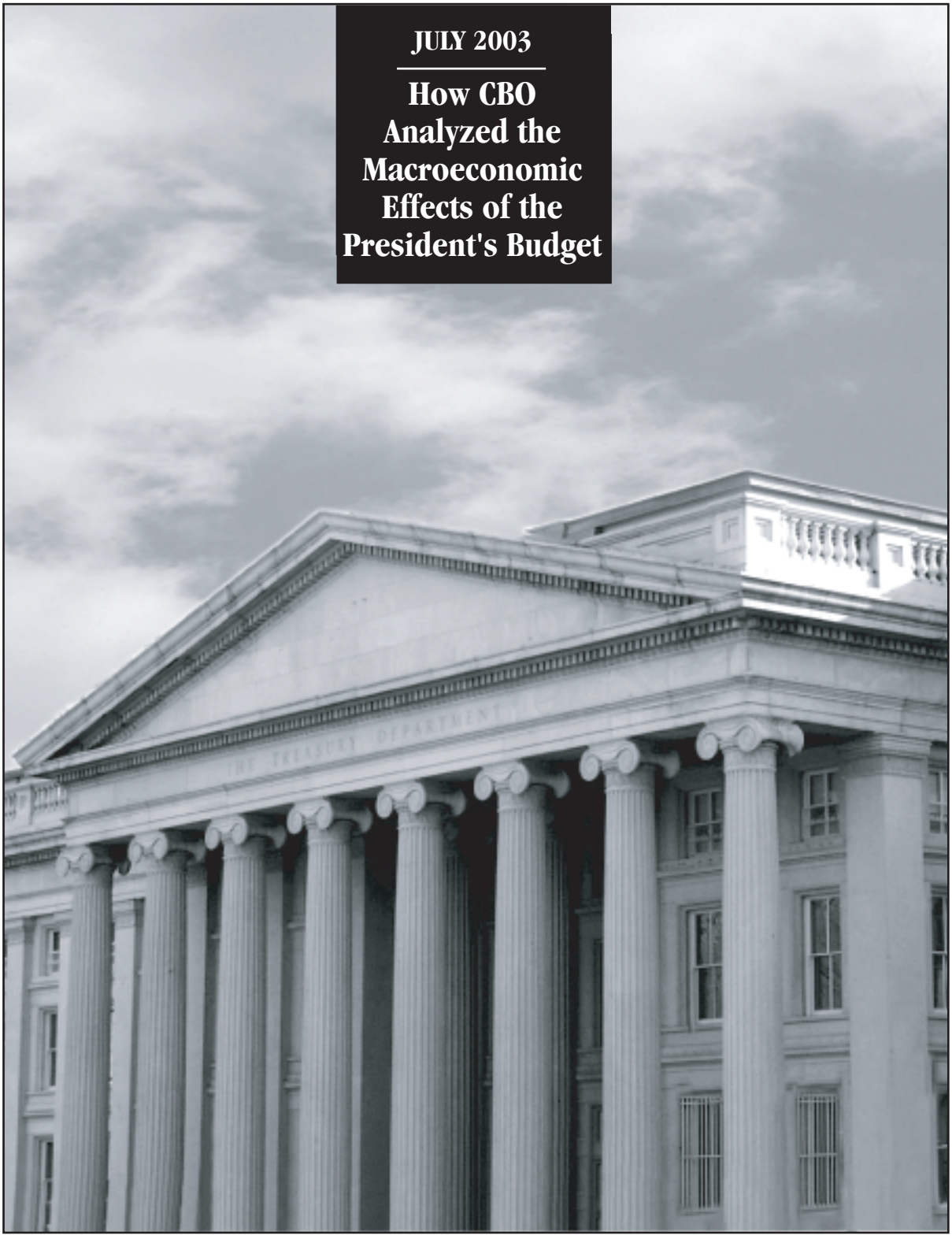
CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE

A
CBO
PAPER

JULY 2003

How CBO Analyzed the Macroeconomic Effects of the President's Budget



A
CBO
PAPER

How CBO Analyzed the Macroeconomic Effects of the President's Budget

July 2003

The Congress of the United States ■ Congressional Budget Office

Notes

Numbers in the text and tables may not add up to totals because of rounding.

Unless otherwise indicated, all years referred to in this paper are fiscal years.

The cover photo of the Main Treasury Building was taken by Binh Thai.

Preface

This paper describes the methods that the Congressional Budget Office (CBO) used to estimate the macroeconomic effects of the President's budgetary proposals. Those estimates were presented in CBO's March 2003 *Analysis of the President's Budgetary Proposals for Fiscal Year 2004*.

Ben Page of CBO's Macroeconomic Analysis Division wrote the paper under the supervision of Robert Dennis and with the assistance of Mark Booth, Paul Burnham, Ufuk Demoroglu, Tracy Foertsch, Mark Lasky, Shinichi Nishiyama, Larry Ozanne, John Sturrock, and David Weiner.

John Skeen edited the report, Christine Bogusz proofread it, and Linda Lewis Harris assisted in its preparation. Annette Kalicki produced the electronic versions for CBO's Web site (www.cbo.gov).

Douglas Holtz-Eakin
Director

July 2003

Contents

Tables

Box

Introduction

The Congressional Budget Office (CBO) recently published its analysis of the potential macroeconomic effects of the proposals in the President's 2004 budget.[1] The analysis concluded that those effects would be relatively small on net, reflecting both the relative size of the proposals (costing $2.7 trillion, including interest costs, in an economy projected to produce more than $144 trillion over the next 10 years) and the fact that the budget contains measures that would work in different directions—some proposals would increase incentives to work and save, while others would increase spending by government and families.

This explains the methods and assumptions that CBO used to arrive at those results. (*See Tables 1, 2, and 3 on pages 2, 4, and 6, respectively,* for the main economic and budgetary results of CBO's analysis; *see the Appendix* for additional details.) CBO used five economic models in its analysis: two commercial macroeconometric forecasting models that focus on the short-run dynamics of demand, by Global Insight and Macroeconomic Advisers, and three models constructed by CBO that focus solely on supply-side effects—a "textbook" growth model, a life-cycle model, and an infinite-horizon model.

First, the paper reviews how CBO translated the provisions of the President's budget into terms that could be used in the various economic models. Second, it reviews how CBO treated several specific proposals that were particularly difficult to analyze. Third, it describes how CBO took the basic economic results and converted them into estimates of how they might affect the estimated cost of the proposals. Finally, it reviews in detail the structure of the models.

Inputs to the Economic Models

The President's proposals would affect the economy in a number of ways. Some provisions would reduce marginal tax rates on labor and capital income, which would tend to encourage people to work and save. However, those and other provisions also would increase people's after-tax income, which would tend to discourage work and saving. Other provisions would increase government consumption of goods and services, which would tend to crowd out investment in productive capital.

Finally, some provisions, such as the reduction in double taxation of corporate income and the expansion of tax-free savings accounts, would have complex effects that CBO calculated outside of the economic models. For example, CBO estimated that the reduction in double taxation of corporate income would probably shift investment from the noncorporate sectors of the economy to the corporate sector

1. See Congressional Budget Office, *An Analysis of the President's Budgetary Proposals for Fiscal Year 2004* (March 2003).

Table 1.

Effects of the President's Budgetary Proposals on Real Gross Domestic Product

(Average percentage change from CBO's baseline)

	2004-2008	2009-2013
Supply-Side Model Without Forward-Looking Behavior		
Textbook Growth Model	-0.2	-0.7
Supply-Side Models with Forward-Looking Behavior		
Closed-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-0.3	-1.5
Higher taxes after 2013	0.5	0.3
Open-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-0.6	-0.5
Higher taxes after 2013	0.3	0.6
Infinite-Horizon Growth Model		
Lower government consumption after 2013	0.2	-0.6
Higher taxes after 2013	0.9	1.4
Macroeconometric Models, Supply-Side Contribution		
Macroeconomic Advisers	-0.3	n.a.
Global Insight	-0.2	n.a.
Macroeconometric Models, Supply-Side and Cyclical Contributions		
Macroeconomic Advisers	0.2	n.a.
Global Insight	1.4	n.a.

(Continued)

and raise the value of corporate stock, among other things; the tax-free saving, CBO estimated, would raise private saving slightly on net over the 10 years covered by the budget. Some of those effects could be translated into variables suitable for each model; others required modifying the initial results of the models. In making its projections, CBO analyzed only changes in federal policies; it assumed that state and local governments' fiscal policies would remain at baseline levels.

Determining Budgetary Aggregates

The different economic models required different levels of detail on spending and revenue categories. CBO's textbook growth model required only the overall change in the surplus or deficit each year. For the life-cycle and infinite-horizon models,

Table 1.

Continued

	2004-2008	2009-2013
Memorandum: Effect on Real Gross National Product		
Open-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-0.8	-2.0
Higher taxes after 2013	0.3	0

Source: Congressional Budget Office.

