Forecasting Individual Income Tax Revenues: A Technical Analysis

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FORECASTING INDIVIDUAL INCOME TAX REVENUES: A TECHNICAL ANALYSIS

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PREFACE

Reliable estimates of federal spending and revenues, and a clear understanding of associated issues, are important to the budget process. The Congressional Budget Office (CBO) has developed elaborate techniques to generate budgetary estimates and to analyze issues affecting spending and revenue totals. In order that these procedures and issues can be evaluated by those outside the agency, it is CBO's practice to provide published analyses of its estimating procedures and of current issues related to major spending items and revenue sources. This paper provides such analysis for individual income tax revenues, the largest single component of federal receipts.

The study was prepared by Frederick Ribe and Kathleen O'Connell of CBO's Fiscal Analysis and Tax Analysis Divisions, respectively, under the direction of Rosemary Marcuss. Mr. Ribe is the principal author. Ms. O'Connell is responsible for parts of Chapters II and IV, and provided expert advice during all other phases of the project. Others to whom the authors are grateful for valuable comments are Timothy Considine, Edward Gramlich, Robert Hartman, Frank de Leeuw, Robert Lucke, Steven Malin, Joseph Pechman, and James Verdier. Susan Goeransson, Debra Holt, and Naif Khouri provided research assistance, Patricia H. Johnson edited the manuscript, and Shirley Hornbuckle and Linda Brockman typed it for publication.

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CONTENTS

		Page
PREFACE		iii
SUMMARY		ix
	Available Revenue Estimating Techniques	ix
	The CBO Tax Model	ix
	The Forecasting Record	xi
	Responsiveness of Individual Tax Revenues to Changes in Income	xii
	Economic Effects of Indexation	xiii
CHAPTER I.	INTRODUCTION	1
	How Revenues Are Estimated	1
	Two-Part Procedures	3
	The CBO Model	4
	Plan of the Study	5
CHAPTER II.	THE CBO INCOME TAX MODEL	7
	Overview	7
	Part 1: Forecast of the Tax Base from Taxable Personal Income	9
	Approach Used in Earlier Studies	9
	Representation in the CBO Model	10
	Part 2: Determining the Effective Tax Rate	13
	How the Effective Tax Rate Works in the Actual Economy	13
	The Structure of Brackets and Rates	13
	How the Tax Base is Spread Over the Bracket Structure	14
	Modeling Movements of Taxable Income Through the Brackets	14
	Predicting Values of the Effective Tax Rate	19
	Accuracy of the Model's Tax Rate Reduction	20
	Part 3: Predicting Individual Income Tax Liabilities	23

CONTENTS (Continued)

		Page
	Part 4: Converting Predicted Tax Liabilities to Individual Income Tax Revenues	24
	Adjustments to Liabilities	24
	Timing Adjustments	25
	Adjustments for the Effects of Recent Tax Legislation	27
	Generating Unified Budget Receipts: A Review	27
	Forecasting Overall Revenues from the Income Tax	27
	Estimating Revenue Impacts of Changes in Tax Policy	28
	Further Research	29
CHAPTER III.	FORECASTING ACCURACY OF THE CBO INDIVIDUAL INCOME TAX MODEL	31
	Causes of Forecasting Errors	31
	Three Forecasts with the CBO Model	31
CHAPTER IV.	ISSUES IN INDIVIDUAL INCOME TAX REVENUES	35
	The Response of Tax Liabilities to Increases in Income Caused by Inflation	35
	Revenue Implications of the Recent Slowdown in Inflation	38
	The Revenue Impact of Tax Indexation in 1985	39
	Economic Implications of Indexation	41
APPENDIX:	ANALYSIS OF ERRORS IN TREASURY REVENUE FORECASTS	45

TABLES

Page

TABLE 1. THREE SIMULATED FORECASTS OF REVENUES FROM INDIVIDUAL INCOME TAX USING CBO TAX MODEL ... 33

TABLE 2. ANALYSIS OF ERRORS IN TREASURY DEPARTMENT FORECASTS OF INDIVIDUAL INCOME TAX REVENUES FOR FISCAL YEARS 1977-1981 34

TABLE 3. CHANGE IN PREDICTED INDIVIDUAL INCOME TAX REVENUES FROM REVISION IN CBO INFLATION FORECAST FOR 1983-1986 39

FIGURES

FIGURE 1. DISTRIBUTION OF TAXABLE INCOME FOR JOINT RETURNS OVER THE BRACKET STRUCTURE, FOR CALENDAR YEARS 1964 and 1979 15

