EXPLORING ISSUES IN THE DEVELOPMENT OF MACROECONOMIC MODELS FOR USE IN TAX POLICY ANALYSIS

Prepared by the Staff
of the
JOINT COMMITTEE ON TAXATION

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INTRODUCTION

The Brookings Institution and the Heritage Foundation invited the staff of the Joint Committee on Taxation ("Joint Committee staff") to participate in a seminar on June 16, 2006, titled "A Seminar on Dynamic Analysis and a Discussion with the Current and Former Directors of the Congressional Budget Office." The purpose of the seminar is to present to Congressional staff and other interested persons a discussion of developments in the use of macroeconomic models for the analysis of proposed changes in Federal tax policy.

This document[1] reproduces the prepared remarks of the Joint Committee staff, in the order in which the remarks were delivered at the seminar. Part I of this document reports on work of the Joint Committee staff identifying the sensitivity of reported macroeconomic results to the type of model being used, assumptions about the sizes of behavioral responses and monetary and fiscal policy reactions, and simplifying assumptions with respect to the level of aggregation used in modeling changes in tax policy. This report demonstrates the importance of the level of disaggregation in the calculation of average and marginal tax rates to the outcome of macroeconomic models.

Part II of this document provides a brief history of Joint Committee staff efforts to estimate the macroeconomic effects of tax proposals. It also presents some recent model developments and describes some future developments under consideration by the Joint Committee staff.

[1] This document may be cited as follows: Joint Committee on Taxation, *Exploring Issues in the Development of Macroeconomic Models for Use in Tax Policy Analysis*, (JCX-19-06), June 16, 2006.

PART I − LESSONS FROM MULTIPLE SIMULATIONS OF THE MACROECONOMIC EFFECTS OF A TEN PERCENT CUT IN INDIVIDUAL INCOME TAX RATES

A. Introduction

The staff of the Joint Committee on Taxation has been actively involved, for about a decade, in developing the capability to perform macroeconomic analysis of tax law changes. One of the most striking results of this effort has been the significant dependence of simulation results on a range of modeling decisions. It is generally recognized that model results will be sensitive to the type of model being used and to assumptions about the sizes of behavioral responses and monetary and fiscal policy reactions. What is less obvious is that model results can vary substantially depending on modeling choices that some might think are insignificant. Simplifying assumptions with respect to the level of aggregation used in modeling changes in tax policy is one of these lesser known areas. This presentation will discuss both types of sensitivity in the modeling of a ten percent cut in tax rates, with a focus on the more often disregarded question of tax sector aggregation.

Effects of tax cuts on individual behavior

A cut in individual income tax rates changes incentives to work through its effect on average and marginal tax rates on wages. The reduction in average tax rates on wages decreases the amount of work necessary to earn a target amount of after-tax income, thus reducing incentives to work. The reduction in marginal rates (i.e., the tax rate on additional increments of earned income) increases the value to the worker of additional labor, thus increasing his incentive to work. Similarly, the reduction in individual income tax rates reduces marginal and average tax rates on income from capital, including dividends, interest, rent, and capital gains, which allows individuals to accumulate more wealth for a given level of saving, while at the same time increasing the after-tax rate of return on additional savings. In theory, these competing effects could cause either a net increase or net decrease in labor supply, savings, and investment, depending on the strength of taxpayer responsiveness to each incentive. These types of responses are often referred to as "supply side" effects.

A number of statistical studies have attempted to measure the size of these effects.[2] While these studies have not yielded a clear consensus on a single set of responses, there is a general indication that the marginal effects outweigh the average effects, and thus a cut in taxes on wages can be expected to provide some incentive for extra work, and a cut in taxes on income from capital can be expected to provide some incentive for additional savings and investment. The amount of growth a model predicts from a ten-percent tax cut is fairly sensitive to the size of the behavioral responses built into the model. In particular, the assumed responsiveness of labor supply can have a large influence on the extent of the short-run supply side effect on the economy.

Fiscal and monetary policy response

A cut in individual income tax rates increases the amount of income available to individuals to purchase goods and services in the immediate short-run, thus providing a short-run stimulus in demand for the output of producers. Depending on whether the economy is already operating at capacity, this increased demand may primarily increase output and employment, or it may primarily increase prices. The Federal Reserve Board may react by increasing interest rates to combat expected inflation, or it may accommodate the increased demand. In the short-run, different assumptions about the response of the Federal Reserve Board to the tax cut can have a large impact on the outcome of the simulations.

The way the Federal government finances the reduction in tax revenues due to the tax cut can also have a significant effect on the predicted effects of the policy. If the Federal government is not operating with a fiscal surplus before the implementation of the tax cut, it will either have to borrow to finance the same real level of expenditures, or it will need to reduce spending or increase taxes in some other way. These Federal government choices regarding how much to borrow for how long, and what type of spending cuts or tax increases should be used to offset lost revenues from the tax cut can have significant effects on the size and timing of any growth effects resulting from the tax cut. The importance of this assumption depends on the type of model framework chosen for analysis.

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[2] For example, see Altonji, Joseph, "Intertemporal Substitution in Labor Supply: Evidence from Micro Data, *Journal of Political Economy,* v.94, no.3, 1986, pp. s176-s215; Boskin, Michael J., "Taxation, Saving, and the Rate of Interest," *Journal of Political Economy,* v.86, no2, April 1978, pp.s3-s28; Blundell, Richard and Thomas MaCurdy, "Labor Supply: A Review of Alternative Approaches, " in *Handbook of Labor Economics, Volume 3A,* edited by Orley Ashenfelter and David Card, Amsterdam: North Holland, 1999; Congressional Budget Office, "Labor Supply and Taxes," *CBO Memorandum,* January 1996; Engen, Eric M., William G. Gale, and John Karl Scholz; "Do Savings Incentives Work?' *Brookings Papers on Economic Activity,* edited by Henry J. Aaron and William G. Gale, Washington, D.C. the Brookings Institution, 1996, pp. 83-121; Engen, Eric M., Jane Gravelle, and Kent Smetters, "Dynamic Tax Models: Why They Do the Things They Do," *National Tax Journal,* v.50, no.3, September, 1997, pp. 657-82; Evans, Owen J., "Tax Policy, the Interest Elasticity of Saving, and Capital Accumulation: Numerical Analysis of Theoretical Models," *American Economic Review,* v.73, no.3, June, 1983, pp. 398-410; and Prescott, Edward C., "Why Do Americans Work So Much More than Europeans?" *Federal Reserve Bank of Minneapolis Quarterly Review,* v. 28, no.1, July 2004, pp. 2-13.