Notes: n.a. = not applicable.

The "textbook" growth model is an enhanced version of a model developed by Robert Solow. The life-cycle growth model, developed by CBO, is an overlapping generations general-equilibrium model. The infinite-horizon growth model is an enhanced version of a model first developed by Frank Ramsey. The models by Macroeconomic Advisers and Global Insight, which are available commercially, are designed to forecast short-term developments. The various models reflect a wide range of assumptions about the extent to which people are forward-looking in their behavior: in the textbook model and those by Macroeconomic Advisers and Global Insight, their foresight is the least, while in the infinite-horizon model, it is perfect and extends infinitely to include a full consideration of effects on descendants.

In models with forward-looking behavior, CBO had to make assumptions about how the President's budget would be financed after 2013. CBO chose two alternatives—cutting government consumption or raising taxes.

spending needed to be broken out into government consumption and transfers. With a few exceptions, discretionary spending was classified as government consumption, while mandatory spending was classified as transfers. For the two macroeconometric models, government consumption was divided into defense and nondefense, and transfers were divided into health and nonhealth.

CBO started with conventional "static" estimates of the impact of the President's budgetary proposals on aggregate spending and revenues; those estimates assumed baseline economic projections and excluded the budgetary implications of any macroeconomic effects of the proposals. Because CBO and the Joint Committee on Taxation (JCT) had not yet completed their estimates of the budgetary effects of the President's proposals, in its calculations of economic effects CBO relied on the Administration's estimates of the budgetary costs of the proposals as published in the *Fiscal Year 2004 Budget of the U.S. Government* (for spending) and the *General Explanations of the Administration's Fiscal Year 2004 Revenue Proposals* (for revenues). The differences between CBO and JCT's estimates and the Administration's estimates were small, however—amounting to about $80 billion over five years—and would not have meaningfully altered the estimated economic effects (*see Table 4 on page 8*).

Table 2.

The Budgetary Implications of the Macroeconomic Feedbacks

(Cumulative change from CBO's conventional estimate of the President's budget, in billions of dollars)

	2004-2008	2009-2013
Supply-Side Model Without Forward-Looking Behavior		
Textbook Growth Model	-45	-218
Supply-Side Models With Forward-Looking Behavior		
Closed-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-44	-286
Higher taxes after 2013	57	91
Open-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-78	-105
Higher taxes after 2013	-49	148
Infinite-Horizon Growth Model		
Lower government consumption after 2013	27	-81
Higher taxes after 2013	122	321
Macroeconometric Models, Supply-Side Contribution		
Macroeconomic Advisers	-57	n.a.
Global Insight	-46	n.a.

(Continued)

The Administration estimated that (with interest costs excluded) the President's proposals would increase mandatory spending by $0.6 trillion and decrease revenues by $1.5 trillion over the 2004-2013 period. The Administration did not publish year-by-year spending numbers for the 2009-2013 period, but, rather, a total amount. CBO distributed that amount evenly over those five years.

Calculating Effective Marginal Tax Rates

In addition to their effects on the dollar amount of revenues, some of the President's proposals would lower the marginal tax rates on labor and capital income, thus altering incentives to work and to save. How CBO incorporated those effects into the models depended on the details of the models' construction.

Table 2.

Continued

	2004-2008	2009-2013
Macroeconometric Models, Supply-Side and Cyclical Contributions		
Macroeconomic Advisers	-75	n.a.
Global Insight	231	n.a.

Source: Congressional Budget Office.

Notes: n.a. = not applicable.

Numbers in this table reflect the positive or negative effects on the budget of the economic impacts shown in Table 1. They do not include the direct, or "static," estimated cost of the proposals. The total impact of the proposals on the budget, including both those direct costs and the secondary effects shown above, are shown in Table 3.

The "textbook" growth model is an enhanced version of a model developed by Robert Solow. The life-cycle growth model, developed by CBO, is an overlapping generations general-equilibrium model. The infinite-horizon growth model is an enhanced version of a model first developed by Frank Ramsey. The models by Macroeconomic Advisers and Global Insight, which are available commercially, are designed to forecast short-term developments. The various models reflect a wide range of assumptions about the extent to which people are forward-looking in their behavior: in the textbook model and those by Macroeconomic Advisers and Global Insight, their foresight is the least, while in the infinite-horizon model, it is perfect and extends infinitely to include a full consideration of effects on descendants.

The two general-equilibrium models—the life-cycle growth model and the infinite-horizon growth model—use effective marginal tax rates on labor and capital income as inputs. Those rates represent an estimate of the marginal tax on the average dollar of additional income earned in the economy (that is, the average marginal rate faced by all recipients of labor or capital income, weighted by the fraction of overall income earned by each type of recipient). The effective tax rates summarize the impact of the President's proposals on marginal tax rates into two numbers (one for labor income and one for capital income).

For most provisions, CBO computed the impact on effective marginal tax rates using a variant of a method developed by Martin Feldstein and Lawrence Summers (*see Box 1 on page 10* for a list of the provisions whose effects CBO estimated in that way).[2] With many details set aside, the method involves four steps:

2. Martin Feldstein and Lawrence Summers, "Inflation and the Taxation of Capital Income in the Corporate Sector," *National Tax Journal,* vol. 32, no. 4 (December 1979), pp. 445-470.

Table 3.

The Cumulative Budgetary Impact of the President's Proposals Including Macroeconomic Feedbacks

(Cumulative change from CBO's baseline, in billions of dollars)

	2004-2008	2009-2013
Supply-Side Model Without Forward-Looking Behavior		
Textbook Growth Model	-847	-2,126
Supply-Side Models With Forward-Looking Behavior		
Closed-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-846	-2,194
Higher taxes after 2013	-745	-1,817
Open-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-880	-2,013
Higher taxes after 2013	-753	-1,760
Infinite-Horizon Growth Model		
Lower government consumption after 2013	-775	-1,989
Higher taxes after 2013	-680	-1,587
Macroeconometric Models, Supply-Side Contribution		
Macroeconomic Advisers	-859	n.a.
Global Insight	-848	n.a.
Macroeconometric Models, Supply-Side and Cyclical Contributions		
Macroeconomic Advisers	-877	n.a.
Global Insight	-933	n.a.

(Continued)

- Calculate the average marginal income tax rate on each type of taxable income—wages, interest, dividends, and so on—for each year of the baseline. CBO obtained those rates by applying a tax calculation model to a large sample of the population in 2000. CBO modified the sample over future years to be consistent with the population projections of Social Security's trustees and CBO's economic projections.[3] The model can accommodate the fact that individuals or households face different marginal tax rates depending on their income and family structure. When averaged across all taxpayers, those rates

3. The population sample is based on tax return data from the Statistics of Income Sample for 2000 (based on about 170,000 returns) supplemented with about 30,000 records from the March 2001 Current Population Survey, to represent people not filing returns.

Table 3.

Continued

	2004-2008	2009-2013
Memorandum:		
Conventional Estimate of the Budgetary Effect of the President's Proposals	-802	-1,908

Source: Congressional Budget Office.

Notes: n.a. = not applicable.

Numbers in this table reflect both the direct, or "static" estimated cost of the proposals (shown in the memorandum line) and the budgetary implications of the macroeconomic feedbacks from the proposals (shown in Table 1).

The "textbook" growth model is an enhanced version of a model developed by Robert Solow. The life-cycle growth model, developed by CBO, is an overlapping generations general-equilibrium model. The infinite-horizon growth model is an enhanced version of a model first developed by Frank Ramsey. The models by Macroeconomic Advisers and Global Insight, which are available commercially, are designed to forecast short-term developments. The various models reflect a wide range of assumptions about the extent to which people are forward-looking in their behavior: in the textbook model and those by Macroeconomic Advisers and Global Insight, their foresight is the least, while in the infinite-horizon model, it is perfect and extends infinitely to include a full consideration of effects on descendants.

In models with forward-looking behavior, CBO had to make assumptions about how the President's budget would be financed after 2013. CBO chose two alternatives—cutting government consumption or raising taxes.

vary by type of income because different types are distributed differently across taxpayers. For example, dividends tend to be more concentrated than interest among higher-income taxpayers, so the average marginal tax rate on dividends tends to be higher than that on interest. For the taxes of C corporations, CBO used an average marginal tax rate of 29 percent.

- Calculate the notional amount of taxes that would have been collected on each type of income reported to the Internal Revenue Service (IRS) if it was all taxed at its average marginal rate from the first step. The notional amount of tax will exceed the actual amount because of various tax deductions and exemptions and because of progressivity in the rate schedule.

- Determine the overall average marginal tax rate on each type of income by dividing its notional tax by the corresponding amount of income reported in the national income and product accounts. The overall tax rate will be substantially lower than the rate from the first step because much income is not reported to the IRS—partly reflecting noncompliance but mostly reflecting the fact that some income (for instance, fringe benefits, imputed income, contributions to tax-free accounts, and earnings of such accounts) is not taxable.