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 21

FIGURE 3. ACTUAL AND PREDICTED EFFECTIVE TAX RATES, CALENDAR YEARS 1964-1980 22

FIGURE 4. IMPLICIT ELASTICITY OF TAX LIABILITIES WITH RESPECT TO TAXABLE PERSONAL INCOME UNDER INDEXED AND UNINDEXED TAXES, ASSUMING DIFFERENT RATIOS OF GROWTH IN THE GNP DEFLATOR TO TOTAL NOMINAL GNP GROWTH 36

SUMMARY

Developing budgetary and revenue forecasts to provide assumptions underlying congressional concurrent resolutions on the budget is an important function of the Congressional Budget Office (CBO). This paper describes major aspects of the techniques used by CBO to forecast revenues from the individual income tax: procedural methods, accuracy, comparison with other techniques, and implications about the future behavior of individual income tax revenues.

AVAILABLE REVENUE ESTIMATING TECHNIQUES

The most prominent available technique for estimating revenues from the individual income tax is the large-scale "microanalytic" model. This model consists mainly of a detailed computer-based miniature replica of the taxpaying population of the United States. The revenue implications of different economic conditions and statutory tax provisions are analyzed by calculating the effects that they would have on the liabilities of taxpayers in different categories, and then adding these estimates together to predict the economy-wide impact.

From a practical perspective, large-scale models are versatile and accurate, but also cumbersome and expensive. These models are especially useful for estimating the revenue implications of changes in tax statutes, which sometimes require detailed analysis that only this technique offers. On the other hand, the elaborate computations of large-scale models are sometimes unnecessary to estimate how revenues change from year to year in response to changes in economic conditions. In fact, if no significant changes in tax statutes occur, such year-to-year revenue forecasts are sometimes developed using extremely simple procedures consisting primarily of a rule of thumb for predicting growth in taxes on the basis of the growth rate of aggregate income. Of course, periods in which the tax structure is unchanged are rare, especially since enactment of the Economic Recovery Tax Act of 1981 (ERTA), which mandated a series of important changes in the structure of the income tax over five years.

THE CBO TAX MODEL

CBO's income tax model represents a compromise between the relatively complex and relatively simple alternatives just described. Al-

24-084 O - 83 - 2

though much smaller than large-scale models, it contains enough detail to account for the revenue implications of the significant current and prospective changes in the tax structure.

Essentially, the CBO model consists of four equations that determine how important constituent parts of the tax have behaved over long periods of time. When combined with current institutional information on statutory tax rates, brackets, and exemption levels, these equations permit forecasts of individual income tax liabilities and federal budget revenues from the individual income tax to be generated on the basis of a separate economic forecast of such variables as personal income, employment, and the price level. The model is designed specifically to account for the effects of several important recent and current developments on the income tax. These are:

- Changes in statutory tax bracket rates, such as those entailed in the Economic Recovery Tax Act of 1981;
- "Bracket creep," or the movement of taxpayers' incomes upward through the bracket structure as a consequence of inflation or productivity growth;
- Indexation of statutory tax brackets and the personal exemption, which is scheduled to take effect in 1985; and
- Cyclical swings in aggregate income.

The main advantages of the model are that it is of manageable size but still accurate and versatile enough to account for many different economic and legislative developments that affect individual income tax revenues. Unlike the other forecasting methods, the CBO model is well-documented and open to scrutiny and constructive criticism by tax professionals (or anyone else). Moreover, since the CBO procedure is different from most other techniques, it can provide a check on their accuracy.

The analysis of overall individual income tax revenues is divided into four parts. The first part produces an estimate of the tax base (gross taxpayer income minus all deductions and exemptions) on the basis of an economic forecast derived separately by CBO's Fiscal Analysis Division, together with assumptions concerning relevant provisions of the tax code. The economic forecast (covering gross national product (GNP), prices, employment, and other variables) is developed in the Fiscal Analysis Division separately from the revenue forecast developed in the Tax Analysis Division and the outlay forecast in the Budget Analysis Division. The three forecasts are, however, adjusted in light of one another to ensure

consistency. Sometimes several different adjustments are made before a final set of forecasts is derived.

