(\frac{CG}{EMP}\right) \\
& - \underset{(-2.178)}{.02311}\ D6469 \\
& - \underset{(-2.609)}{.01980}\ D7076
\end{aligned}
$$

$R^2 = .9809$
Standard error =.01369
Durbin-Watson statistic = 1.3985
Sample period = 1954-1980 (annual data)
(Numbers in parentheses are t-statistics)

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6 Another modification relative to earlier papers is more technical. If increases in taxable personal income per return that are accompanied by increases at the same rate in the personal exemption and deduction (as, for example, under the indexed tax in the face of "pure" inflation in which all prices and wages rise at the same rate), it is reasonable to expect that the tax base should rise at the same rate as taxable personal income. With this concern in mind, the coefficient of the log of taxable personal income per employee was constrained to be equal to minus the sum of the coefficients of the logs of the exemption and standard deduction. The implicit coefficient for log (TPY/EMP) in the estimate shown below is .31425, which differs by .00091 from its value when estimated freely. As this result suggests, the constraint on this coefficient appeared not to be binding: an F test rejects at the 99 percent confidence level the hypothesis that the coefficient of log (TPY/EMP) is not equal to minus the sum of the coefficients of log (ESTAT) and log (SDSTAT).

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Z is taxable income under the individual income tax (the tax base, IRS definition). To ensure consistency with data for earlier years, the figures exclude the zero bracket amount in 1977-1980. (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

TPY is Taxable Personal Income (wage and salary disbursements plus personal interest income, personal dividend income, rental income of persons, and farm and nonfarm proprietors' incomes.) (Source: National Income and Product Accounts.)

EMP is total employment (household survey). (Source: Bureau of Labor Statistics.)

ESTAT is the statutory per capita exemption (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

SDSTAT is 50 percent of the statutory maximum per-return standard deduction for joint returns (the zero-bracket amount in 1977-1980). (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

CG is net capital gains. (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

D6469 is a dummy variable that accounts for the presence of the minimum standard deduction during the period 1964-1969.

D7076 is a dummy accounting for the introduction of the low-income allowance during 1970-1976.

This equation does well at explaining the past behavior of the tax base. This is attested by the R^2 statistic, which indicates that the equation explains 98.09 percent of the variation in the tax base as a proportion of taxable personal income. In addition, all of the a priori theoretical suppositions listed above regarding the effects of changes in particular explanatory variables are confirmed by the estimated coefficients.

PART 2: DETERMINING THE EFFECTIVE TAX RATE

How the Effective Tax Rate Works in the Actual Economy

Once each taxpayer has subtracted exemptions and deductions from his gross income, the remaining income (the tax base for that taxpayer) is divided into pieces, or "brackets," and a different tax rate is applied to each. An overall effective tax rate for that taxpayer is determined by the different bracket rates that apply to his income in combination with the amount of his income that is subject to each rate. It is useful to think of the effective tax rate as a weighted average of the different statutory rates, in which the weight attached to each rate is the percentage of the taxpayer's taxable income that is taxed at that rate.

The way that this process works in the aggregate can be conceived in much the same way. Aggregate tax liabilities, L, can be determined using the tax base, Z, determined in Part 1, by applying an aggregate effective tax rate, t:

(2) $L = Zt.$

As it is for an individual, the effective tax rate for the whole economy is determined by two factors: the set of statutory tax rates that apply to the different brackets and the aggregate amount of taxable income that falls into each bracket and is taxed at the associated rate. Together, these two factors determine the aggregate effective tax rate as a weighted average of the statutory rates that apply to different brackets. Because of their important role in the determination of the effective tax rate in both the actual economy and in the CBO model, each of these two factors is described below in some detail.

The Structure of Brackets and Rates

Four different categories of tax returns have been established, and a different pattern of tax brackets, with a correspondingly different schedule of tax rates, applies to each one. These categories are joint returns and returns of surviving spouses, accounting for 70 percent of the tax base in 1980; returns of single persons (24 percent); returns of heads of households (5 percent); and separate returns of husbands and wives (1 percent).

Prior to 1979, each bracket structure was composed of 25 brackets. Beginning in 1979, however, each has consisted of at least 12 brackets that increase in width as income increases. On joint returns for 1984, for example, the first bracket (after the zero bracket amount), will be $3,400 to $5,500 while the top bracket will be $162,400 and over. The corresponding schedule of tax rates will rise from 11 percent on the first bracket to 50 percent on the last.

How the Tax Base is Spread Over the Bracket Structure

A relatively large percentage of all taxable income falls into the lowest brackets, while increasingly little falls into the higher ones. This is because every taxpayer--including those with high incomes--has some income taxed in the first bracket. Less and less income falls into each succeeding bracket because the incomes of lower-income taxpayers gradually are exhausted and do not reach the higher brackets. As a result, the percentage spread of the aggregate tax base over the bracket structure has a triangular shape: it is high for the low brackets and low for the high ones (see Figure 1).