B. Role of Modeling Assumptions

Simulation results

In the first set of results, the Joint Committee staff used its macroeconomic equilibrium growth model[3] (referred to as "MEG") to examine the sensitivity of modeling results to different assumptions about labor supply responsiveness and monetary and fiscal policy responses.[4] MEG models the long-run equilibrium growth path of the economy according to neoclassical growth theory, but it is also designed to include the effects of demand stimulus and monetary policy in simulating the short-run transition path in response to policy changes. The consumption and savings decision is made by a representative household that maximizes its desired consumption subject to a budget constraint. The labor supply response used in these simulations is modeled separately for four groups of workers: low-income primary earners, low-income secondary earners, moderate-and-high income primary earners, and moderate-and-high income secondary earners. "Low-income earners" are defined as earners who meet the income requirements for the earned income credit. Primary earners are assumed to be less responsive to decreases in marginal tax rates than secondary earners. Low-income earners are assumed to be more responsive to changes in tax rates than high income earners.[5] Because of the sensitivity of growth effects to these parameters, these simulations were run with two sets of elasticities. The labor supply parameters used in these simulations are shown in Table 1.[6]

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[3] The Joint Committee on Taxation macroeconomic equilibrium growth model was developed for use in macroeconomic revenue analysis in consultation with Macroeconomic Advisers, LLC.

[4] These simulations and their results are described in more detail in John Diamond and Pamela Moomau, "Issues in analyzing the Macroeconomic Effects of Tax Policy," *National Tax Journal,* vol. LVI, no.3, September 2003, pp. 447-462.

[5] It is important to note that there is a distinction between labor supply responsiveness and taxable income responsiveness. While studies of the responsiveness of taxable income to changes in tax rates have indicated that high income taxpayers appear to be more likely to make adjustments in taxable income through timing changes, portfolio adjustments, and other shifting behavior, the labor supply responsiveness of high income primary earners has been found to be lower than for others. See, for example, Emmanuel Saez, "Reported Incomes and Marginal Tax rates, 1960-2000: Evidence and Policy Implications," National Bureau of Economic Research Working Paper 10273, www.nber.org/papers/w10273 regarding taxable income elasticities. See Chinhui Juhn, Kevin M. Murphy, and Robert H. Topel, "Why Has the Natural Rate of Unemployment Increased over Time? *Brookings Papers on Economic Activity,* 199(2), pp. 75-142 and Robert Moffitt and Mark Wilhelm, "Taxation and the Labor Supply Decisions of the Affluent," *Does Atlas Shrug? The Economic Consequences of Taxing the Rich,* Joel Slemrod, ed., New York: Harvard University Press and Russell Sage Foundation, 2000 regarding labor supply responsiveness.

[6] More detail about both models and their parameters used in these simulations may be found in Joint Committee on Taxation, *Overview of the Work of the Staff of the Joint Committee on Taxation to Model the Macroeconomic Effects of Proposed Tax Legislation to Comply with House Rule XIII.h.2,* December 22, 2002, JCX-105-03, pp.38-43.

Table 1.−Labor Supply Parameters
Macroeconomic Equilibrium Growth Model

Labor Supply Elasticities in Macroeconomic Equilibrium Growth Model	Income	Substitution	Low Elasticity Substitution
Low Income Primary	-0.1	0.2	0.15
Other Primary	-0.1	0.1	0.1
Low Income Secondary	-0.3	0.8	0.4
Other Secondary	-0.2	0.6	0.3

In order to test for the sensitivity of simulation results to short-run stimulus effects, these simulations are presented assuming two different types of monetary policy. The first assumes that the Federal Reserve Board reacts nearly instantaneously to counteract temporary demand stimulus, thus returning the economy quickly to equilibrium levels of employment and potential Gross Domestic Product. The second assumes that the Federal Reserve Board ignores changes in fiscal policy, and adheres to a fixed rate of money growth.

Table 2 shows the range of results in terms of changes in growth in Gross Domestic Product depending on assumed labor supply elasticity, and monetary and fiscal policy reactions.

Table 2.−Percent Change in Real GDP Due to Ten Percent Cut
in Individual Income Tax Rates
Using Macroeconomic Equilibrium Growth Model

	First Five Years	Second Five Years	Long Run	First Five Years	Second Five Years	Long Run
Modeling Assumptions	Fed Targets Potential GDP			Fed Targets Fixed Money Growth		
(a) Debt-Financed Cut	0.21	-0.50	-0.94	0.29	0.03	-0.87
(b) Debt-Financed Cut, Low Labor Elasticity	0.17	-0.07	-0.99	0.29	0.03	-0.87
(c) Concurrent G Decrease	0.33	0.30	0.64	0.26	0.28	0.64
(d) Offsetting Tax Increase After Ten Years	0.21	-0.05	-0.46	0.32	0.05	-0.38

Predictably, the growth effects of the tax cut are lower when lower labor responsiveness is assumed (row (b) of table), when monetary policy is conducted to counteract the demand stimulus of the tax cut (left half of table), and when the tax cut is financed through increasing government debt (all but row (c) on table). Within the first five years, the slightly lower labor

supply elasticity in the second simulation results in a nearly 25 percent reduction in forecast GDP growth than the higher elasticity projects. Less restrictive monetary policy results in almost one-third more GDP growth in the first five years.

In the long run, the amount of growth predicted by the tax cut is crucially dependent on whether the cut is debt-financed, or financed by a cut in spending or future increase in taxes. Because decision-making in the MEG model is myopic, and thus individuals don't see or react to coming fiscal crises, these alternate government finance simulations are of limited interest. They do produce the familiar result that tax cuts result in more growth when they are accompanied by simultaneous reductions in spending.

More simulations using an overlapping generations lifecycle model[7] (referred to as "OLG") provide additional information about the sensitivity of outcomes to fiscal policy response assumptions. In this model, consumption, savings, and labor supply are determined by utility-maximizing individuals represented by 55 cohorts of individuals who maximize consumption subject to a lifetime budget constraint (as opposed to the single period budget constraint in the MEG model). The labor supply choice is determined through the preference for leisure in the utility function. Results from these simulations are summarized on Table 3.

Table 3.−Percent Change in Real GDP to Ten Percent Cut in Individual Rates Using Overlapping Generations Model

Finance Assumption	First Five Years	Second Five Years	Long Run
(a) Cut in non-valued government spending after ten years	0.17	0.02	-0.04
(b) Cut in government transfer payments after ten years	0.21	0.14	0.10
(c) Increase in tax rate on labor income after ten years	0.20	0.14	-0.10
(d) Increase in tax rate on capital income after fifteen years	0.18	0.05	-0.43
(e) Cut in government transfer payments after twenty years	0.19	0.10	-0.21

In contrast to behavior in the MEG model, in the OLG simulations, individuals can foresee changes in government spending or taxation after the ten-year tax cut policy period, and adjust their behavior immediately in response to these changes. In the OLG model anticipated cuts in future "non-valued" government spending will result in less growth over the first ten years relative to anticipated cuts in "valued" government transfer payments or anticipated

[7] The Joint Committee staff contracts with Tax Policy Advisers for the use of this OLG model, and works collaboratively with TPA on adapting it for Joint Committee needs.

increases in taxes on labor.[8] People work and save more over the first ten years in anticipation of a future loss of valued spending or tax increases, because they recognize the need to accumulate more assets against the anticipated lean period later in their life cycle. The farther in the future these increases are the longer the timeframe that individuals have to accumulate extra wealth, and the more muted these effects are on current labor supply and savings.