The second part of the analysis predicts the effective tax rate that applies to the tax base developed in Part 1. This computation involves predicting the pattern by which the tax base will be spread over the statutory tax bracket structure and how this pattern changes through bracket creep. By taking detailed account of the statutory characteristics of the bracket structure, this part of the model permits analyses of various changes in statutory bracket boundaries and rates, such as the changes mandated by ERTA.

The third part of the model develops a forecast of aggregate tax liabilities before credits using the results from Parts 1 and 2. Finally, the fourth part generates and incorporates estimates of tax credits and other tax items, and applies timing and other accounting adjustments to the tax liability forecast to derive a forecast of budget revenues from the individual income tax.

The Forecasting Record

The most important test of the reliability of any forecasting model is a comparison of the record of its forecasts, together with those of alternative procedures, to actual data after the forecasting period is completed. CBO's model is quite new, and therefore doesn't have an extensive record. Nevertheless, CBO has developed evidence on the model's reliability by developing "ex post" (or after the fact) forecasts of revenues in past years. This is done by putting oneself in the position of an imaginary forecaster several years ago who is using the CBO model to forecast revenues in later years that by now have been observed.

CBO has developed figures comparing the accuracy of ex post forecasts by its tax model with the Treasury Department's published individual income tax revenue forecasts for the same years. Attention is restricted to forecasting errors caused by technical inaccuracy in the procedures as opposed to errors resulting from inaccurate assumptions about the economy and about the passage of tax legislation affecting revenues. CBO's average errors for forecasts one, two, and three years into the future were all smaller than CBO's estimates of corresponding Treasury Department errors. Overall, these figures show that the CBO model is quite accurate, and compares favorably with alternative procedures.

Responsiveness of Individual Income Tax Revenues to Changes in Income

As this discussion has already noted, much interest centers on summary measures of the response of overall tax revenues to changes in the economy. Several recent developments, moreover, have altered the responsiveness of the tax. For example, the ERTA rate cuts that make the tax less progressive by reducing the top rates have likewise made it less responsive to economic changes, and the ERTA provision calling for indexation of certain tax provisions to the Consumer Price Index starting in 1985 will reduce the responsiveness even more.

The CBO income tax model can be used to calculate the response of revenues to different economic developments under various configurations of the tax laws. For example, under the bracket tax rates that will be in effect during 1984--following all the reductions that were mandated in ERTA--simulations with the model show that the responsiveness of tax liabilities to changes in GNP depends significantly on whether the GNP change primarily reflects inflation or represents a change in real output. Revenues change more sharply when GNP changes because of inflation rather than other factors. This occurs because increases in GNP resulting from inflation alone are taxed at higher rates as taxpayers are pushed into higher tax brackets. In quantitative terms, individual income tax revenues may grow as much as 70 percent faster than GNP if nominal GNP growth is entirely due to inflation.

By contrast, when GNP increases because of an increase in real output, some of the resulting income accrues to existing workers as a result of productivity increases, and this can cause bracket creep for these individuals. At the same time, however, much of the increase in aggregate income accrues to new workers who are drawn into employment by the upswing in the economy. New workers' incomes are taxed at relatively low rates, and this makes the responsiveness of income tax revenues to changes in real GNP relatively small. Estimates from the CBO model suggest that revenues increase roughly 30 percent faster than GNP when the GNP change is entirely real.

When the tax structure is assumed to be indexed to the price level, as it will be in 1985 and later years under the terms of ERTA, the tax will be more responsive to changes in aggregate income that are primarily "real" than to those that reflect inflation. Indexation prevents inflation from causing bracket creep, and this reduces the strength of the revenue response to inflation. Estimates from the CBO model suggest that revenues under the indexed income tax will grow at roughly the same rate as GNP when the GNP change is entirely due to inflation. This is a dramatic reduction in responsiveness from that in the unindexed tax, where revenues are estimated to grow as much as 70 percent faster than income

under the same conditions. Income increases that result from strong growth in real output, by contrast, accrue in part to new workers and in part to existing workers as a consequence of growth in productivity. Productivity growth can cause these workers' incomes to move into higher tax brackets without protection from indexation, which is designed to eliminate bracket creep only when it results from inflation. Thus, some bracket creep may occur in response to real economic growth under the indexed income tax. As a result, CBO estimates that revenues from the indexed income tax will grow 30 percent faster than GNP if the GNP change is entirely real.