Inflation and productivity growth can bring about an increase in the percentage of total taxable income that appears in the upper brackets of any given category of returns, and a corresponding decline in the percentage appearing in the lowest brackets. Figure 1 provides an illustration of the way this process has worked in the past. The figure shows the bracket structure for joint returns in 1964 and 1979, together with "curves" showing the percentage of all taxable income on joint returns that appeared in each bracket in each of those years. In 1979, the curve was higher for the upper brackets and lower in the bottom brackets.

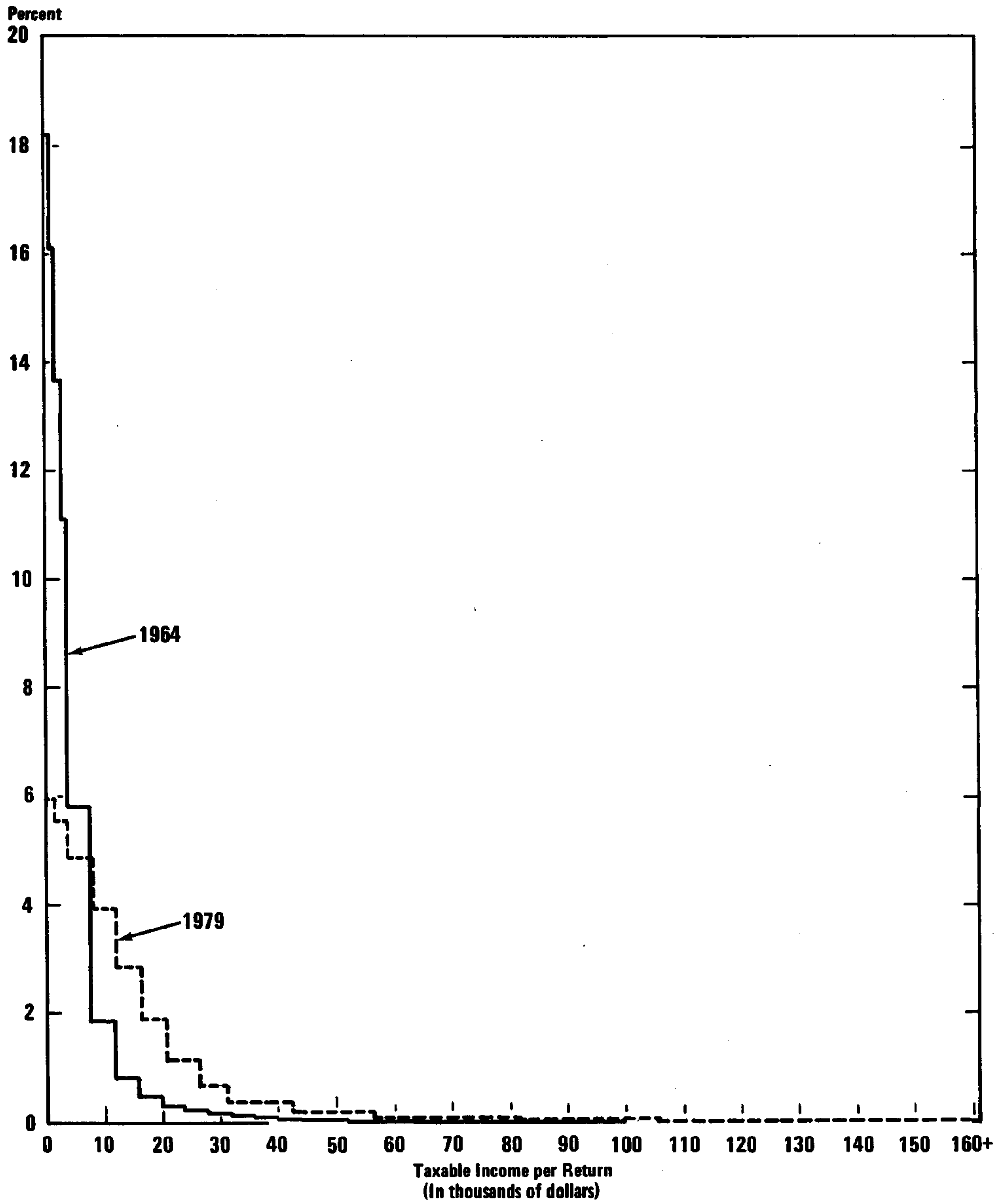
Modeling Movements of Taxable Income Through the Brackets

It is important to capture the effects of such income movements when forecasting individual income tax revenues. Changes in the rate at which incomes move into higher brackets affect the weights that are associated with different statutory tax rates, with significant implications for the weighted-average tax rate, and, consequently for income tax revenues. In order to explain and predict this process in a tax model, a means is needed first to replicate the distribution of the tax base over the bracket structure (shown in Figure 1) and then to account for the way economic and statutory factors cause it to change. Fortunately, a mathematical tool, the distribution function, is available and is well suited to this job.