Modeling extension

The range of results due to modeling assumptions presented above do not represent the entire spectrum of possible models or the entire range of assumptions about economic reactions to a tax cut. Another important model feature that has been shown to affect the results of macroeconomic tax policy simulations is whether or not the model includes international capital flows.[9] The more responsive savings are to changes in the after-tax return to capital, the more capital deepening and growth are likely to occur, even in the presence of debt financing of the tax cut. Alternatively, if the model includes an international sector, then rising interest rates in the U.S. attract foreign capital and there is an increase in investment, resulting in capital deepening and faster growth. The MEG model includes a simple international sector in the form of a second "rest of the world" economy, which reacts to simulated changes in the U.S. economy. Foreign capital is attracted to the U.S. when U.S. interest rates increase, and imports are stimulated by increasing consumption and prices in the U.S. Exchange rates adjust to bring the U.S. economy and the "rest of world" economy into purchasing power parity.[10]

The OLG model used in the simulations above is a closed economy, relying on increases in savings to finance increased investments. A more recent version of the OLG model used by the Joint Committee staff includes a fairly rudimentary modeling of international capital, with international capital flowing into the U.S. economy in response to rising interest rates. However, in contrast to the MEG model, there is not a complimentary goods market in the OLG model. Unlike many "small, open economy" models with an interest-rate driven international capital flow, this module in OLG is not implemented by setting the after-tax interest rate equal to its pre-policy level. Instead, an interest rate elasticity determines foreign capital flows in an attempt to simulate a "large, open economy." The Joint Committee staff is continuing to make further refinements of the international sector. Ideally, the OLG model would also include an international goods market as well as the capital market.

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[8] "Non-valued" government spending is government spending that consumers don't include in their calculation of personal utility. "Valued" government spending is modeled as directly increasing individuals' disposable income - equivalent to transfer payments.

[9] The role of international capital flows is explored in some detail in Joint Committee on Taxation, *Joint Committee on Taxation Tax Modeling Project and 1997 Tax Symposium Papers,* JCS-21-97; see summary Table 5, pp. 32-33.

[10] Purchasing power parity is achieved when exchange rates between currencies allow for goods and services to be purchased at essentially the same price in each country.

C. Role of Tax Rate Aggregation and Model Calibration

Simulation results

A perhaps little-known source of variation in macroeconomic simulation results is the way changes in effective tax rates are measured and translated into macroeconomic simulation models. The next set of simulation results will show that predicted growth and revenue feedback in models can change depending on how detailed the modeling of taxable income flows is within a model.

The U.S. individual income tax is extremely complex, with a progressive rate structure, a plethora of deductions and tax credits targeted at large and small subsets of taxpayers, different tax rates on dividends and capital gains than on other sources of income, and the alternative minimum tax. Thus even the seemingly straightforward ten percent cut in all individual income tax rates can change effective tax rates for different individuals in different ways.

The Joint Committee staff uses large microsimulation models based on a statistically matched sample of individual income tax returns and survey information from the Current Population Survey to simulate tax policy changes for individuals. For the ten-percent tax cut, it is a fairly simple exercise to obtain the change in marginal and average tax rates for each of the 280,000 records on the merged tax and Current Population Survey microsimulation file, including changes in rates on business income that is taxed as flow-through to individuals.[11] This is in contrast to tax sectors in many macroeconomic simulation models, which are generally quite simple and stylized. Tax policy changes are implemented in macroeconomic models by determining how the policy changes tax rates in the model. Fewer different tax rates (more aggregation) in a model mean that fewer distinct tax sectors are separately modeled. Aggregation of tax rates into a single tax sector effectively uses an underlying assumption that all agents subject to that aggregate tax react in the same way to tax policy changes.

However, there is a substantial amount of research that suggests individuals in different circumstances are likely to react differently to tax policy changes. In order to explore the importance of this concern in the modeling of tax policy, the Joint Committee staff uses the MEG model to simulate the ten-percent tax cut assuming different levels of tax rate aggregation.[12] In contrast to the simulations presented above, all of the simulations presented in this portion of the paper assume the same set of labor supply elasticities, monetary policy and

[11] Joint Committee staff makes use of a similar data base and tax calculator based on a large sample of corporate income tax returns to obtain marginal and effective tax rate changes from tax policy initiatives affecting corporations. This data set allows us to take account of the impact of net operating losses, special business credits, and the corporate alternative minimum tax in calculating effective corporate tax rates under specific proposals.

[12] These simulations and their results first appeared in Altshuler, Rosanne, Nicholas Bull, John Diamond, Timothy Dowd, and Pamela Moomau, "The Role of Dynamic Scoring in the Federal Budget Process," *American Economic Review: Papers and Proceedings,* 95, no.2, May 2005.

government finance, so that the only source of variation in the results is the level of aggregation of tax rates in the model.[13]

While the level of tax rate aggregation does affect the results of the ten-percent across-the-board tax cut, the relative simplicity of this proposal masks the importance the aggregation effect can have on proposals that affect only portions of income, or that have significantly different effects on average and marginal tax rates of people in different parts of the income distribution. For this reason, this analysis includes simulations of a ten-percent cut in wage taxes only, as well as of an increase in the personal exemption, which reduces tax liability without changing the marginal tax rate of most people.

In the first set of simulations, there is only one average tax rate ("ATR") in the model, determined by dividing taxable income in the initial period by receipts in the starting model period, which is usually the most recent time period for which historical data exist. This rate is used to represent the changes in tax rates in both the labor and investment behavioral equations, and in a single equation that determines total tax receipts. This single rate, single tax sector approach has been commonly used in econometric models that focus on modeling the effects of tax policy on short-run fluctuations in demand. It is not well-suited to simulating supply side effects because it fails to examine the effects of changes in marginal tax rates.

In the second set of simulations, the change in average and marginal rates is separately calculated, allowing the simulation to account for possibly differential effects of the tax policy on after-tax income versus after-tax rate of return on income. But these simulations still require averaging of these effects across all taxpayers and sources of income for both behavioral effects and the determination of tax receipts.

In the third set of simulations, there are separately calculated average and marginal tax rates ("MTRs") for each of the seven income sources and four labor supply groups in the MEG model's behavioral equations, but as in the first two simulations, a single average tax rate is applied to an aggregated, single measure of taxable income to determine tax receipts. For the two sets of primary and secondary workers that make up the four labor supply groups, the same average tax rate applies to the primary and secondary worker in each category, reflecting the fact that primary and secondary workers experience average tax rates as a family. The potential wages of the secondary workers are assumed to be added to the wages for the primary worker; thus marginal tax rates for secondary workers are somewhat higher than those for the primary workers.