Table 4.

Sources of Differences Between CBO's and the Administration's Estimates of the President's Budget

(Cumulative change from CBO's baseline, in billions of dollars)

	2003	2004	2005	2006	2007	2008	Total, 2004-2008
Administration's Estimate							
Deficit Under the President's Budget	-304	-307	-208	-201	-178	-190	-1,084
Sources of Differences Between CBO and the Administration							
Revenues							
Differences in baselines	24	-7	-30	7	35	55	60
Policy differences	-4	-8	-5	3	*	-2	-13
Total Differences in Revenues	**20**	**-15**	**-35**	**10**	**35**	**52**	**47**
Outlays							
Discretionary	13	17	-1	-3	-3	-4	7
Mandatory							
Differences in baselines	-8	2	8	14	17	19	60
Policy differences	3	7	13	4	4	3	30
Subtotal, mandatory	-5	9	21	18	21	21	90
Net interest	-6	-10	6	12	12	11	31
Total Differences in Outlays	**3**	**16**	**26**	**27**	**30**	**28**	**128**
All Differences	**18**	**-31**	**-62**	**-17**	**6**	**24**	**-80**
CBO's Estimate							
Deficit Under the President's Budget	-287	-338	-270	-218	-173	-166	-1,164
Memorandum:							
Economic Differences							
Revenues	-10	-13	2	26	46	60	121
Outlays	*	-1	10	23	29	31	93
Total	**-9**	**-12**	**-9**	**2**	**17**	**29**	**28**

(Continued)

Table 4.

Continued

	2003	2004	2005	2006	2007	2008	Total, 2004-2008
Technical Differences							
Revenues	30	-2	-37	-16	-11	-8	-73
Outlays	3	17	16	4	*	-2	35
Total	**27**	**-18**	**-53**	**-20**	**-11**	**-5**	**-108**

Sources: Congressional Budget Office; Joint Committee on Taxation.

Note: * = between -$500 million and $500 million.

- Calculate an overall average marginal tax rate on income from labor and from capital. For labor, sum the notional income tax on labor, the marginal payroll tax for Medicare and Social Security, and the self-employment tax—all as a percentage of labor compensation. The calculation allows for the fact that the income of about 7 percent of workers exceeds the cap on Social Security taxes, meaning that those workers do not face those taxes on the margin. For capital, take a weighted average of the separate rates for interest; dividends; capital gains; rent; capital income of proprietors, partners, and owners of S corporations; and income of C corporations.

The Feldstein-Summers approach, applied to the tax rate on capital, assumes that the marginal source of financing for firms is similar to the average. In other words, a large proportion of financing comes from untaxed sources, such as pension funds and individual retirement accounts. That assumption lowers the estimated effective marginal tax rate.

CBO's calculations reflected a number of additional elements:

- CBO excluded interest on government debt and Federal Reserve earnings and taxes from the measure of capital income so that the result would reflect the marginal tax on an additional dollar invested.

- CBO's estimates of effective marginal tax rates assumed that workers would pay income tax on their and their employers' contributions to pension funds and retirement or similar accounts, even though those contributions are actually exempt from taxation. By contrast, CBO's estimates assumed that withdrawals would be untaxed, while in fact they are taxable. Those assumptions made it

Box 1.

Provisions Whose Effects on Effective Marginal Tax Rates Were Estimated Using the Feldstein-Summers Method

The provisions whose effects on effective marginal tax rates were estimated using the Feldstein-Summers method included these:

- Accelerate the expansion of the 10 percent individual income tax rate bracket;
- Accelerate the reduction in individual income tax rates;
- Accelerate the expansion of the 15 percent individual income tax rate bracket for married taxpayers filing joint returns;
- Accelerate the increase in the standard deduction for married taxpayers filing joint returns;
- Accelerate the increase in the child tax credit;
- Provide relief to individuals from the minimum tax; and
- Permanently extend provisions expiring in 2010 (except for the extension of the repeal of estate and generation-skipping transfer taxes and the modification of gift taxes, which were analyzed separately).

By the Administration's estimates those provisions account for $788 billion of the $1.461 trillion cost of the President's revenue proposals over the years from 2004 to 2013. The proposal to eliminate double taxation of corporate income (with a 10-year cost of $385 billion) would also affect the marginal tax rate on capital, but the Congressional Budget Office (CBO) estimated that effect in a separate calculation (described later). The proposals to expand the availability of tax-free savings accounts (with a 10-year cost of $1 billion) would also affect the marginal tax rate on capital, but their effect on the incentive to save would be complex, so CBO estimated it separately from its calculation of effective tax rates.

practical to calculate effective rates, and if the marginal rate faced at the time of contribution is the same as that faced at the time of withdrawal, the assumptions do not alter the estimated effective tax rates. But people may face lower marginal tax rates when they withdraw funds in their retirement years than they did during their working years. Because the calculation does not take that probabil ity into account, it may understate effective rates. However, CBO used those assumptions only to calculate effective tax rates; the estimated aggregate reve-

nues that CBO used as an input assumed that contributions would be deductible and that withdrawals would be taxable.

- CBO's estimate of the marginal tax rate on capital gains allows for the deferral of taxes and the step-up in basis at death.

- CBO assumed that state and local taxes were 6 percent of individuals' reported income. To account for the portion of taxpayers who itemize and can claim those taxes as a deduction, CBO deducted about 62 percent of those tax receipts from the reported federal tax base. CBO also assumed that state and local corporate taxes applied to income of C corporations at a rate of 5.6 percent and deducted all such tax receipts from the reported federal tax base.

- CBO split the income of proprietorships and partnerships 60-40 between labor and capital income.

The provision in the budget that temporarily would allow firms to expense 30 percent of investment in equipment through 2004 would lead to shifts in the timing of tax payments and profits. Those shifts, unless adjusted for in some way, would distort the calculation of effective rates: 30 percent expensing reduces taxable income (and therefore tax payments) in the year of investment but raises it in following years because only the remaining 70 percent of investment can be depreciated over the normal tax life (seven years at most for nearly all equipment). Calculations based on those tax payments and profits would falsely suggest a disincentive to save in the years after 2004. In addition, profits in the initial years of the projection are unusually low because of cyclical factors, which could also distort the estimated effective rates. To avoid those problems, CBO calculated effective tax rates assuming that the shares of income from wages, dividends, interest, and other components for 2003 to 2012 matched those projected for 2013, when those shares are assumed to have settled to their long-term values. (Because of that adjustment, in calculating effective tax rates, CBO assumed, for example, that profits as a share of gross domestic product (GDP) would be 8.4 percent in 2003, the share projected for 2013, rather than 7.4 percent, the share that CBO actually projects for 2003.)

CBO estimates that by 2013, the President's proposals would reduce the effective tax on labor income by about 1.3 percentage points and the effective tax on capital income by about 1.5 percentage points (*see Table 5*). CBO incorporated those estimated changes into the two general-equilibrium models, with no attempt to model changes in the shape of the rate schedule (for example, changes in progressivity).

The levels of effective tax rates estimated for the two models differ because those used in the life-cycle model do not include payroll and state and local taxes; those taxes are included in the model separately from federal income taxes. Despite the different levels of effective tax rates, though, the year-by-year changes from the rates in CBO's baseline are very close. (They differ only because of interactions

Table 5.

Effective Tax Rates Used in the Life-Cycle and Infinite-Horizon Models

(In percentage points by calendar year)

	Labor			Capital		
Year	Current Law	President's Proposals	Change	Current Law	President's Proposals	Change
			Life-Cycle Model			
2002	19.9	19.9	0	13.8	13.8	0
2003	19.9	18.1	-1.8	13.8	12.6	-1.2
2004	19.5	18.3	-1.3	13.7	12.6	-1.1
2005	19.5	18.4	-1.1	13.7	12.6	-1.1
2006	19.1	19.0	-0.1	13.5	12.5	-0.9
2007	19.4	19.4	0	13.5	12.5	-0.9
2008	19.6	19.6	0	13.5	12.5	-1.0
2009	19.6	19.6	0	13.5	12.5	-1.0
2010	20.1	20.1	0	13.5	12.5	-1.0
2011	21.8	20.4	-1.5	14.1	12.6	-1.5
2012	21.8	20.4	-1.5	14.1	12.6	-1.5
2013	22.2	20.9	-1.3	14.1	12.6	-1.5
			Infinite-Horizon Model			
2002	34.0	34.0	0	16.7	16.7	0
2003	34.0	32.3	-1.7	16.7	15.5	-1.2
2004	33.7	32.5	-1.2	16.6	15.5	-1.1
2005	33.7	32.6	-1.1	16.6	15.5	-1.1
2006	33.3	33.2	-0.1	16.4	15.5	-0.9
2007	33.5	33.5	0	16.4	15.5	-0.9
2008	33.8	33.8	0	16.4	15.4	-1.0
2009	33.8	33.8	0	16.4	15.4	-1.0
2010	34.2	34.2	0	16.4	15.4	-1.0
2011	35.9	34.5	-1.4	17.0	15.5	-1.4
2012	35.9	34.5	-1.4	17.0	15.5	-1.4
2013	36.3	35.0	-1.3	17.0	15.5	-1.5

Source: Congressional Budget Office.