A mathematical distribution function is a formula for a curve like those shown in Figure 1. Such formulas typically involve only a few variables, or "parameters," that must be assigned particular values in order to determine the full distribution explicitly. If a distribution function can be found that fits the actual spread of the tax base in different years

Figure 1.

Distribution of Taxable Income for Joint Returns Over the Bracket Structure, for Calendar Years 1964 and 1979.



closely enough, then the parameters of this function can be used as summary measures of the position and movement of the actual distribution. Equations can be developed explaining and predicting the behavior of these parameters in terms of the economic and statutory factors that determine bracket creep in the actual economy. To forecast the effective tax rate, it is necessary only to use these equations to predict values of the parameters; put these values into the mathematical formula to generate a predicted distribution of the tax base; and then use this distribution to calculate the predicted amount of the base that falls into each bracket. When these predicted figures are combined with values of the statutory bracket tax rates, the predicted weighted-average tax rate can be computed.

Treatment in the CBO Model. CBO has found that a relatively simple distribution function having only one parameter, the "exponential" distribution, works well in this role. The formula is

$$(3)\quad f(x) = (1/b)\, e^{(-x/b)}$$

or equivalently

$$\log\ f(x) = -\log(b) - (x/b)\ .$$

Here e is the mathematical exponentiation operator, b is the parameter, x is the level of the tax base on an individual return (in terms of which the statutory brackets are defined), and f(x) is the height of the curve above that level of the tax base. The percentage of the aggregate tax base that falls into the bracket associated with x dollars of tax base per return is shown by f(x). The parameter to be estimated is b.

An example might clarify how this distribution function is used. Suppose we want to find out how much of the tax base is predicted to fall into the first bracket on joint returns in a given year. Once b is known, each level of x in the first bracket is substituted into the formula, and values of f(x) that are given by the formula for these levels of x are added together.[7] The result is the percentage of the aggregate tax base reported on joint returns that is predicted to fall into the first bracket.

Before any of this can be done, a means of predicting b must be found. This is done in two steps. First, the b value is estimated for each year in the past using detailed data on the income distribution. Then, once

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7 "Adding up" of the levels predicted by the exponential distribution is done simply and efficiently by a mathematical process known as "definite integration."

this series of past b values has been developed, it is used to estimate an equation that explains and predicts the behavior of b in terms of other variables.

In the first step, a b value was determined for each year during the 1964-1979 period, using a standard statistical procedure--the maximum likelihood estimator.[8] The second step mainly involved choosing the most appropriate other variables for determining how b behaves.

The most important factor in explaining the movement of the tax base through the bracket structure (represented by changes in b) seems likely to be aggregate income per tax return.[9] A good proxy for this

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8 The Internal Revenue Service has decided not to publish data on this distribution for 1978, 1980, and apparently for subsequent even-numbered years. Adequate information is, however, available in the annual figures published for 1977 and prior years and the semiannual data that will be published subsequently. For discussion of ways to fit and analyze income distribution functions, see Charles Metcalf, An Econometric Model of the Income Distribution (Chicago: Markham, 1972); A.B.Z. Salem and T.D. Mount, "A Convenient Descriptive Model of Income Distribution: The Gamma Density," Econometrica, vol. 74 (1974), pp. 1115-1127; and N.A.J. Hastings and J.B. Peacock, Statistical Distributions (New York: Wiley, 1974). The treatment in this paper is not based on a formal representation of the underlying frequency distribution of taxable personal income. The formal distribution function that is used here represents not the frequency distribution of personal incomes, but the percentage of all taxable income that appears at a given per return taxable income level on tax returns. In fitting the exponential distribution, the dollar amounts in terms of which the statutory tax brackets are defined were expressed in units of $100,000. The mean of the actual distribution in each year was computed by multiplying the lower boundary of each bracket by the percentage of all of the tax base reported on that type of returns that was in that bracket. Then the mean was computed as a weighted average by adding together the figures for all the different brackets. The data on amounts of the tax base falling in different brackets are reported in annual issues of U.S. Treasury Department, Internal Revenue Service, Statistics of Income: Individual Income Tax Returns. For figures for joint returns in 1979, for example, see p. 97, column 23.

9 The distribution of the tax base over the bracket structure (of which b is the mean) is related to, but not equivalent to, the conventional frequency distribution of income (of which per capita income is the

variable, in turn, is some measure of per capita income. This is simply because such movement results directly from changes in per capita income. (Variations in per capita income, in turn, are explained or determined by inflation, real economic growth, and other economic developments that are outside the scope of the tax model.) Using the ratio of the aggregate tax base, Z, to total employment, for example, CBO has estimated the following equations to explain b:

$$(4)\quad \log(b_{jr}) = \underset{(-18.96)}{-3.36733} + \underset{(10.95)}{.68414} \log \left(\frac{Z}{EMP}\right) + \underset{(2.982)}{.11996} \log \left(\frac{CG}{EMP}\right) - \underset{(-4.023)}{.16990}\, D6469 - \underset{(-2.514)}{.06396}\, D7076$$