The aggregation of a single average tax rate for determining revenues is a simplifying assumption that is sometimes used in macroeconomic models because it allows for a relatively easy calibration between the income measures in the National Income and Product Account

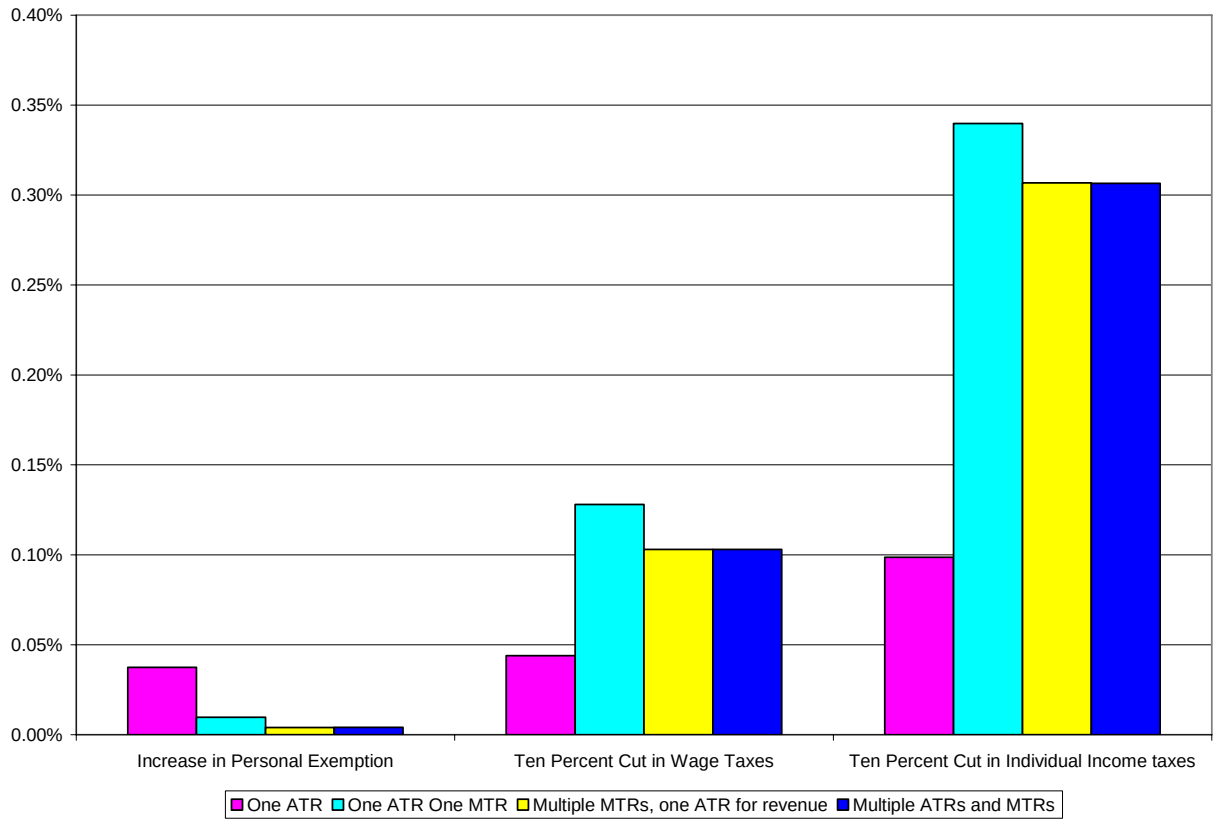
[13] Labor supply elasticities used in these simulations are those in the first two columns of Table 1. It is assumed that the Federal Reserve Board targets fixed GDP and the Federal government debt-finances the tax cuts.

("NIPA") data used in most macroeconomic simulation models and taxable income as reported on income tax returns.

In the fourth set of simulations, in addition to the separately calculated average and marginal tax rates for each income source and labor supply group in the MEG model's behavioral equations, there are separate average tax rates for each income source in the revenue equations. This last step can have an important effect on projected changes in tax receipts.

The effects of different levels of tax rate aggregation on projected economic growth are shown in Figure 1:

Figure 1.−Percent Change in Real GDP Under Different Levels of Tax Rate Aggregation

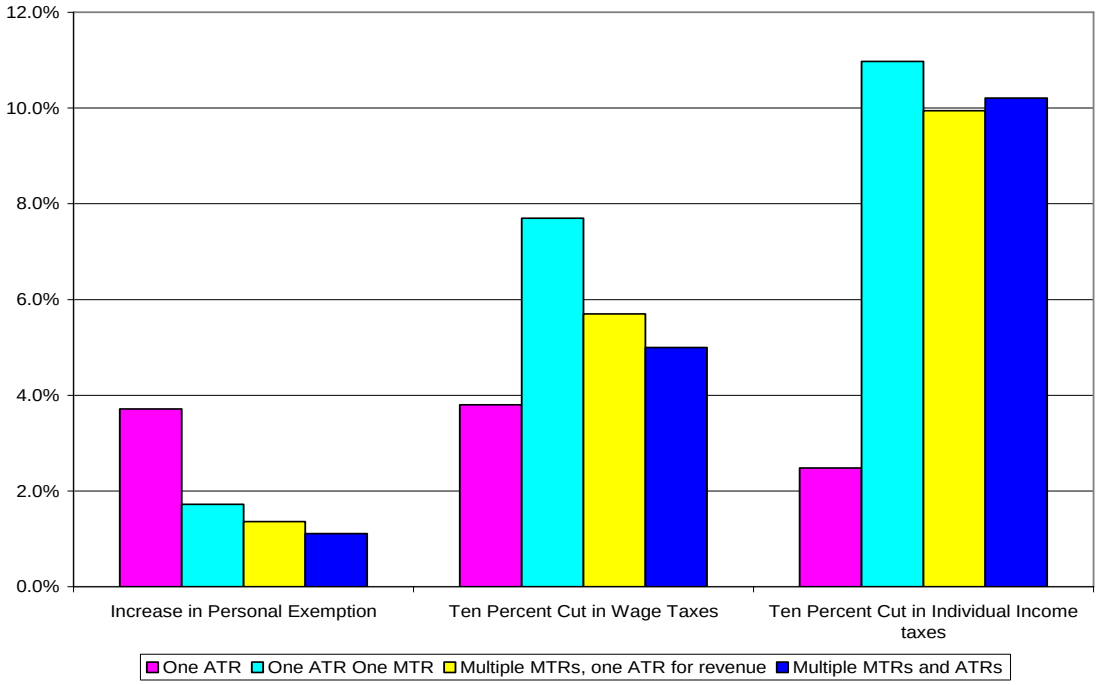


The comparison of interest here is the influence of the level of tax rate aggregation on the results for each proposal. The GDP growth rate for the single tax average tax rate (the first bar in each group) differs the most from the other levels of aggregation for all three proposals. This is because of the inability of the single average tax rate to account for most likely supply side effects. For the increase in the personal exemption, which does not significantly affect marginal tax rates and therefore is where demand stimulus is the most likely engine of growth, the more aggregated measure produces more growth than the more detailed tax sectors.

Interestingly, for the ten-percent wage rate cut and the ten-percent across the board tax cut, the one average rate, one marginal rate aggregation produces more growth than the more detailed versions with multiple average and marginal tax rates. When the tax rate change is represented as a weighted average change that applies to the whole universe of taxpayers, it effectively attributes the incentive effects of the tax cut equally to all taxpayers, thus producing a phantom response from taxpayers that are not actually experiencing the tax cut being attributed to them.