Note: For the effective rates calculated for the life-cycle model, the tax on labor income includes only the federal income tax. The tax on capital income includes the federal corporate and personal income taxes. For the infinite-horizon model, the tax on labor income includes federal, state and local income taxes and federal Social Security and Medicare payroll taxes. The tax on capital income includes federal, state, and local income taxes on personal and corporate income. State and payroll taxes are not included in the estimates for the life-cycle model because that model treats those taxes separately.

between federal taxes and state and local taxes—for example, some state and local taxes can be deducted from the reported federal tax base by households that itemize.)

Estimating Changes in Labor Supply for Models with No Endogenous Response to Marginal Tax Rates

The general-equilibrium models predict changes in labor supply on the basis of changes in marginal tax rates on labor and changes in current and future income. However, in the three remaining models that CBO used—the textbook growth model and the two macroeconometric models—there is little or no mechanism for marginal tax rates to affect labor supply.[4] Therefore, for those models CBO separately estimated the effect of marginal rates on labor supply and then imposed the results on the models.

In particular, to calculate the response of labor supply, CBO used the same model as it used to calculate effective tax rates. For each tax return in the model, it calculated marginal tax rates on labor as well as after-tax income both under current law and under the President's proposals. It then combined the changes in marginal tax rates and income with assumed substitution and income elasticities to predict the change in labor supply.

CBO's calculations allowed for different effects for primary and secondary earners in a household and for effects that vary by income. For primary earners, the population-weighted uncompensated labor supply elasticity with respect to after-tax wages averaged 0.07 (the sum of an income elasticity of -0.07 and a compensated substitution elasticity of 0.14). Within that average, primary earners in the first decile of earnings were assumed to have a net elasticity of 0.17, while earners in the top 40 percent, a net elasticity of 0.028. Secondary earners were assumed to have a compensated substitution elasticity of 0.75 and an elasticity with respect to after-tax household income of -0.25. Those elasticities were based on a review of empirical estimates.[5]

CBO then directly adjusted labor supply in the textbook growth model and the macroeconometric models by the estimated percentage change derived from that method.

In estimating the economic effects of marginal tax rates on labor income, CBO concentrated on the effect on hours of work supplied. Analysis of many other effects, such as shifts between taxable and nontaxable forms of income or changes in

---

4. Global Insight's model incorporates responses of labor supply to changes in after-tax wages. However, those responses are much smaller than CBO's estimates, and CBO overrode them for the purposes of its analysis.

5. Congressional Budget Office, *Labor Supply and Taxes* (January 1996).

the portion of taxable income that is reported to the IRS, should already be included in the static revenue estimates of the Joint Committee on Taxation. There could be additional effects, however, on the intensity of work, but CBO did not include any such effects because of a lack of empirical evidence on which to base estimates.

The Proposal to Reduce Double Taxation of Corporate Income

The President's budget includes one proposal—to reduce double taxation of corporate income—that would have particularly complex economic effects. The proposal would eliminate taxation of dividend income paid out of profits that were already taxed at the corporate level. In addition, it would eliminate taxation of capital gains attributable to retained earnings that were already taxed at the corporate level.

The proposal would have three important economic effects. First, it would reduce marginal tax rates on capital income and lower firms' cost of capital investment. Second, it would increase the market value of corporations. Third, reducing double taxation of corporate income would, over time, make the allocation of capital among different sectors of the economy more efficient.

Economists have not agreed on how the taxation of dividends affects the economy. Two views are prevalent.[6] Under the first (or "traditional") view, the tax on dividends raises the cost of capital and reduces investment. Under the second (or "new") view, the tax on dividends permanently reduces the value of a firm but leaves unaffected both the cost of capital and investment by the firm.

CBO's calculations reflect an average of the implications of those two views. That average was created in different ways in the different models. For the macroeconometric models, CBO made economic projections under two sets of assumptions for model inputs such as the cost of capital and the valuation of firms, with one set reflecting the traditional view and one set reflecting the new view. CBO then took the average of the economic variables from the two projections as its estimate. For the remaining models, the only variable for which the traditional view and the new view had different implications was the efficiency effects of the provision. CBO estimated those effects on the basis of prior research, adjusted its estimate to reflect an average of the two views, and then added it back into the model results.

Corporate behavior probably more closely matches the assumptions of the first view—indeed, that is what is generally taught to business school students. However, in an open economy, results are likely to lean toward the second view as long as capital is reasonably available in the world market at a price that is unaffected by

6. See George R. Zodrow, "On the 'Traditional' and 'New' Views of Dividend Taxation," *National Tax Journal,* vol. 44, no. 4, pt. 2 (December 1991), pp. 497-509.

U.S. tax policy.[7] Firm evidence of the actual effects of dividend-taxation policy in the United States is scarce. Given the difficulty of determining precisely how investment would respond to the President's proposal, CBO simply split the difference between the two views.

Marginal Taxes on Capital

The estimated effective tax rates on capital used in the life-cycle and infinite-horizon models (shown in Table 5) incorporate the effects of the proposal to reduce double taxation of corporate income. CBO calculated those effects outside the tax simulation model used to estimate the effects of most other provisions. Those effects do not differ under the traditional and new views of dividends.

CBO assumed that the proposal to reduce double taxation of corporate income would allow corporations to shelter only about 80 percent of their dividends in 2003 but that that proportion would rise to 90 percent over the next five years and then remain at that level. That rise has to do with the timing of tax payments.

The amount of dividends and capital gains that a firm could shelter would be limited to the amount of its fully taxed profits. That amount would be measured as:

fully taxed profits = corporate taxes * (1/0.35 -1)

where 0.35 is the top corporate tax rate and corporate taxes include foreign tax credits. The factor in parentheses indicates that a firm could shelter income equal to 1.86 times the amount of taxes it paid. CBO assumed that firms would probably shelter all of the dividends they could before sheltering their retained earnings (which would eventually show up as capital gains) because dividend income tends to be taxed at higher rates. Firms that, for whatever reason, incurred low corporate taxes in the first few years after the proposal became effective might not be able to shelter all of their dividends. However, over time, most firms will experience years when they pay more than enough taxes to shelter all of that year's dividends. Some of the extra increment can be carried over to shelter dividends in future years with lower tax payments, implying that the overall average share of dividends that can be sheltered rises over time.

Once firms have sheltered all possible dividends, they can use any remaining amount of the extra increment to shelter retained earnings. CBO concluded that about 40 percent of the portion of capital gains that reflect retained earnings could be sheltered in that way.

---

7. Clemens Fuest and Bernd Huber, *The Optimal Taxation of Dividends in a Small Open Economy*, Working Paper No. 348 (Munich: CESifo, 2000).

Of course, some of the sheltering would be redundant—much corporate income accrues to firms or entities that are already untaxed. Under current law, the effective overall marginal tax on dividends is about 19 percent, much lower than the effective statutory rate that applies to taxable shareholders. Tax rate changes and a 90 percent dividend exclusion under the President's plan would reduce the effective overall rate to about 5 percent. Likewise, the proposal would reduce the overall effective rate on capital gains from about 5 percent to roughly 3 percent.

Cost of Capital

The macroeconometric models require as an input an estimate of the effect of the proposal to reduce double taxation of corporate income on the cost of capital to firms. That effect differs under the traditional and new views of how dividend taxes affect economic behavior. Under the first view, reductions in both the effective tax rate on dividends and that on capital gains reduce the cost of capital. Under the second view, only the reduction of the effective tax rate on capital gains reduces the cost of capital. The reduction of the tax on dividends does nothing more than permanently raise the value of the shares of C corporations. (S corporations do not pay corporate tax, and, thus, their income would not qualify for an exclusion.) To represent the second view, CBO calculated the change in the marginal tax on capital as if the proposal would shelter about 40 percent of the retained earnings of C corporations but none of their dividends. CBO generated two economic projections with the two macroeconometric models, one using inputs consistent with the traditional view and one with the new view, and then took the average of the economic results.

As with the estimate of the effective marginal tax rates on capital, described earlier, CBO calculated the proposal's impact on the cost of capital assuming that the shares of output coming from corporate profits, dividends, and retained earnings in 2013 would apply to all years between 2003 and 2013. The shares in 2013 represent historically typical shares, while shares in earlier years are affected by the availability of extra expensing and cyclical factors.