$R^2 = .9929$
Standard error = .02422
Durbin-Watson Statistic = 1.7071

$$(5)\quad \log(b_{sr}) = \underset{(-20.57)}{-4.09986} + \underset{(7.089)}{.64559} \log \left(\frac{Z}{EMP}\right)$$

Footnote Continued

mean). For this reason, use of per capita income to explain b is not tautological, as it might at first appear. The relationship between the two distributions is close enough, however, that factors that increase the mean of one also increase that of the other. In particular, one of the main hypotheses of this paper is that inflation increases the means of both distributions more strongly than do cyclical increases in real GNP. This hypothesis is supported in a qualitative way with respect to the frequency distribution by at least one formal study. See A.B.Z. Salem and T.D. Mount, "A Convenient Model of Income Distribution: The Gamma Density," Econometrica, vol. 74 (1974). The argument here is also consistent with empirical evidence developed by Charles Metcalf on the behavior of the distribution of income among families in which both spouses are in the labor force. See Charles E. Metcalf, "The Size Distribution of Personal Income During the Business Cycle," American Economic Review, vol. 59 (1969). Metcalf's evidence for other components of the population, however, is only partially consistent with the present argument, as is that in Lester Thurow, "Analyzing the American Income Distribution," American Economic Review, vol. 60 (1970); and Joseph J. Minarik, "The Size Distribution of Income During Inflation," The Review of Income and Wealth, 4 (1979).

$$- .20467\ D6469 - .10884\ D7076$$
$$(-2.600) \qquad (-2.178)$$

$R^2 = .9674$
Standard error = .04765
Durbin-Watson Statistic = .9447

Estimation period: 1964-1979 (annual data); data for 1978 are excluded because figures for that year are unavailable. (Figures in parentheses are t-statistics.)

b_{jr} is the maximum likelihood estimate of the b parameter for joint returns. (Source: calculations described in text. For purposes of this computation, income per return is expressed in units of \$100,000.)

b_{sr} is the maximum likelihood estimate of the b parameter for returns of single persons. (Source: calculations described in text.)

Z is IRS Taxable Income. (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

EMP is total employment, (household survey). (Source: Bureau of Labor Statistics.)

CG is net capital gains. (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

D6469 is a dummy variable that accounts for the presence of the minimum standard deduction during the period 1964-1969

D7076 is a dummy variable accounting for the introduction of the low-income allowance during 1970-1976.

Predicting Values of the Effective Tax Rate

The above analysis is sufficient to permit predictions of the aggregate effective tax rate to be made. First, predicted values of the tax base, Z, drawn from equation (1) are substituted with actual values for employment, EMP, in equations (4) and (5). These yield predictions of the b parameters determining predicted distributions of taxable income for joint and nonjoint returns. The distribution for each type of return in each year is given explicitly by equation (3) after the b value for that type and year is substituted. The predicted bracket weights (percentages of taxable income predicted for each bracket) are then computed taking into account the statutory boundaries of each bracket. Combining these predicted weights with the corresponding statutory tax rates yields the predicted effective tax rate for each of these two types of returns.

A final step in computing the effective rate is combining the separate effective rates computed above for joint and nonjoint returns to form an overall effective rate. This is done by computing a weighted average of the two rates, in which the weights are a percentage of the aggregate tax base that appeared on joint returns in a given year, and one minus this percentage, respectively.

Accuracy of the Model's Tax Rate Predictions

How accurate is this method of predicting weights and rates? The CBO predicted distributions for joint returns in 1964 and 1979 are shown with the actual data in panels one and two of Figure 2.[10] The fit is not precise, but the change over time in the predicted distribution corresponds to that of the actual data. Panel three of Figure 2 shows the model's projection of how the distribution will look in 1985 (based on a recent CBO projection of economic conditions in that year.) The outward shift in the profile continues according to the projections, despite the fact that recent and projected inflation rates are significantly lower than they had been.

Figure 3 presents the actual and CBO predicted effective tax rates for 1964-1980. The predicted rate is based on the predicted distribution and actual tax bracket rates. The predicted and actual tax rates move closely together. Both series drop in 1965 as a result of the "Kennedy" tax rate cut, and in 1979 as a result of the Revenue Act of 1978. They rise during 1968-1970 because of the Vietnam surtax, and otherwise show a rising trend reflecting bracket creep. The predicted rate falls below the actual rate by a consistent percentage, resulting from the fact that the distribution function underpredicts the percentages of taxable income that fall into the upper brackets. Part 3 of the model is able to correct for this problem, as the next section shows.

The most important test of the accuracy of the predicted tax rate as a representation of the actual rate, however, is the closeness with which it

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10 The exponential distribution actually slopes continuously downward. It is represented as a step function in the figure to facilitate comparison with the actual percentages. The step function shown for the exponential distribution was derived by computing the percentage implied by the function for each bracket and then spreading this percentage uniformly over the bracket.