One of the major interests in dynamic analysis is in determining how much of the estimated revenue cost of a tax cut proposal might be offset by induced revenue growth due to GDP growth, often referred to as "revenue feedback." The effects of different levels of tax rate aggregation on the estimated revenue feedback of the tax cuts are shown in Figure 2:

Figure 2.−Percent Revenue Feedback Under Different Levels of Tax Rate Aggregation



The variation in revenue feedback between the different simulations by and large reflects the variation in GDP growth in the different simulations; those simulations producing more GDP growth generally also produce more revenue feedback. However, the most interesting contrast here is between the third and fourth simulations. For all the proposals, the GDP effects of the third and fourth simulations were virtually the same, as would be expected because they have the same tax rates in the behavioral equations. However, the revenue feedback varies depending on how detailed the revenue equations are. For the two proposals that affect some income sources more than others, the exemption increase and the wage tax cut, the revenue feedback from the

simulation with only one revenue equation is greater than the revenue feedback from the simulation with multiple revenue equations. The single aggregate revenue equation falsely attributes a change in the average tax rate to all sources of income, rather than the sources of income specifically affected by the proposal. In contrast, for the ten-percent across-the-board tax cut, the disaggregation of the revenue equation results in more revenue feedback than the single equations.

Modeling extensions

For the variation in results that arise from different modeling assumptions described earlier in Part I.B, , there is no general agreement as to which of the various behavioral assumptions and modeling frameworks are more or less correct for use in analyzing tax policy. There is much less uncertainty as to which of the approaches to modeling tax sectors (described in this section) is the "correct approach." The more disaggregation of tax sectors in a macrosimulation model, the more accurately the model is able to represent the change in tax policy that is being analyzed. Unfortunately, the more detail there is in an equilibrium macrosimulation model, the more difficult it is to develop a set of parameters and a solution algorithm that result in the model converging to the steady-state equilibrium that is necessary to produce simulation results. Typically, models that have multiple business sectors have only one household sector, and models with multiple household sectors have very simple business sectors. Thus, although the modeler might be reasonably certain about how the tax sector would be modeled ideally, it is still necessary to make choices as to which sectors to model separately, and many macroeconomic simulation models currently in use have sacrificed detail in tax modeling in order to incorporate detail about other aspects of the economy.

The Joint Committee staff has disaggregated the tax equations in the macroeconomic simulation models we use, particularly the MEG model. Most recently, this effort has extended to improving the long-run forecast in the MEG model by iterating between the Joint Committee staff's individual microsimulation model and the MEG model to allow long-run average and marginal tax rates to be determined by the interaction between present law tax policy and the expected path of income growth as projected by MEG. Because average and marginal tax rates affect the rate of growth in MEG, and the rate of growth affects average and marginal tax rates, it is necessary to iterate back and forth between the two models until there is convergence in the rates produced by each model. The models' income flows are calibrated so that they are consistent with short- and long-run demographic forecasts from the Department of the Census.

The analysis of cuts in the individual income tax presented above demonstrates that it is desirable to have models with more detail in the tax sectors for taxes on individuals. It is similarly desirable to have as much disaggregation as possible in the modeling of taxes on business. Currently both the MEG model and the OLG model have separate business, owner-occupied housing, and rental housing sectors. OLG also has fully separate corporate and non-corporate sectors, while MEG incorporates a portion of proprietors' income into its cost of capital equations. One of the major planned modeling improvements will increase the number of business sectors in MEG, in order to allow analysis of a tax proposal that treats different business sectors differently. The simulations above showing the role tax rate aggregation plays in the analysis of individual income tax proposals demonstrates the importance of such an improvement.

PART II − THE DEVELOPMENT OF MACROECONOMIC ANALYSIS OF TAX LEGISLATION AT THE JOINT COMMITTEE ON TAXATION

A. Introduction

This presentation discusses the development of macroeconomic analysis of tax legislation at the Joint Committee on Taxation. First, it provides background on revenue estimating. Next, it provides some history of the Joint Committee staff's efforts to estimate the macroeconomic effects of tax proposals. And finally, it discusses some recent model developments and give a sense of some future developments the Joint Committee staff are considering or are working on.

The Joint Committee staff is nonpartisan and serves the entire Congress. One of the JCT staff's key responsibilities is to provide revenue estimates: These are estimates of the change in Federal receipts that would result from proposed tax legislation. The Joint Committee staff's objective is to produce accurate, consistent, and impartial revenue estimates that can be relied upon by Members of Congress in making legislative decisions. For budget purposes, the Congressional Budget Act of 1974 ("the Budget Act") stipulates that revenue estimates provided by the Joint Committee staff will be the official estimates for all tax legislation considered by the Congress.

B. Conventional Analysis

What is a revenue estimate?

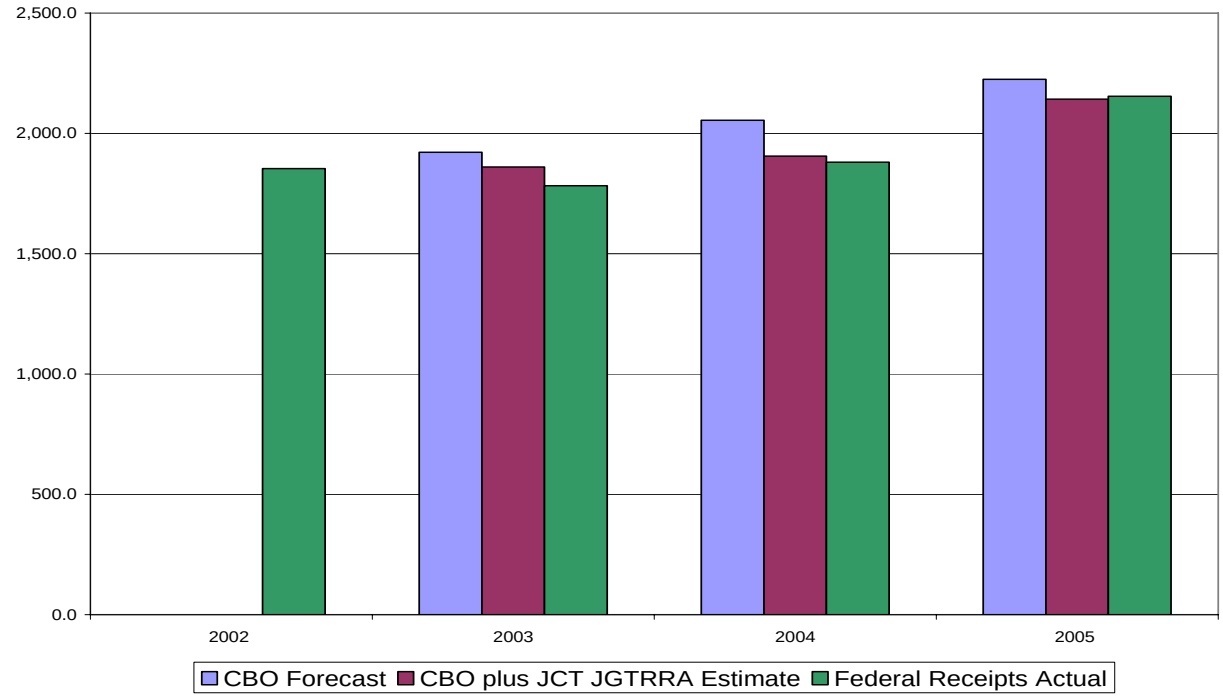
What is a revenue estimate? A revenue estimate is an estimate of the change in projected Federal baseline receipts that would result from a change in law. The starting point for a revenue estimate prepared by the Joint Committee staff is the Congressional Budget Office ("CBO") 10-year projection of Federal receipts, referred to as the "receipts baseline." The receipts baseline serves as the benchmark for measuring the effects of proposed tax law changes. The baseline assumes that present law remains unchanged during the 10-year budget period. Thus, the receipts baseline is an estimate of the Federal receipts that would be collected over the next 10 years in the absence of statutory changes. The Joint Committee staff is required to estimate the revenue effects of proposals relative to the projected CBO receipts baseline.