Economic Effects of Indexation

The shift in the behavior of the income tax that will be caused by indexation may have significant implications for the economy. Taxpayers will gain because indexation will protect them from unlegislated tax increases caused by inflation-induced bracket creep. Increases in economic efficiency may also result since marginal tax rates will be prevented from drifting upward. Indexation could also have adverse impacts, however. It could contribute to the tendency of structural budget deficits to increase over time (in the absence of legislation to control them). The expectation of large and rising deficits, in turn, may help explain the persistently high levels of interest rates, which may ultimately reduce living standards by reducing investment. Indexation may also reduce the value of the income tax as an automatic stabilizer of the economy.

CHAPTER I. INTRODUCTION

A principal responsibility of the Congressional Budget Office (CBO) is to forecast federal revenues and spending in future years under various assumed budgetary policies and economic conditions. Generating such estimates can sometimes be an elaborate process for certain revenue sources and spending programs. Because of its complexity, the individual income tax is one such case. This paper describes the various procedures that are available for estimating individual income tax revenue and, in particular, the nature and forecasting record of CBO's methods.

HOW REVENUES ARE ESTIMATED

Occasionally, when the tax structure is not expected to change, accurate revenue forecasts can be made using simple rules relating the growth of tax liabilities to the projected growth in the economy. This is possible because, during periods in which the tax law has not changed in the past, the response of individual income tax liabilities to growth in the tax base has exhibited some regularity.[1]

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1 The most common summary measure of the response of tax liabilities to income changes is the "tax elasticity," expressing the percentage by which tax liabilities change for every percentage change in income. Estimates of the elasticity are available from several sources. See, for example, Joseph A. Pechman "Anatomy of the U.S. Individual Income Tax," in S. Cnossen, ed., Comparative Tax Studies: Essays in Honor of Richard Goode (North-Holland, 1983). This study reports estimates based on simulation of a microeconomic model as well as others based on time-series regression estimates. See also A. Fries, J. P. Hutton, and P.J. Lambert, "The Elasticity of the U.S. Individual Income Tax: Its Calculation, Determinants, and Behavior," Review of Economics and Statistics, vol. 64 (1982), which reports estimates calculated directly using an analytic formula; and Vito Tanzi, "The Sensitivity of the Yield of the U.S. Individual Income Tax and the Tax Reforms of the Past Decade," International Monetary Fund Staff Papers, vol. 23 (1976), which reports cross-section regression estimates based on data from different states. A number of technical issues surround the estimation of the tax elasticity. These are discussed in Chapter IV.

Often, however, changes in the income tax law are contemplated or enacted, and revenue forecasts must take these changes into account. For example, the Economic Recovery Tax Act of 1981 (ERTA) set in motion a sequence of tax rate cuts in 1981, 1982, 1983, and 1984, and of changes in exemption and tax bracket levels in 1985 and later years. As a result, simple revenue forecasting rules based on an unchanging tax structure are not of much value.

In order to forecast revenues under such changing tax provisions, tax analysts sometimes resort to elaborate computer representations of the tax law and of the taxpaying population.[2] The Treasury Department's Tax Calculator is one such procedure, and others like it are in use by the Congressional Joint Committee on Taxation and under development at CBO. These procedures essentially forecast the taxpaying decisions and calculations of individual taxpayers--grouped together with others like them whenever possible--taking into account the details of the tax code.

While these procedures can be accurate, they are also costly and time-consuming. Moreover, additional problems affecting the accuracy as well as the manageability of the procedures are introduced by the need to generate separate forecasts of certain underlying variables. These are economic and demographic variables that are not included in the formal economic forecast that forms most of the basis for the tax forecast. For example, supplemental forecasts are needed of the distribution of income, the number of dependents claimed by different types of taxpayers, itemized deductions, and certain income items like capital gains that are not covered by the formal forecast of personal income. Forecasts of these

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2 Such models are computer-based samples drawn from the population of U.S. tax returns, consisting of substantially fewer returns than the number actually filed but still representing in a statistically sound manner the characteristics of the taxpaying population. Different amounts of total taxable income, different income distributions, and different tax structures can be assumed, and the corresponding aggregate tax liabilities calculated by recomputing the taxes due on each return in the sample. This method was developed by Joseph A. Pechman and his associates at the Brookings Institution, and is described in Joseph A. Pechman, "A New Tax Model for Revenue Estimating," in Alan T. Peacock and Gerald T. Hauser eds., Government Finance and Economic Development (Organization for Economic Cooperation and Development, 1965); and Joseph J. Minarik, "The Merge 1973 Data File," in Robert H. Haveman and Kevin Hollenbeck, eds., Microeconomic Simulation Models for Public Policy Analysis, vol. 1 (Academic Press, 1980).

items are typically produced using simple rules that may detract from the sophistication and accuracy of the overall procedure. In addition, the need to carry out these supplemental forecasts makes the overall procedure still more cumbersome.