Figure 2.

Actual and CBO Predicted Distributions of Taxable Income for Joint Returns Over the Bracket Structure for Calendar Years 1964 and 1979 and CBO Predicted Distribution for Calendar Year 1985.

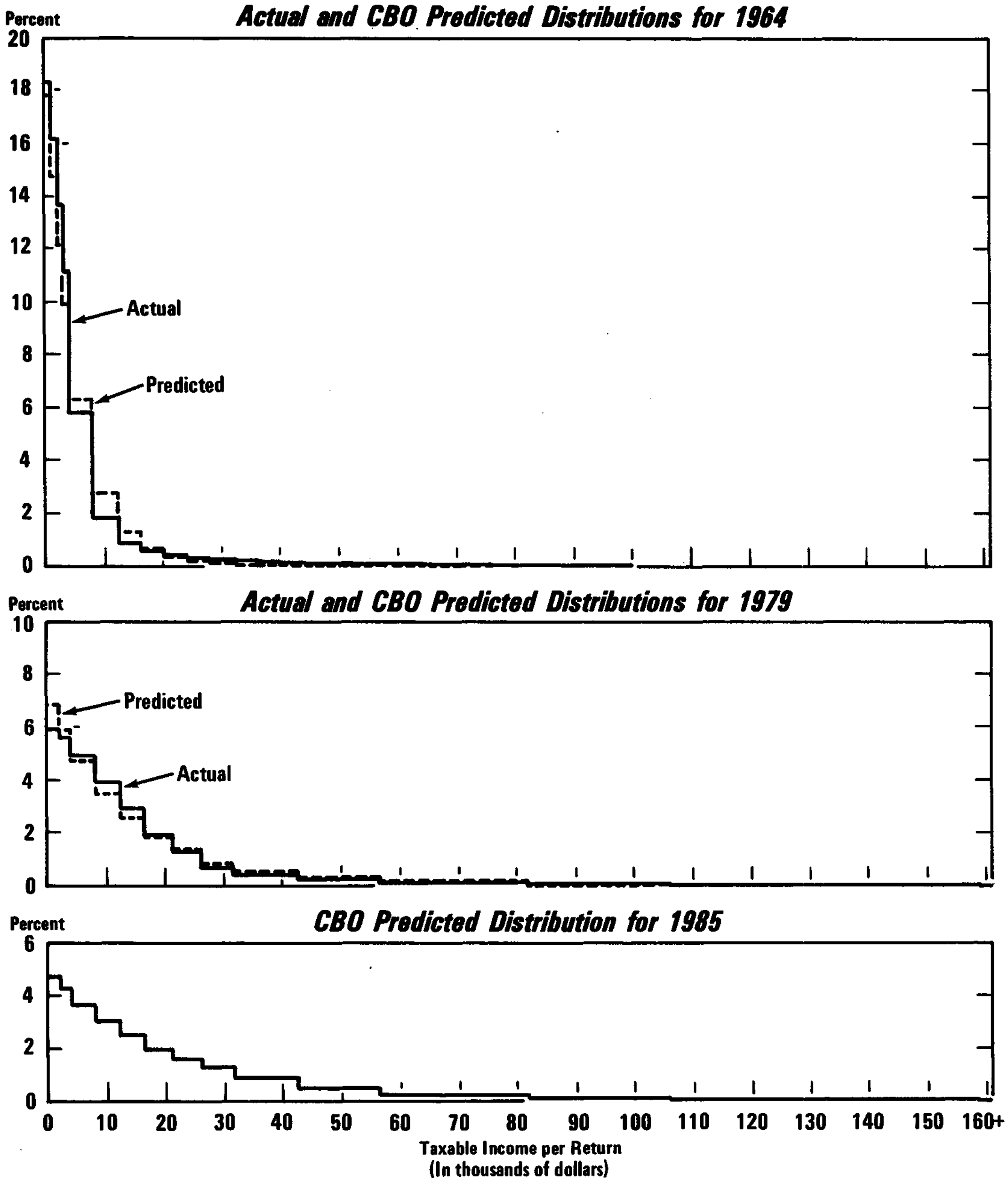
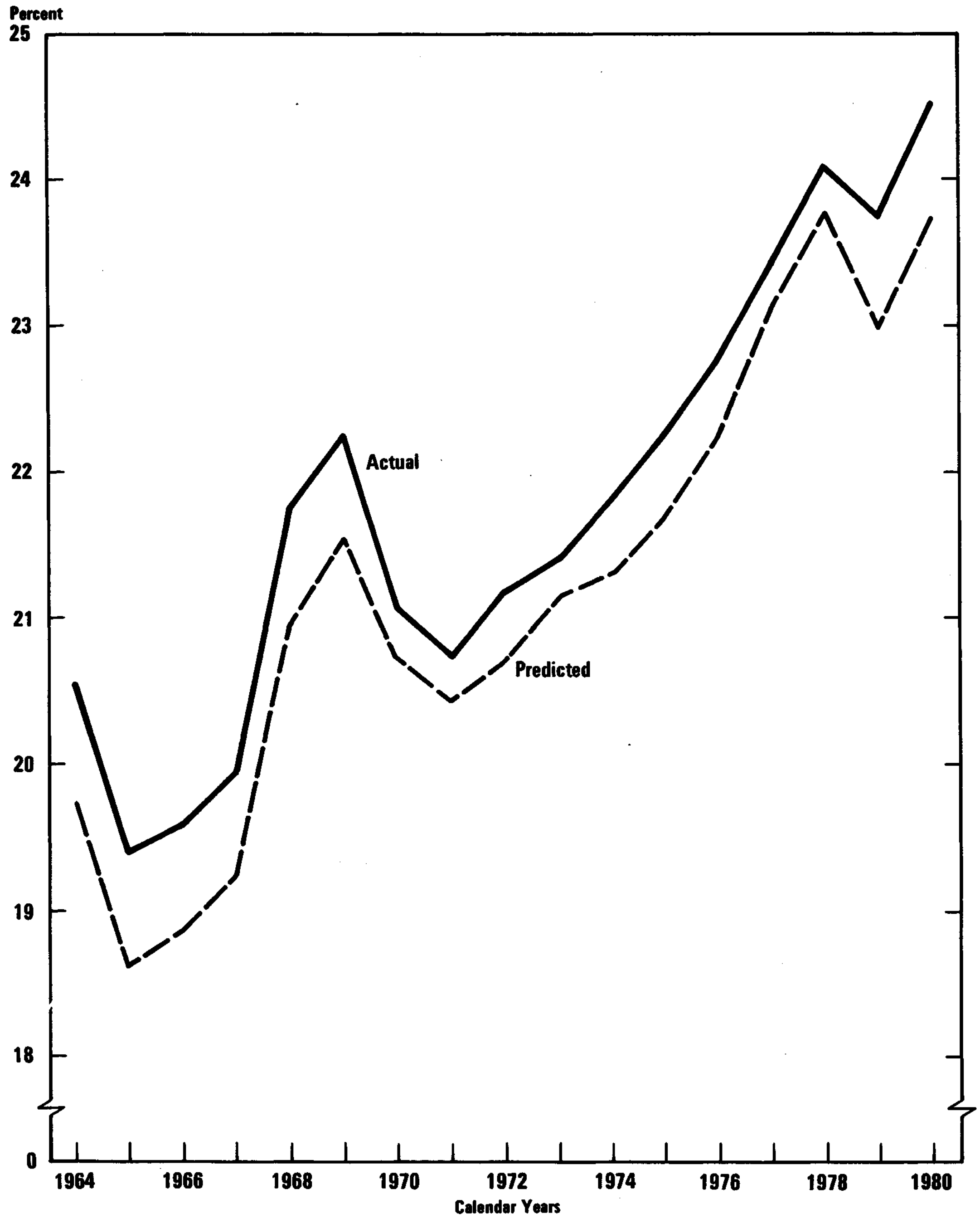