Valuation of Firms

Changes in the valuation of firms are important to the macroeconomic results, because they help determine what will happen to consumer wealth and consumer spending. In CBO's two forward-looking models (the life-cycle model and the infinite-horizon model), the simulated people in the models automatically calculate the wealth effect of the tax change with perfect foresight. However, the two macroeconometric models require an exogenous estimate of the increase in firms' valuation because those models contain no mechanism to automatically convert the present value of the expected change in stockholders' after-tax income into a change in equity prices. The estimated effect on the valuation of firms differs under the traditional view and new view of dividends.

The structure of both models allows a reduction in taxation of dividends to affect consumption in two ways: through a reduction in tax payments, which increases

disposable income, and through an increase in the value of firms, which increases wealth (and therefore affects consumption). However, both effects are reflections of the same thing—the expectation of lower tax payments on dividends—so including both would overstate the effect of the policy change on consumption. To avoid that double-counting, CBO adjusted the models to eliminate the direct effects on consumption of the increase in disposable income stemming from lower taxes on dividends.

Under the traditional view, reducing double taxation of corporate income reduces the cost of capital and increases investment. In the short run, stock prices rise because expected after-tax returns to investors increase. In the long run, however, additional investment will drive down the pretax return to capital. Thus, current shareholders initially benefit from the lower taxes on dividends, but eventually the higher investment raises the capital/labor ratio, increasing real wages and transferring the benefit of the lower taxes to workers. CBO estimated that under the traditional view of dividends, the President's proposal to reduce double taxation of corporate income would initially increase the market value of shares by 3 percent. That estimate reflected both the additional returns that investors would expect and their belief that the returns would be temporary. That estimate assumed that asset prices would respond immediately to increased expected future returns but that workers would not spend the extra income from higher wages (due to the larger capital stock from increased investment) until they received it.

Under the new view, by contrast, cutting taxes on dividends permanently increases the value of firms but leaves unchanged the cost of capital and, therefore, investment. CBO estimated that under the new view, the President's proposal would permanently raise the value of the shares of corporations by some 10 percent, reflecting the present value of the expected decline in taxes under the assumption that the tax benefit would be permanent. CBO's estimate assumed, as discussed earlier, that the fraction of a marginal additional dollar of dividend income that was taxable would be the same as the fraction of average dividend income that was taxable. Other commentators have arrived at substantially higher estimates by assuming that all of a marginal change in dividend income would be taxable.

CBO generated two economic projections with the two macroeconometric models, one using inputs consistent with the traditional view and one with the new view, and then took the average of the economic results.

Efficiency

Double taxation of corporate income causes deadweight loss principally because it shifts economic activity from the corporate to the noncorporate sector. In addition, it distorts the choice between equity and debt financing. The deadweight loss from those effects generates welfare costs that are partially reflected in a lower level of GDP because resources are not employed optimally. However, some of the efficiency losses—such as the effect of the choice between debt and equity financing

on individuals' asset portfolios, or changes in marginal incentives that are offset by income effects—may not show up in output measures.

To gauge the effect on output, CBO reviewed various of estimates of the impact of corporate taxation. Efforts to quantify the deadweight loss from corporate taxes have produced a wide range of estimates that are typically reported as welfare losses (including such items as the value of leisure) and not the effect on GDP. Translating the disparate conclusions of studies into an expected change in GDP from the President's proposal involves a large amount of judgment.

The standard Harberger model, in which industries are either corporate or noncorporate, suggests efficiency costs of less than 20 percent of corporate tax revenues, or about 0.4 percent of GDP at today's ratio of corporate taxes to GDP.[8] Using time-series data, several studies estimate smaller effects of around 5 percent to 10 percent of corporate taxes, or about 0.1 percent to 0.2 percent of GDP.[9]

Gravelle and Kotlikoff employ a different ("mutual-production") model that measures the deadweight loss in an economy in which corporate and noncorporate production occurs within the same industry. Their work indicates a much higher deadweight loss, possibly exceeding 100 percent of the tax, or 2 percent of GDP.[10] That loss results from the greater substitution between corporate and noncorporate activities that exists when both occur in the same sector. Goolsbee concludes from work based on the mutual-production model that the estimates based on time-series data are low, although the deadweight loss is still "modest."[11]

---

8. See Arnold C. Harberger, "Efficiency Effects of Taxes on Income from Capital," in Marian Krzyzaniak, ed., *Effects of the Corporation Tax* (Detroit: Wayne State University Press, 1966); and Charles L. Ballard and others, *A General Equilibrium Model for Tax Policy Evaluation* (Chicago: University of Chicago Press, 1985). The ratio of corporate taxes to GDP was significantly higher at the time of earlier studies, but if the deadweight loss was proportional to the level of taxes, using today's ratio to convert to a share of GDP would be appropriate.

9. See Roger H. Gordon and Jeffrey MacKie-Mason, "Effects of the Tax Reform Act of 1986 on Corporate Financial Policy and Organizational Form," in Joel Slemrod, ed., *Do Taxes Matter?* (Cambridge, Mass.: MIT Press, 1990); Gordon and MacKie-Mason, "Taxes and the Choice of Organizational Form," *Journal of Finance*, vol. 50, no. 2 (June 1997); and Austan Goolsbee, "Taxes, Organizational Form, and the Deadweight Loss of the Corporate Income Tax," *Journal of Public Economics*, vol. 69, no. 1 (July 1998), pp. 143-152.

10. See Jane G. Gravelle and Laurence Kotlikoff, *Does the Harberger Model Greatly Understate the Excess Burden of the Corporate Income Tax?* Working Paper No. 2742 (Cambridge, Mass.: National Bureau of Economic Research, October 1988); Gravelle and Kotlikoff, "The Incidence and Efficiency Costs of Corporate Taxation When Corporate and Non-Corporate Firms Produce the Same Good," *Journal of Political Economy*, vol. 97, no. 4 (1989), pp. 749-780; and Gravelle and Kotlikoff, "Corporate Tax Incidence and Inefficiency When Corporate and Noncorporate Goods Are Close Substitutes," *Economic Inquiry*, vol. 97 (1993), pp. 501-516.

11. See Austan Goolsbee, *The Impact and Inefficiency of the Corporate Income Tax: Evidence from State Organizational Form Data*, Working Paper No. 9141 (Cambridge, Mass.: National Bureau of Economic Research, September 2002).

Estimates by Shoven and by Fullerton indicate losses of about 0.75 percent to 1.5 percent of consumption, or about 0.5 percent to 1.0 percent of GDP.[12] But those estimates are based on average, rather than marginal, effective tax rates. Studies using average rates tend to estimate larger effects than those using theoretically preferable marginal rates.[13]

Finally, models incorporating the new view of dividends show very small losses, on the order of 0.014 percent of consumption. That is to be expected. Under the new view, after-tax returns to corporate and noncorporate activity are equilibrated by a fall in the price of corporate equity rather than by a differential in before-tax rates of return, substantially decreasing the distortion caused by the taxes.

In 1992, Treasury estimated the effects of several different proposals to integrate the individual and corporate tax systems (none exactly like the current one) using both the Harberger model and the mutual-production model.[14] The Harberger model estimated welfare gains ranging from 0.29 percent to 0.35 percent of consumption, or about 0.19 percent to 0.23 percent of GDP. The mutual-production model estimated gains ranging from 0.53 percent to 0.74 percent of consumption, or about 0.35 percent to 0.49 percent of GDP. (In those proposals, the revenue loss was made up with a lump-sum tax, which is the appropriate assumption for CBO's current modeling strategy.)

Relying on that evidence and taking the average of effects under the traditional and new views of dividends, CBO concluded that the impact of the President's proposal on the allocation of capital would raise GDP by about 0.14 percent (about $15 billion in 2003) once the capital stock was fully adjusted. That estimate resulted from averaging an effect of 0.28 percent under the traditional view of dividends with an effect of about zero under the new view. CBO assumed that fully adjusting the capital stock would take 10 years, with the addition to GDP increasing linearly over that period. CBO added that increment to the predictions of the textbook, the life-cycle, and the infinite-horizon growth models.

A slightly different procedure was appropriate for the two macroeconometric models, because those models incorporate multiple sectors and thus can reflect endogenously some of the efficiency effects of the President's proposal. In both models,

---

12. John B. Shoven, "The Incidence and Efficiency Effects of Taxes on Income from Capital," *Journal of Political Economy*, vol. 84, no. 6 (December 1976), pp. 1261-1283; and Don Fullerton and others, "Corporate Tax Integration in the United States: A General Equilibrium Approach," *The American Economic Review*, vol. 71, no. 4 (1981), pp. 677-691.

13. See Department of the Treasury, *Report of the Department of the Treasury on Integration of the Individual and Corporate Tax Systems* (January 1992), p. 140.

14. Ibid.

changes in the cost of capital for business investment will automatically shift investment from the housing sector to the business sector. In practice, CBO ran the models twice, with assumptions corresponding to the traditional view and the new view of the effects of dividend taxation. Under the traditional view, CBO assumed that 75 percent of the efficiency effects of the proposal were captured within the models (the effects were not fully captured because the models cannot reflect efficiency gains from shifting capital into C corporations from other businesses). Under the new view, as before, there were no efficiency effects.