A common misunderstanding that arises in reporting revenue estimates to policy makers is the distinction between a revenue estimate and receipts forecast. Generally, when the economy is growing, the CBO forecast of baseline receipts is growing. A negative revenue estimate of a tax proposal does not mean that the Joint Committee is predicting receipts will fall. It means that receipts are predicted to grow more slowly if the proposal is enacted than they are projected to grow under present law in the baseline receipts forecast. Receipts would only decline if the revenue estimate were for a loss in revenues that was greater than the underlying growth in baseline receipts.

For example, consider the Joint Committee staff's estimates of the overall revenue effects of the Jobs and Growth Tax Relief Reconciliation Act of 2003 ("JGTRRA"). Figure 1 allows a comparison of CBO's January 2003 forecast of receipts (the blue bars), the CBO's forecasted receipts as modified by the Joint Committee staff's estimates for JGTRRA (the red bars), and actual receipts (the green bars) for fiscal years 2002 through 2005. The red bars show that after adjusting the CBO's receipts forecast for the Joint Committee staff's estimate of JGTRRA, receipts were estimated to continue to increase. However, the estimated increase is slower than in the CBO's original baseline forecast (the blue bars). In fact, actual receipts (the green bars) for 2003 through 2005 totaled $93 billion less than total receipts estimated by the Joint Committee staff (the red bars).

Enactment of legislation in 2004 makes comparison using 2004 and 2005 receipts problematic. However, Figure 3 shows that, while the combined CBO/Joint Committee estimate of receipts for 2004 and 2005 is slightly less than actual receipts, it reflects a projected overall increase in receipts for these years relative to receipts prior to enactment of the legislation.

Figure 3.−Fiscal Year Federal Receipts in Billions of Current Dollars



Conventional analysis includes taxpayer behavior

Another frequently expressed misconception about conventional revenue estimates provided by Joint Committee staff is the notion that they assume taxpayers will not change their behavior in any way in response to tax policy changes.

One of the conventions that is followed for both revenue estimates prepared by the Joint Committee staff and expenditure estimates prepared by the Congressional Budget Office is that they are done against a fixed forecast of aggregate economic activity; the Joint Committee staff generally assumes that a proposal will not change total aggregate production and therefore holds forecasted Gross National Product ("GNP") fixed. However, conventional revenue estimates prepared by the Joint Committee staff should not be confused with "static" revenue estimates. Joint Committee staff revenue estimates always take into account many likely behavioral responses by taxpayers to proposed changes in tax law. Such behavioral effects incorporate or include shifts in the timing of transactions and income recognition, shifts between business sectors and entity form, shifts in portfolio holdings, shifts in consumption, and tax planning and avoidance strategies.

To summarize Joint Committee staff's conventional revenue estimating methodology: the Joint Committee staff provide estimates relative to baseline receipts projected for future years under present law, not relative to receipts in years prior to the enactment of the proposal; the Joint Committee staff generally assumes a fixed GNP forecast; and the Joint Committee staff incorporate many types of microeconomic behavioral responses in Joint Committee staff revenue estimates.

C. History of Joint Committee on Taxation Involvement in Macroeconomic Analysis

The beginning: 1995

In January 1995, the Senate and House Budget Committees held a joint hearing to consider the feasibility of including macroeconomic effects in revenue estimates of tax legislation. The consensus of most of the speakers at that hearing was that, while in theory incorporating macroeconomic feedback effects in revenue estimates would be a good idea, in practice, the rudimentary state of macroeconomic modeling of tax policy made it infeasible. During the following spring, the Joint Committee staff on Taxation began studying and testing macroeconomic models to determine their usefulness in revenue estimation. To further this work, the Joint Committee staff hosted symposiums of respected macroeconomic modelers in 1996 and 1997.

1997 symposium

On January 17, 1997, the Joint Committee staff hosted a symposium entitled "Modeling the Macroeconomic Consequences of Tax Policy." This symposium presented the results of a year-long modeling experiment to explore the predictions of a variety of models regarding the macroeconomic feedback effects of fundamental tax reform, with a focus on evaluating the feasibility of using these types of results to enhance the U.S. budgeting process. Eleven macroeconomic modelers were invited to the symposium: each was asked to analyze the effects of two proposals, a broad-based unified income tax, and a broad-based consumption tax. Modelers were asked to calibrate their models to the same starting economic baseline, and to simulate similar proposals.

There were a number of common results from this symposium. First, all of the models found that restructuring the U.S. tax system into a consumption-based tax resulted in increased economic growth in the long run. However, the size and timing of the increases in economic output varied considerably. For example, the increase in GDP after ten years ranged from a 0.7 percent increase to a 16.4 percent increase. The substantial variation in results arose from different assumptions about the responsiveness of the households and producers to the changes in taxes, differences in modeling frameworks, and differences in the way the tax changes themselves were modeled in each different macro model. To make the results of the symposium accessible to Congressional staff and interested parties, the Joint Committee staff published the symposium papers and discussions.[14]

[14] A complete description of the different models and their results can be found in Joint Committee on Taxation, *Joint Committee on Taxation Tax Modeling Project and 1997 Tax Symposium Papers*, JCS-21-97, November 20, 1997.

Modeling developments since 1997

Since the 1997 symposium, much of the Joint Committee staff's developmental work has focused on enhancing and adapting standard models of the economy for use in the analysis of the macroeconomic effects of tax policy changes. Because different types of models have different strengths and weaknesses, the Joint Committee staff has worked to become proficient in the use of several types of modeling frameworks.