Figure 3.

Actual and Predicted Effective Tax Rates, Calendar Years 1964-1980.



explains the historical behavior of tax liabilities. The evidence on this score is presented in the next section.

PART 3: PREDICTING INDIVIDUAL INCOME TAX LIABILITIES

Once the weighted-average tax rate has been estimated in Part 2, developing a means of predicting tax liabilities involves using the predicted tax rate in place of "t" in equation (2) and estimating that equation using historical time-series data. Making this estimate permits a test to be made of the quality of the estimated weighted-average tax rate as an approximation of the true rate. The estimate also permits certain other factors that affect the relationship between the tax base and tax liabilities to be taken into account. The results, in logarithmic form for 1954-1980,[11] are

$$\text{(6)}\quad \log(L) - \log(WRP) = \underset{(-.3680)}{-.00867} + \underset{(245.0)}{1.00813}\log(Z) \underset{(-23.48)}{-.08795}\, D5463 \underset{(-6.156)}{-.02451}\, D70$$

R^2 = .9999
Standard error = .00517
Durbin-Watson Statistic = 1.6774
Sample period = 1954 to 1980 (annual data)
(Figures in parentheses are t-statistics)

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11 In this form, the percentage response of tax liabilities to percentage changes in the predicted effective tax rate from Part 2 is constrained to equal its expected one-to-one value in order to focus on the percentage response of liabilities to the tax base. This response also has an a priori expected value of unity if the predicted average tax rate is an adequate representation of the actual tax rate. Consequently, whether or not the liability-tax base relationship does turn out to be unity is a test of the adequacy of the predicted tax rate. A formal statistical "t" test of this proposition confirms that one can conclude with 99 percent confidence that the response of liabilities to the tax base takes its expected 1.0 value. Consequently, the predicted effective tax rate can be inferred to be a good representation of the actual rate.