For two reasons, CBO's estimate of efficiency effects did not include any gains from reducing the distortion in the decision of whether to finance investment by debt or by equity. First, most of those gains would show up in utility rather than GDP. Second, a large part of the efficiency gains might not be realized because of the President's proposal to expand tax-free savings accounts (to the extent that interest was untaxed, a new differential would arise between the tax treatment of dividends and interest).

Expansion of Tax-Free Savings Accounts

The President's budget includes a proposal to form two new tax-free accounts, lifetime savings accounts (LSAs) and retirement saving accounts (RSAs). LSAs would be designed to facilitate everyday saving, and withdrawals could be made from them at any time without penalty. RSAs would be designed as a vehicle for retirement saving and would carry a penalty for early withdrawals. The new accounts would increase the amount that people could save tax-free. The effects of the accounts on saving are not easily analyzed within the models used by CBO, so the agency estimated those effects in a side calculation. (The proposals for savings accounts were therefore not included in CBO's calculation of the effective tax rates on capital.)

The proposals would both raise the after-tax return to saving, generating a substitution effect that would tend to increase saving, and increase after-tax income, generating an income effect that would tend to increase consumption and reduce national saving. CBO estimated those two effects separately.

Substitution Effect

The substitution effect applies only to people on the margin, that is, those who currently contribute the maximum tax-free amounts but who might save more if those amounts were increased. Those not on the margin are people who do not currently contribute the maximum tax-free amounts and people who do but who have enough taxable assets to shift so that they would not have to save more to take full advantage of additional opportunities for tax-free saving. To estimate the substitution effect, CBO estimated the saving of people on the margin and the change

in the after-tax rate of return associated with LSAs and RSAs and applied an estimated elasticity to that change, adjusting saving accordingly.

Who Is on the Margin? Tax advantages comparable to those offered by LSAs (specifically, the ability to withdraw funds at any time without penalty) do not currently exist. Hence, CBO needed to identify who would not be affected by the accounts on the margin—those who have sufficient assets to shift into the accounts without saving any more. To accomplish that, CBO tabulated taxable assets in the 1998 Survey of Consumer Finances (SCF) and classified households by the number of years that they could fund an LSA for every person in the family (assuming a baseline of 2.6 percent net growth in assets per year). Beginning in the second year, the households had to be able to fund an RSA in the previous year for every worker in the family as well. Households that lacked enough existing assets to contribute the maximum to an account even in the first year were assumed to be on the margin in 2003 and all subsequent years; those who could fund the maximum contribution in the first but not the second year were assumed to be on the margin in 2004 and all subsequent years, and so forth. Those with enough assets to fund the maximum contribution through 2013 were assumed not to be on the margin at any time during the budgetary projection period.

By contrast, the tax advantage offered by RSAs is comparable to that of Roth individual retirement accounts (IRAs)—if one ignores the reduction in the age for penalty-free withdrawals from 59 and a half to 58. For simplicity, CBO assumed that traditional IRAs and 401(k)s also had the same tax advantages, although that would be true only if a person's preretirement and postretirement tax rates were the same. By that reasoning, households that were not currently contributing the maximum to either their IRA or 401(k) were not on the margin. So CBO reclassified SCF assets by the number of years that they could fund both LSAs for all family members and RSAs for all workers but then scaled those assets by the percentage of workers receiving the maximum tax benefit from their IRA or 401(k) (ranging from 3 percent for lower-income workers to 36 percent for the highest-income workers).

Having identified households on the margin, CBO assigned a baseline level of saving to them. CBO estimated the overall level of saving to be 2.8 percent of personal income (based on the average over the past five years) and distributed saving in proportion to assets.

Change in the After-Tax Rate of Return. CBO used a case study model to calculate the after-tax rate of return for regular savings versus a Roth IRA using a 6 percent before-tax rate of return. CBO assumed that the President's proposals to accelerate the decrease in marginal tax rates and to reduce double taxation of corporate income were in place for regular savings (effectively exempting 40 percent of investment income from tax). CBO estimated the after-tax rate of return for five different marginal rates (15 percent, 25 percent, 28 percent, 33 percent, and 35 percent). For LSAs, the after-tax rate of return was the same as the before-tax

rate—6 percent. For RSAs, CBO assumed that 30 percent would be subject to a penalty upon withdrawal, reducing the after-tax rate of return to 5.892 percent. For taxable accounts, the after-tax rate of return depended on the tax bracket. (*See Table 6* for a summary of the results.)

Results. CBO partitioned the SCF tabulations into the five income classes shown in Table 6, assumed to correspond to the five marginal tax rates. CBO then calculated the percentage change in the after-tax rate of return, applied an elasticity of 0.5, and multiplied the result by the savings deemed to be on the margin.[15]

Income Effect

An income effect applies to people who experience a reduction in taxes on the return to saving, whether or not they are on the margin. The reduction in taxes increases the value of a tax-free account relative to the value of a regular account. People can then save less and still receive the same after-tax income over their lifetime.

Because the reduction would apply to the amounts that people were expected to contribute to LSAs and RSAs, CBO estimated those amounts using SCF data. CBO determined the maximum possible contribution by people on the margin in each year and added the maximum contribution for all those not on the margin because they could shift enough assets to fully fund the accounts.

CBO attempted to reconcile its estimates of contributions with estimates of the revenue effects of the LSAs from the Department of the Treasury. CBO's estimates most closely approximated the pattern of Treasury's estimates assuming a withdrawal rate of 18 percent per year. To match the level of revenue losses as well as the pattern over time, however, CBO had to assume a relatively low rate of return of 2.5 percent within LSAs. That low rate of return would be consistent with participants' converting interest-bearing checking accounts, savings accounts, and money market accounts to LSAs.

To estimate the percentage reduction in saving due to the income effect, CBO used the case study model, assuming a 4.5-year holding period and 2.5 percent rate of return for LSAs and a 21-year holding period and 6.0 percent rate of return for RSAs.

CBO also scaled the estimated RSA contributions to eliminate households not currently contributing the maximum tax-free amount; they presumably would not increase their contributions and therefore would experience no income effect.

---

15. The elasticity of 0.5 was based on evidence reviewed in Douglas W. Elmendorf, "The Effect of Interest-Rate Changes on Household Saving and Consumption: A Survey," Finance and Economics Discussion Series No. 1996-44 (Board of Governors of the Federal Reserve System, 1996).

Table 6.

The Effect of Tax-Free Accounts on the After-Tax Rate of Return

Marginal Tax Rate (In percent)	Income Class (In dollars)	After-Tax Rate of Return (In percent) by Type of Account		
		Taxable Account	LSA	RSA
15	Under 50,000	5.460	6.000	5.892
25	50,000-99,999	5.100	6.000	5.892
28	100,000-199,999	4.992	6.000	5.892
33	200,000-499,999	4.812	6.000	5.892
35	500,000 and Over	4.740	6.000	5.892

Source: Congressional Budget Office.

Notes: LSA = lifetime savings account; RSA = retirement savings account.

The table assumes that all accounts earn a pretax rate of return of 6 percent. The LSA would earn the full 6 percent. The RSA would earn slightly less, because CBO assumed that 30 percent of withdrawals would be subject to a penalty for early withdrawal. Ordinary taxable accounts would earn an after-tax return on each extra dollar invested that depended on the marginal tax rate faced by the owner.

The substitution and income effects together imply a small negative effect on saving in the early years of the projection period, moving gradually to a small positive effect in later years. CBO added those calculated changes in saving to the macroeconometric models: the substitution effect as a change in consumption, and the income effect as if income had changed. In the other models, the estimated changes in saving had virtually no effect on average GDP over the 10-year period.

Extension of the Repeal of the Estate Tax

The President's proposal to make permanent the repeal of the estate and gift taxes after 2010 was particularly difficult to analyze. To begin with, there is no clear consensus on people's motives for leaving bequests or even on whether bequests are typically the result of a deliberate saving plan. If bequests are accidental rather than deliberate, repealing the estate tax would not encourage saving. Moreover, analysts who believe that estate taxes affect consumption and saving disagree about the direction of the effect: a lower estate tax makes it cheaper for people to leave money to their heirs, which could encourage them to save more in order to leave larger bequests; in contrast, with a lower estate tax, people can leave the same after-tax bequest with less saving, which might induce them to save less. Also, all other things being equal, a lower estate tax increases the after-tax size of bequests, which could lead potential recipients to increase their consumption and reduce their saving. Finally, although a great deal of attention has been focused on the effects of

estate taxes on sectors such as agriculture or activities such as entrepreneurial ventures, there remains little agreement on those effects or their implications for the economy as a whole.