The Joint Committee staff drew on the results from the symposium and began to standardize the methods for translating conventional estimates and tax changes into inputs for these macroeconomic models. In order to account for the complexities of the present-law Internal Revenue Code, much of the Joint Committee staff's macroeconomic modeling work has involved enhancing and expanding tax-related equations in several types of macroeconomic models so that they can make better use of the wealth of information available from the Joint Committee microsimulation models. For example, most macroeconomic models start with a very rudimentary tax structure, in some cases just a single Federal tax rate. However, the microsimulation models, such as those long used by the Joint Committee staff, combine individual and business tax return data with tax calculators that provide detailed estimates of tax liability under current and proposed tax laws. These detailed microsimulation models allow for very specific average and marginal tax rates on different types of taxpayers and different types of income, which in turn may be incorporated in each macroeconomic model. In the late 1990's the use of different average and marginal tax rates for different groups of taxpayers generally was absent from macroeconomic models. These computations provide the primary tax-related input to the macroeconomic models used by the Joint Committee staff. Use of microsimulation models to estimate changes in tax rates due to proposed law changes permits incorporating the effects of tax proposals in more detail than otherwise possible. A significant amount of variation in results can be traced to the way that tax rates are modeled in a macro model.[15]

Macroeconomic simulation models used by the Joint Committee staff

The most substantial effort with respect to macroeconomic simulation, conducted in consultation with a private contractor,[16] has resulted in the development of the Joint Committee staff's Macroeconomic Equilibrium Growth ("MEG") model. In order to explore multiple perspectives on the economic modeling of tax policy, the Joint Committee staff has worked with several additional macroeconomic models. The most in-depth work involves the use of an overlapping generations lifecycle model ("OLG").[17] Key features of the MEG and OLG models were described in more detail in the discussion of modeling the effects of a ten-percent tax cut.

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[15] Altshuler, Rosanne, Nicholas Bull, John Diamond, Tim Dowd, and Pamela Moomau, "The Role of Dynamic Scoring in the Federal Budget Process: Closing the Gap between Theory and Practice," *American Economic Review* volume 95, number 2, May 2005: 432-436.

[16] Macroeconomic Advisers, LLC provided initial developmental work for the MEG model.

[17] The OLG model is used pursuant to a contract with Tax Policy Advisers.

The Joint Committee staff also maintains service contracts with the distributors of two commercially available econometric models: the Global Insight model and the Macroeconomic Advisers model.

Macroeconomic analysis of tax bills: information provided to Congress

In 2002, Joint Committee staff presented information about the models they were using and the results of numerous sets of simulations from these models to a panel of public finance and macro economists during three full-day sessions in June, October, and December. Staff from the House and Senate tax writing and budget committees as well as the staff from the Joint Economic Committee, the Congressional Budget Office, and the U.S. Treasury Office of Tax Analysis attended these sessions as observers. In 2003, the Joint Committee staff published a report on the sessions and the models and assumptions.[18]

House Rule

A succession of rules passed by the House of Representatives have directed the Joint Committee staff to supplement conventional revenue estimates with an analysis of the macroeconomic impact of certain tax legislation. In 2003, this resulted in the first official macroeconomic analysis of tax legislation, analysis of H.R. 2, The Jobs and Growth Tax Act of 2003, as reported by the House Ways and Means Committee on May 6, 2003. The macroeconomic analysis was inserted into the *Congressional Record* for Thursday, May 8, 2003 in compliance with the House rule and in time to be available to Members of Congress for deliberation. An expanded version of this analysis is included in a December, 2003, Joint Committee on Taxation publication, JCX-105-03.

Macro analysis of H.R. 2, the Jobs and Growth Tax Reconciliation Act of 2003 ("JGTRA")

In that report, the Joint Committee staff found that H.R. 2 would likely stimulate the economy immediately after enactment by creating temporary incentives to increase work effort, business investment, and consumption. The simulations predicted that H.R. 2 would increase real GDP over the first six years by between 0.2 percent and 0.9 percent. The report also indicated that the anticipated stimulus would be reduced over time because the consumption, labor, and investment incentives are temporary, and because the positive business investment incentives arising from the tax policy change are eventually likely to be outweighed by the reduction in national savings due to increasing Federal government deficits.

Other official statements Pursuant to the House Rule

Since the analysis of JGTRA, macroeconomic statements have been provided with respect to a number of tax bills in accordance with House rules. In general, these have been

[18] Joint Committee on Taxation, *Overview Of Work Of The Staff Of The Joint Committee On Taxation To Model The Macroeconomic Effects Of Proposed Tax Legislation To Comply With House Rule XIII.3.(h)(2)*, JCX-105-03, December 22, 2003.

bills that the Joint Committee staff's macroeconomic modeling indicated would have an effect on the macro economy so small as to be incalculable in the context of a macroeconomic model.

D. Recent Exploration and Developments in Macroeconomic Analysis by the Joint Committee Staff

Modeling issues explored by the Joint Committee staff

Over the last several years, the Joint Committee staff has completed a number of analyses and presented their results both in written reports and in various different forums, both technical and non-technical. These presentations and reports have provided a forum for a professional dialogue about the Joint Committee staff's models and provide the staff with technical feedback about its methodologies. The following is a description of some of these presentations and reports.

Joint Committee staff presented work on analyzing a ten-percent across the board tax cut at the spring 2003 meetings of the National Tax Association.[19] The analysis found that there is a considerable amount of uncertainty about the macroeconomic effects of ten-percent across the board rate cut.

In the fall of 2004 at the National Bureau of Economic Research ("NBER") working group on behavioral effects of tax policy, and at the spring 2005 National Tax Association symposium, Joint Committee staff presented work on the feasibility of incorporating a fiscal policy reaction function in macro models.[20] Often, when analyzing tax policy, macroeconomic models need to close the budget gap that results from a tax cut. One potential mechanism that is often suggested for closing the budget gap is to econometrically estimate a fiscal policy reaction function that reproduces the legislative responses to fiscal gaps. The paper found that fiscal policy reaction functions that are consistent with econometrically estimated equations in the economics literature, can both return the Federal government to a sustainable fiscal situation and can result in a continuation of increasing Federal debt, depending on arbitrary assumptions of how to implement the fiscal policy reaction function in the macro model.

In the spring of 2005 at the NBER working group on behavioral effects of tax policy, Joint Committee staff presented work on the dynamic revenue effects of a reduction in capital and labor tax rates following the work of a widely reported paper by Mankiw and Weinzierl.[21]

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[19] Diamond, John W. and Pamela H. Moomau "Issues Analyzing the Macroeconomic Effects of Tax Policy," *National Tax Journal* Volume LVI, Number 3, September, 2003, 447-462.

[20] Bull, Nicholas, and Timothy Dowd, "Use of Fiscal Policy Reaction Function in Analyzing the Macroeconomic Effects of Tax Policy," *National Tax Journal*, Volume LVIII, Number 3, September 2005, 373-390.

[21] Mankiw, N. Gregory, and Mathew Weinzierl, "Dynamic Scoring: A Back of the Envelope Guide," NBER Working Papers, December 2004, No. 11000. In collaboration with Eric Leeper of Indiana University, the Joint Committee staff's work has been circulated as an NBER working paper, Leeper, Eric, and Susan Yang, "Dynamic Scoring: Alternative Financing Schemes," NBER Working Papers, February 2006, No. 12103.