L is individual income tax liabilities before credits. (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

WRP is the predicted weighted-average tax rate. (Source: computations described in text.)

Z is IRS taxable income. (Source: Internal Revenue Service, Statistics of Income: Individual Income Tax Returns, annual issues.)

D5463 is a dummy variable accounting for the discontinuous behavior of the effective tax rate during the sample period; the rate was inexplicably stable before 1964. Accordingly, this variable takes the value unity before 1964 and zero thereafter. The fit of this equation is not significantly changed if the sample period is confined to 1964-1979, permitting this dummy to be dropped.

D70 is a dummy variable accounting for the effects of the Tax Reduction Act of 1970 in changing the percentage of taxable income that appeared on nontaxable returns. It also accounts for a minor inconsistency in the data for L before and after 1970; before that year, these figures are net of small amounts of tax credits, but they are gross of all credits in 1970 and later years. D70, accordingly, is zero before 1970 and unity subsequently.

The dummy variable for 1954-63 helps offset the fact noted above that the predicted effective tax rate WRP systematically understates the actual rate. The overall result is satisfactory, as is shown by the R^2 statistic, whose value in this case is .9999. That figure states that the equation explained all of the variation in tax liabilities during the sample period. The equation, therefore, seems likely to forecast accurately, though a more direct test is the record of accuracy of actual forecasts by the complete model. This record is described in the next chapter.

PART 4: CONVERTING PREDICTED TAX LIABILITIES TO INDIVIDUAL INCOME TAX REVENUES

Projections of income tax liabilities described above do not indicate the amount of revenue that will be available to the government in a given budget cycle. Several additional computations must be made in order to produce an estimate of fiscal year individual income tax receipts. These computations fall into three categories: adjustments to liabilities for credits and additional taxes for tax preferences, adjustments for the timing of tax payments, and adjustments for the effects of recent tax legislation.

Adjustments to Liabilities

The measure of liabilities used thus far in the CBO model, liabilities before credits, is the appropriate measure for calculating the amount of tax generated by the assumed levels of income and characteristics of the taxpaying population. It is not, however, a measure of total income tax liabilities. Because some taxpayers are allowed credits against the amount of taxes owed and some taxpayers are required to pay tax additional to the amount resulting from the standard tax calculations, adjustments must be made to account for these items.

Tax credits are allowed for a variety of reasons. The earned income credit is intended as relief for low-income taxpayers with dependent children; other credits, such as the investment credit and the jobs credit are intended to encourage certain kinds of behavior on the part of some taxpayers. Because total tax credits bear a stable relationship to overall income, CBO projects the aggregate amount of credits using a trend based on recent tax credit experience. The estimate of liabilities before credits developed in Part 3 is reduced by this amount.

An additional adjustment is made to liabilities to account for the payment by some taxpayers of a minimum tax on certain income and deduction items they claim on their tax return. Because the preferential treatment of these items results in lower taxable income and, therefore, lower tax liabilities, these items are designated in the tax code as "tax preferences." Taxpayers who claim these items are required to pay a minimum of 15 percent tax on the amounts, computed according to IRS rules. Because the total "additional tax for tax preferences" has, for several years, followed the same pattern as total net capital gains, CBO projects these additional taxes on the basis of projected capital gains, using the most recently observed ratio of these two variables. The projected amount of additional tax for tax preferences is then added to liabilities before credits. These adjustments are summarized below.

Total Income Tax Liabilities = Liabilities Before Credits
- Total Tax Credits
+ Additional Tax for Tax Preferences

Timing Adjustments

The computation of taxes owed is done on a calendar-year basis because the tax year coincides with the calendar year for most taxpayers. The federal government's budget year is different. The fiscal year now runs from October 1 through September 30 of the following year. (The current fiscal year, fiscal year 1983, began October 1, 1982, and will end on September 30, 1983.) The second timing distinction is definitional. Total income tax liability is a measure of taxes owed. The federal unified budget accounts for taxes on an "as paid," or cashflow basis. Because CBO is called upon to forecast tax revenues on a fiscal year, unified budget basis, estimated tax liabilities must be transformed to account for the timing difference that results from the varied schedule on which tax payments are made.

Payments from taxpayers to the Department of the Treasury fall into three categories: withheld taxes, quarterly estimated taxes, and final payments. Withheld taxes, by far the largest of the three types, are paid on liabilities derived from wage and salary income. Employers retain part of each employee's gross earnings and remit these to the Treasury on behalf of the employee. Therefore, withheld tax payments flow into the government accounts regularly throughout the year, about as often as paychecks are rendered. Quarterly estimated payments are required from taxpayers whose income is derived from sources other than wages and salaries (for example, interest, dividends, rents, royalties, capital gains, profits of unincorporated businesses, alimony payments, etc.) Deadlines for filing quarterly declarations are mid-January, April, June, and September, so payments are very heavily concentrated in those months. Because both withheld taxes and quarterly payments are based on predictions of taxpayers' annual income and deductible expenses, and these payments are required to cover a very large share but not 100 percent of tax liabilities, some final reconciliation is necessary. The familiar April 15 filing date is the deadline for making final adjustments and paying any amounts still due on the previous calendar year's tax bill. Most final payments are made between January and April but are particularly heavy in March and April. Taxpayers who have overpaid receive a refund from the Treasury Department as final reconciliation. Refunds, which reduce total federal revenues, are mailed mainly from February through May and are concentrated in April and May.