Because so little is understood about how repealing the estate tax would affect consumption, CBO's estimates from all but the infinite-horizon model assumed that in their consumption and saving, people would respond in the same way as they have, on average, to past spending or tax changes that affected the budget deficit. That assumption implies that people would spend about 60 percent of their increased after-tax income, boosting aggregate consumption. In the infinite-horizon model, however, CBO assumed that people would respond in the same way that they would to a change in lump-sum taxes. In that model, the assumption implies that people would save all of the increase in after-tax income from lower estate taxes and that consumption would not rise.

Translating the Models' Outputs into Spending and Revenue Estimates

Calculating the implications of the models' results for spending and revenues required estimates of the effects of the proposals on a number of income variables and on prices and interest rates. Those variables are a part of the normal output of the macroeconomic models by Global Insight and Macroeconomic Advisers. The textbook, life-cycle, and infinite-horizon growth models have very simple income categories, however. Because each of those models assumes that production follows a Cobb-Douglas function, the models predict that the change in GDP due to the President's proposals would be split into a change in total capital income of about 30 percent of the change in GDP, and a change in total labor compensation that accounts for the remaining 70 percent of the change in GDP. However, revenue estimates require additional details for domestic book profits; wages and salaries; dividends; personal monetary interest income, excluding that earned in publicly administered government employee retirement plans; both farm and nonfarm proprietors' income; and rental income.

CBO assumed that wages and salaries would change in proportion to GDP. Because the models also assume that total labor compensation changes with GDP, the implication is that other labor income also changes in proportion to GDP. Since most of proprietors' income is payment for their work, CBO assumed that that income would change in the same way.

CBO assumed that changes in personal interest income reflected changes in interest payments by businesses and by government and changes in interest payments to and from foreigners. CBO used its budget calculations to derive government interest payments. Under CBO's assumptions, business interest payments depended on both GDP and on interest rates: higher interest rates imply that a higher share of GDP is

accounted for by business interest payments. CBO assumed that every increase of 100 basis points in interest rates would raise business interest payments as a share of GDP by 0.4 percentage points. That relationship is consistent both with the output from the macroeconometric models and with a historical regression of the share on a weighted average of interest rates.

The two open-economy simulations of the life-cycle model imply changes in the flows of capital income across the nation's borders. In those simulations, a part of the additional borrowing from the President's proposals is financed by higher borrowing from abroad. Consequently, the simulations also predict higher payments of capital income to foreigners that are reflected in weaker projections for gross national product than for GDP. The portion of those capital payments that are made in the form of interest—which CBO estimated to be about 75 percent—must be subtracted from total interest payments in calculating taxable personal interest income because foreigners do not pay U.S. taxes on their interest income.

The model, however, calculates capital payments to foreigners on the basis of an interest rate equal to the marginal product of capital, or roughly double the government's interest rate. That assumption overstates the interest payments made to foreigners and understates the share of total interest payments that goes to domestic investors and is therefore taxable. CBO therefore reduced its estimate of taxable interest income only by half of the model's estimate of interest payments to foreigners in the open-economy simulations.

CBO assumed that the sum of the shares of GDP constituted by economic profits and business interest payments remained constant; hence, any change in the interest share of GDP was reflected with the opposite sign in profits. That calculation implied that the share of depreciation in GDP was unchanged. Two factors would affect depreciation. First, the lower national saving would mean lower overall investment, which would tend to reduce depreciation. Second, because the President's proposals would tend to reduce the taxes on corporate investments relative to housing, more of each year's investment would go to business and less to housing. CBO's models do not currently distinguish between business and housing investment, so the agency was unable to determine the relative magnitude of those two effects and hence the sign of the impact on business investment and depreciation. For that reason, CBO kept the share of GDP devoted to depreciation unchanged.

Under CBO's assumptions, dividends remained the same share of domestic economic profits as in the agency's baseline, and rental income changed by the same percentage as GDP.

Once CBO translated the economic output from the models into the proper variables, the agency estimated the spending and revenue implications using its usual methods. The impact on revenues depended mostly on the level and distribution of different types of income, which in turn depended largely on overall output, interest

rates, and price levels (as described above). The impact on spending depended largely on interest rates, price levels, and wages. It is important to note that CBO held discretionary spending at its baseline level in nominal dollars under any economic assumptions because the President's budget proposals specified dollar amounts. Consequently, in CBO's estimates, higher inflation, which tends to raise nominal revenues, does not affect discretionary spending and therefore tends to improve the budget balance.

Description of the Models

This section provides a summary description of the models that CBO used in its analysis: the textbook growth model, the life-cycle model, the infinite-horizon model, and the two macroeconometric models.

The Textbook Growth Model

The textbook growth model is the model CBO uses to compute historical values of potential output and to estimate potential output in its 10-year baseline projections. It is an enhanced version of the Solow growth model.[16] Real GDP in the nonfarm business sector (which accounts for roughly three-quarters of GDP) is determined by a Cobb-Douglas production function of a capital aggregate, labor hours, and exogenous total factor productivity. The coefficient on capital in the production function equals 0.30 and that on labor equals 0.70. Specifically:

- Labor input is the number of hours worked.
- Capital input is an index of capital services that aggregates such services for four types of equipment (computers, software, communications equipment, and other equipment), as well as nonresidential structures, inventories, and land.
- Total factor productivity is calculated as a residual over history and projected on the basis of historical trends, adjusted for business cycles and changes in the measurement of prices.

The model includes four additional sectors: government, farm, households and nonprofit institutions, and residential housing. Projected output in most of those sectors is based on their historical share of the labor force and historical productivity in the sectors. Output in the housing sector is a constant ratio to the stock of housing.

The policies in the President's budget would affect output in the growth model primarily through the impact of higher deficits on investment and lower marginal

16. For a more detailed description of the textbook growth model, see Congressional Budget Office, *CBO's Method for Estimating Potential Output: An Update* (August 2001).

tax rates on labor supply. The effect of changes in deficits on investment is the same whether it stems from changes in taxes, transfers, or government consumption. Therefore, the two key inputs that determine the estimated effects of the President's budgetary proposals are the overall change in the surplus and the estimated change in the labor supply.

In the growth model, capital accumulation is determined by the rate of national saving and net capital inflows. Changes in the federal surplus affect national saving and, therefore, private investment and the capital stock. The President's budget implies lower surpluses than those in CBO's baseline, which would tend to result in a lower projected capital stock, less output, and higher interest rates.

The impact of changes in the federal surplus on investment is partially offset by changes in private saving and capital inflows. Those offsets are determined by simple rules of thumb based on historical averages and the behavior of a variety of economic models. The private-saving offset equals 40 percent of the initial change in the federal surplus (for example, if the surplus falls by $1, private saving increases by 40 cents); the net-foreign-investment offset equals 40 percent of the change in national saving (for example, if the change in national saving equals 60 cents, as in the previous example, the change in net foreign investment equals 24 cents, or 40 percent of 60 cents, and domestic investment falls by 36 cents). Therefore, a decrease in the surplus not only causes domestic investment to fall but also causes capital inflows to rise, which implies higher net payments to foreigners in the future. Those higher payments subtract from domestic income, so when the surplus declines, gross national product (which is based on income) tends to fall by more than gross domestic product (which is based on domestic output).

The textbook growth model does not automatically incorporate any effect of marginal tax rates on labor supply. Therefore, CBO estimated the effect on labor supply of the lower marginal tax rates under the President's budget in a side calculation, described previously, and added the estimated effect to the projected number of labor hours in the model. The growth model incorporates no direct effect of after-tax interest rates on consumption and saving, but private saving would rise under the President's budget because of the private-saving offset described above.

The textbook growth model also has no internal method of taking account of how the President's proposal to reduce double taxation of dividends would affect the allocation of capital. That proposal would shift some investment from the housing and noncorporate business sectors to the corporate sector, which would tend to increase output. CBO estimated the magnitude of the effect on output in a side calculation, also described previously, and added it to the estimated changes in income derived from the growth model's projections.

Finally, the textbook growth model also does not incorporate any demand-side effects; it assumes that output is always at its potential level. With output always at

its potential, prices remain at their baseline levels—there is no estimated effect of policy on inflation. The model also does not incorporate any explicit forward-looking response to future policy changes.

The Life-Cycle Model

The life-cycle model is a general-equilibrium growth model. It incorporates simulated households that make decisions about how much to work and save in order to make themselves as well off as possible over their lifetime.[17] Those simulated households differ in their ages, working ability (measured by hourly wages), accumulated savings, and earnings histories (which determine their Social Security benefits). A household is assumed to consist of a married couple with some children. A household enters the economy when it is 20 years old.

Every year, each household below age 80 may shift from its current working ability to another one (technically speaking, working ability follows a Markov process). That means future income, on an individual level, is uncertain in the model. However, the individual shocks to earnings cancel one another out in the aggregate, so aggregate earnings and output are not uncertain. There are eight distinct working-ability levels for each age below 80.