Since agencies that are responsible for budgetary revenue forecasts are sometimes called upon to generate many such forecasts in a short period, the detailed procedures that have just been described can be impractical. Instead, simpler procedures have been developed.

Two-Part Procedures

One simplified approach that is often used by the Treasury Department involves two separate parts. In the first part, a hypothetical "constant-law" revenue forecast is made on the assumption that no change in tax structure has taken place. Then, in a second part, this figure is combined with an estimate of the gain or loss in revenues that is entailed at the forecast level of taxable income by any changes in tax law that have occurred. The overall procedure is streamlined because the "constant-law" estimate in the first part is made using simple procedures for estimating the response of "constant law" revenues to changes in economic conditions. The forecast of the gain or loss in revenue from a given change in tax law in the second part of the procedure is made using a separate and more detailed model like those described in the last section. The overall procedure is nevertheless simplified because this estimate must only be made once for a given change in tax law, and then can be used again and again with minor adjustments as part of the simpler procedure.[3]

Even an occasional need to resort to a detailed tax model can make this two-part procedure cumbersome, however. It means, for example, that if a new tax change is proposed for which a revenue-change estimate has not already been made, the procedure cannot be completed until a revenue-change estimate is made with the detailed model. For this reason, some analysts have developed simplified revenue-change models that are more nearly self contained. The CBO income tax model is one example.

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3 The revenue change estimate can be adjusted for changes in the underlying economic forecast using simple rules.

24-084 O - 83 - 3

THE CBO MODEL

CBO's procedure is an extension of a time-series approach to income tax modeling that has been developed by several economists over the past 20 years.[4] Some of the model's advantages are that it is of manageable size and largely self-contained, but still quite accurate. The procedure incorporates enough detail about the tax structure to account accurately for past and current changes in tax provisions that have significant implications for revenues. Still, the model is quite flexible, primarily because it achieves considerable simplification relative to other approaches by representing the income tax in terms of relatively broad and aggregative characteristics, such as total returns, the ratio of the tax base to personal income, and the pattern by which the tax base is spread over the bracket structure. The behavior of these parts of the tax is forecast by exploiting regularities in their past responses to changes in economic variables whose predicted values are readily available as part of the (separate) economic forecast.

The CBO model accounts more carefully than others for the revenue implications of certain economic developments, such as changes in the rates of inflation and real economic growth. Apart from its technical characteristics, however, attractive features of the model are that, unlike other tax models that are used in the government, it is described in detail in public documents like this publication and can, therefore, be evaluated and criticized by outside analysts. There is value, moreover, in the fact that the approach underlying the CBO model is different from most others

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4 See E. Cary Brown and Richard Kruizenga, "Income Sensitivity of a Simple Personal Income Tax," Review of Economics and Statistics, vol. 41 (1959); William H. Waldorf, "The Responsiveness of Federal Personal Income Taxes to Income Change," Survey of Current Business, vol. 47 (1967); Joseph A. Pechman, "Responsiveness of the Federal Individual Income Tax to Changes in Income," Brookings Papers on Economic Activity, 2, 1973; and Ned Gramlich and Fred Ribe, "More on the Elasticity of the Federal Personal Income Tax" (The Brookings Institution, processed, 1974). Ideally, such models should be developed in combination with larger models to enhance the data set on which the small models are based. A detailed model (a version of the Treasury tax calculator) is being developed at CBO for use in this and other ways. For discussion of ways in which smaller and larger models can be combined, see "General Discussion" in "Responsiveness of the Federal Individual Income Tax to Changes in Income," pp. 426-427.

that are in active use in policy analysis; it therefore provides a check on the reasonableness and accuracy of those procedures.

PLAN OF THE STUDY

Chapter II describes the CBO model in detail. Chapter III provides evidence on the accuracy of the model's forecasts, and Chapter IV presents estimates from the model bearing on current issues in federal revenues.