The paper uses a neoclassical growth model to evaluate the effects of bond-financed tax reductions that eventually result in adjustments in future government consumption, transfers, capital tax rates, or labor tax rates. It finds that Mankiw and Weinzierl's result can change substantially under a different financing mechanism for a tax cut.

In January of 2005 at the American Economics Association meetings, the Joint Committee staff presented work investigating the range of effects from increasing disaggregation of tax parameters in macro models.[22]

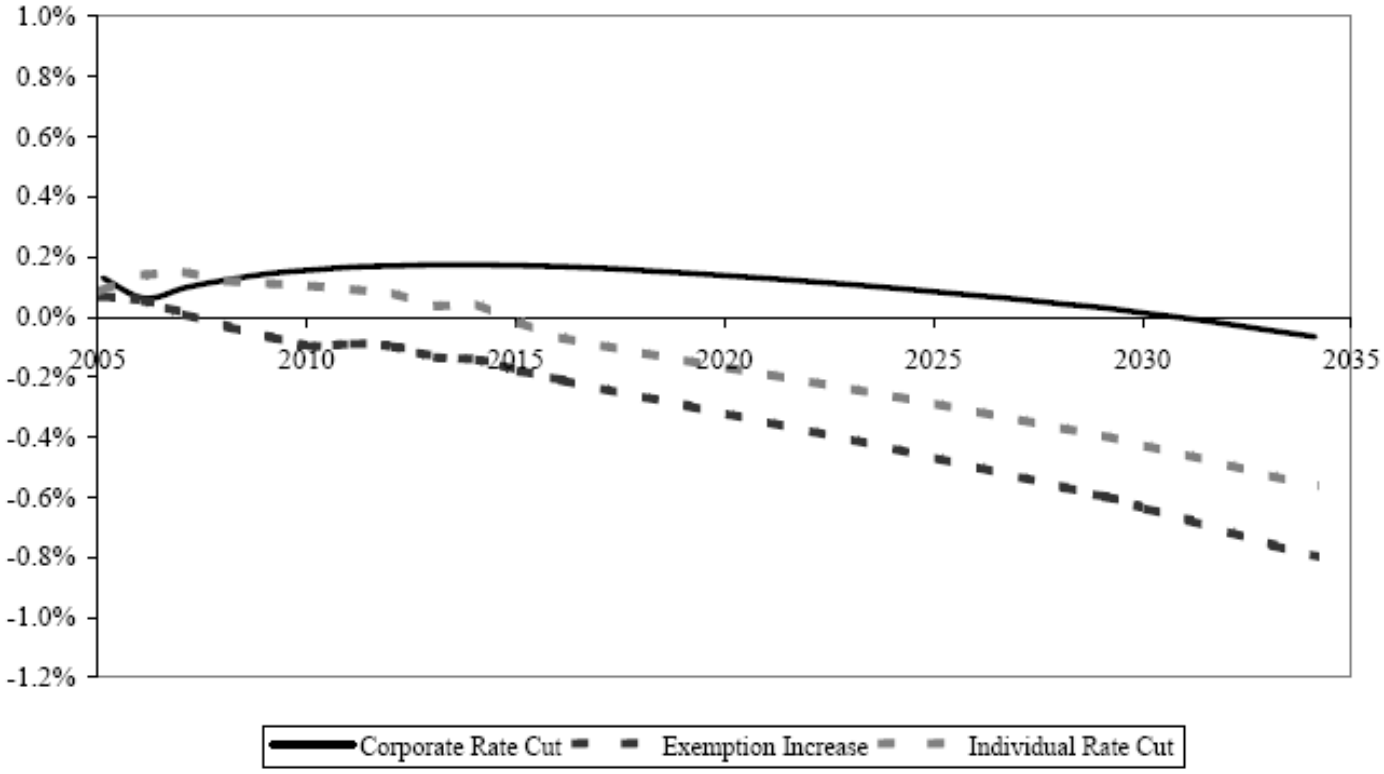
Also in 2005 at the request of Chairman Thomas, in order to provide Congress with information about the differential effects on the economy of different types of tax policy, Joint Committee staff presented work on estimating the macroeconomic effects of three different proposals all with a conventional revenue effect of $500 billion.[23] The three proposals are a decrease in individual income tax rates, an increase in the personal exemption, and a decrease in the corporate income tax rate. Despite the fact that each of these tax cuts reduces revenues by the same amount according to conventional revenue estimates, their effects on the economy vary greatly, both within the ten-year budget planning horizon and in the longer run. For example, using the same model assumptions and assuming contemporaneous reduction in government expenditures, the estimated range of effects on real GDP in the long run were from 0.2 for the increase in the personal exemption, to 0.4 and 0.9 for the reduction in individual and corporate tax rates, respectively. Moreover, the range of results includes negative long-run effects when there is not a contemporaneous decrease in government expenditures.

In this study, the Joint Committee staff experimented with ways to make this comparative information easily accessible, presenting the results in a series of graphs showing the different growth paths generated by the tax cuts, in addition to providing more precise information in the tables than had been provided in previous reports. One of the challenges in the graphic presentation is providing both information about the different effects of the different types of proposals, and providing information about the sensitivity of the results to differing modeling assumptions. The graph below presents the percent change in real GDP from the baseline. As can be seen in the graph, the corporate rate cut resulted in more economic growth for a longer period of time.

[22] Altshuler, Rosanne, Nicholas Bull, John Diamond, Tim Dowd, and Pamela Moomau, "The Role of Dynamic Scoring in the Federal Budget Process: Closing the Gap between Theory and Practice," *American Economic Review* volume 95, number 2, May 2005: 432-436.

[23] Joint Committee on Taxation, *Macroeconomic Analysis of Various Proposals to Provide $500 Billion in Tax Relief*, (JCX-4-05), March 1, 2005.

Figure 4.−Percent Change from Baseline in Real GDP:
No Fiscal Offset; Aggressive Fed Policy



Areas for Further Development

Recently, the Joint Committee staff has been developing an infinite agent neo-classical growth model for tax analysis. It is a dynamic stochastic general equilibrium model with full microeconomic foundations. Developmental work on this model is continuing. The Joint Committee staff hope to use this new model to address issues relating to anticipation effects and distributional effects of tax policy.

There are a number of other areas for continued research, including, but not limited to, the introduction of human capital and imperfect competition into the models. The introduction of each of these could have profound impacts on the type of results that the models find from different types of tax policies.

E. Conclusion

For the past ten years the Joint Committee staff has been investigating the ability to use macroeconomic models incorporating sophisticated tax modeling to provide information to Members of Congress as part of the tax legislative process. During this time the Joint Committee staff has convened respected macroeconomic modelers and public finance experts to understand the intricate details of various models; identified, developed, and enhanced models that are appropriate for analyzing tax policy; and continued to improve the models and adapt them to specific tax policy proposals. In this process the Joint Committee staff has highlighted the importance of disaggregated tax policy variables and calibration methods in the modeling of tax policy. More recently, under the House rule the Joint Committee has provided macroeconomic analysis, including sensitivity analysis, on legislation where there is a sizeable macroeconomic effect capable of being modeled.