The resulting pattern of total income tax collections is dominated by withheld taxes, which flow into the Treasury on a regular and fairly smooth basis, with additional spurts from other types of tax payments in January, April, June, and September. Considerable historical data on the mix and timing of tax payments exist. CBO relies heavily on prior payment patterns in determining likely patterns for the future.

Because a fiscal year spans two calendar years, estimates of budgetary receipts are based on projected tax liabilities for two different tax years and on the payments schedule mentioned above. CBO incorporates all available historical data, institutional information, and analysis of collections-to-date (for the current fiscal year) in producing its fiscal year, unified budget estimates.

Adjustments for the Effects of Recent Tax Legislation

Newly enacted tax legislation has implications for the amount of tax owed and, sometimes, for the schedule on which taxes are paid. A model based on historical relationships, such as CBO's individual income tax model, cannot fully take account of some prospective tax changes. While the CBO model does allow for changes in income brackets and tax rate schedules, it is less able to account for smaller changes in deduction and income adjustment items. Since the tax legislation of the past two years has effected major structural changes in the tax code as well as a wide variety of smaller changes, the CBO model can explicitly account for some but not all of the implied revenue effects of the new legislation.

The Joint Committee on Taxation (JCT) is required to provide the Congress with estimates of the revenue effects of proposed tax legislation. CBO uses these estimates as marginal adjustments to the aggregate estimates of budget revenues. After a tax bill is passed and signed by the President, CBO uses the JCT estimates of provisions that the CBO model does not incorporate to increase or reduce its estimates of total individual income taxes. Adjustments of this kind are usually temporary. Once data become available on the actual effects of legislation, they are explicitly included in the model whenever possible.

GENERATING UNIFIED BUDGET RECEIPTS: A REVIEW

Forecasting Overall Revenues from the Income Tax

Estimates of overall individual income tax revenues over a given projection period--typically five years--are derived using economic assumptions (principally taxable personal income and employment) and assumptions about statutory tax provisions (principally the personal exemption, the bracket structure, and the bracket tax rates) that will be in effect during each year of the projection period. Then a revenue forecast is generated in several steps. First, the tax base is estimated (Part 1). Then the weighted-average tax rate that applies to this base each year is estimated, based on an estimate of the distribution of the tax base over the bracket structure (Part 2). The tax base estimates are combined with the weighted-average tax rates (Part 3). The resulting estimates of tax liabilities are adjusted for relatively minor items and then timing factors are applied to generate estimated unified budget revenues (Part 4).

Estimating Revenue Impacts of Changes in Tax Policy

The main responsibility for generating estimates of the revenue implications of changes in tax policy and of other developments lies with the staff of the Congressional Joint Committee on Taxation. Occasionally, however, CBO is called upon to make such estimates, and the CBO model can readily be used to make at least some of these calculations. A few examples follow.

Analyzing Changes in Statutory Tax Rates. Incorporating the effects of changes in bracket tax rates, such as those that were enacted as part of the Economic Recovery Tax Act of 1981, is done in Part 2 of the model. The tax rates that are combined with the predicted distribution of the tax base to form the weighted-average tax rate in that section of the model are altered as is specified in such legislation.

Analyzing Changing Rates of Bracket Creep. Bracket creep--the movement of taxable incomes through the bracket structure as a consequence of inflation--is analyzed in CBO's model by changing the assumed levels of per capita gross income. This is done because inflation works principally through its effects in increasing wage rates and salary scales, which increase per capita gross income directly. In this tax model, changes in per capita incomes are reflected in the ratio of taxable personal income to employment. A given increase in this variable (determined outside the model itself) causes the ratio of the tax base (determined in Part 1) to employment to increase (unless offsetting increases in the personal exemption or standard deduction occur). The predicted increase in this ratio then causes the spread of the tax base over the bracket structure, predicted in Part 2, to change. A higher percentage of the tax base is predicted to fall into higher tax brackets when the ratio of the tax base to total employment rises. This means that a higher percentage of the base is taxed at higher rates, so the overall weighted-average tax rate and, consequently, overall taxes, increase.

Variations in the rate of movement of the tax base through the bracket structure are represented independently of changes in the tax rates that apply to the different brackets. Thus the revenue increase due to rising incomes under unchanging tax rates can be estimated by holding the assumed tax rates constant in Part 2, while the predicted spread of the tax base over the bracket structure changes. Alternatively, if the tax rates are assumed to be changing at the same time that incomes are, as during