At the end of each year, a fraction of the households die, according to current U.S. mortality rates. Households can live at most 110 years; that is, the mortality rate at the end of age 109 is one.

Each household chooses its optimal consumption, labor supply (working hours), and savings, taking a series of current and future factor prices (such as the interest rate and wage rate) and policy variables (such as marginal income tax rates) as givens. Households in the model can foresee those future factor prices and policy variables because they are assumed to know all future government policies as well as the current distribution of households does and because there are no aggregate shocks in the model.

The utility function of a household is a constant relative risk aversion function of a Cobb-Douglas aggregate of consumption and leisure. The share parameter of consumption is 0.47, the elasticity of intratemporal substitution of consumption for leisure is 1.0, and the elasticity of intertemporal substitution is 0.5. The rate of time preference is chosen so that the capital stock is 2.7 times output, and the share parameter on consumption is chosen so that the average household supplies a total

17. For a more detailed description of the life-cycle model, see Shinichi Nishiyama and Kent Smetters, "Consumption Taxes and Economic Efficiency in a Stochastic OLG Economy," Technical Paper 2002-6 (December 2002), available from CBO's Macroeconomic Analysis Division or at www.cbo.gov/tech.cfm. In addition, a forthcoming CBO technical paper will describe the life-cycle model's estimates of the effects of simple tax experiments (such as a proportional change in all marginal tax rates).

of 3,360 hours of labor in the baseline steady state (the estimated values in the U.S. economy).

The model has a representative (but perfectly competitive) firm with Cobb-Douglas production technology. The share parameter of capital is assumed to be 0.30 and that of labor 0.70, just as in the textbook growth model.

The model assumes two polar cases for the degree of openness of the economy—a closed economy and a small open economy. In a closed economy, no international capital flow is assumed, and the trade surplus is assumed to be zero. The interest rate and the wage rate are determined by the domestic capital stock (which is equal to the sum of total private wealth and net government wealth) and labor supply. In a small open economy, a perfectly flexible international capital flow is assumed. The interest rate and the wage rate are fixed at their international levels. The domestic capital stock is determined by the labor supply of the economy, and the difference between domestic capital and national wealth (the sum of private wealth and net government wealth) is made up by international capital inflows (or outflows). Therefore, in a small open economy, the percentage change in GDP is equal to the percentage change in labor supply.

The model includes a progressive federal income tax that is modeled on the current rate structure, a flat state income tax, and a Social Security system calibrated to the existing one. For federal income taxes, the statutory marginal rates are modified by two adjustment factors so that the effective tax rates on labor income and capital income are roughly the same as those in the U.S. economy. State and local taxes are assumed to be 4 percent after standard deductions and exemptions similar to the federal ones. For the Social Security system, the payroll taxes for both the Old-Age, Survivors, and Disability Insurance (OASDI) and the Hospital Insurance portions of Medicare are included, as are OASDI benefits, at levels consistent with statutory formulas. To solve a dynamic model for equilibrium, the model economy has to be on a balanced growth path with a constant per capita real growth rate and population growth rate in the long run. To make the economy return to a balanced growth path, CBO needed to make some financing assumption to stabilize the debt-to-GDP ratio at some time in the future, because the tax cuts and spending increases in the President's proposals would otherwise result in an unsustainable increase in the debt/GDP ratio relative to the baseline.

CBO assumed that the debt/GDP ratio was stabilized either by a permanent lump-sum tax increase or a cut in government consumption in the 11th year, that is, in the first year after the 10 years covered by the fiscal policy specified in the budget. In subsequent years, the tax increase or spending cut remains a constant share of economic output. Most of the policy change in the 11th year offsets the tax cuts and spending increases included in the budget, which are assumed to continue permanently. Increased interest costs and budgetary losses or gains due to the economic impacts of the budget also affect the size of the policy change that is required.

In order to stabilize the ratio of debt to GDP, government consumption has to be cut by between 2.8 percent and 3.0 percent of GDP between 2013 and 2014, from about 0.6 percent of GDP above its baseline level in 2013 to about 2.2 percent to 2.4 percent below its baseline level in 2014. Lump-sum taxes must be raised by about 2.3 percent of GDP between 2013 and 2014, from about 0.8 percent of GDP below their baseline level in 2013 to about 1.5 percent above their baseline level in 2014.

Those policy changes beyond the 10-year budget window are foreseen by households and can affect their behavior during the first 10 years. For instance, if taxes are going to be raised in 2014, people in the model will tend to work and save more in preparation. That additional work and saving tends to improve the budget balance, which is why the adjustment to lump-sum taxes required to stabilize the debt/GDP ratio is smaller than the required adjustment to government consumption. There is no similar impact of cuts in government consumption on work and saving because the model assumes that government consumption does not provide value to people. (Estimates assuming a future increase in marginal tax rates, not shown for brevity, fall between those assuming a future cut in government consumption and those assuming a future lump-sum increase in taxes.)[18]

The model assumes no intergenerational altruism—that is, the utility of children does not enter the utility function of parents. All of the bequests in the model are accidental, due to uncertain life span. For simplicity, the wealth left by the deceased households is collected and distributed to the working-age households (ages 20 to 64) in a lump-sum manner. (Each working-age household *rationally* expects to receive the future accidental inheritances when it makes decisions about consumption, labor supply, and saving.)

The President's budgetary policies affect output in the life-cycle model mainly through reductions in marginal tax rates on labor and capital income, increases in after-tax income (from both reduced taxes and increased transfers), increases in government consumption, and changes in expected budgetary policies outside the 10-year projection period. CBO's method for calculating changes in the effective marginal tax rate on labor and capital income were described previously. CBO used the Administration's spending and revenue projections to estimate changes in after-tax income and government consumption. (Most discretionary spending was classified as government consumption, and most mandatory spending was classified as transfers.) The reductions in marginal tax rates under the President's budget reduce projected tax revenues in the model somewhat; CBO made additional adjustments

18. Beyond 2013, the relative effects on output under the three assumptions about financing are very different. Assuming that the President's proposals are ultimately financed by an increase in marginal tax rates implies the most negative effect on output in the long run, while assuming that they are financed by a lump-sum increase in taxes (or a cut in government consumption that is valued as highly as personal consumption) implies the most positive effect on output. (Assuming a cut in government spending that is not valued leads to an intermediate effect on long-run output.)

through lump-sum taxes to match the Administration's revenue estimates. In the models, changes in transfers are also distributed on a lump-sum basis.

Reductions in marginal tax rates on labor income affect labor supply by raising after-tax wages. That change induces households to increase their labor supply by raising the price of leisure relative to consumption. The response of labor supply to after-tax wages in the model depends on how the lost revenue is assumed to be financed outside the 10-year projection period. In a closed economy, the effective long-run wage elasticity of labor supply with respect to after-tax wages is 0.21 when the tax cut is financed by a cut in government consumption and 0.36 when it is financed by a lump-sum tax increase; in an open economy, the elasticities are 0.16 and 0.35, respectively. Those elasticities were calculated on the basis of the change in the steady-state quantity of labor supplied relative to the change in after-tax wages from an across-the-board 10 percent tax cut.

Reductions in taxes and increases in transfers that do not affect after-tax wages (such as child tax credits or a prescription drug benefit) tend to reduce households' labor supply through an income effect—people tend to work less because they can maintain the same standard of living with less work.

Reductions in the marginal tax rate on capital income tend to reduce current consumption and increase saving because they make future consumption relatively less expensive than current consumption. Once again, the effect on consumption depends on how the tax cut is assumed to be financed. In a closed economy, the long-run elasticity of savings with respect to the after-tax interest rate is 1.40 when the tax cut is financed by a cut in government consumption and 1.60 when it is financed by a lump-sum tax increase. In an open economy, the elasticities are 0.95 and 1.10, respectively.

Government consumption affects behavior in the model by reducing the share of output available for private consumption and investment. Government consumption is not included in the utility function, so it is assumed to be pure waste. Alternatively, one could assume that government consumption is a perfect substitute for private consumption. In that case, the effect of a change in government consumption is the same as that of an equal change in transfers or lump-sum taxes.

The Infinite-Horizon Model

The infinite-horizon growth model is a Ramsey-type model similar in many ways to the life-cycle model.[19] A simulated household chooses how much to work and consume in order to maximize its well-being over its lifetime. The basic forms of the utility function and production function are the same as in the life-cycle model,

19. For a detailed discussion of this type of model, see Robert J. Barro and Xavier-I-Martin, *Economic Growth* (New York: McGraw-Hill, 1995).

and government consumption is assumed to have no value. Like the life-cycle model, the infinite-horizon model requires an offsetting policy change to stabilize the debt-to-GDP ratio beyond the 10-year projection period. That policy change is fully foreseen and affects behavior over those 10 years.

Rather than including a set of overlapping households of different ages and earnings ability, the infinite-horizon model includes just one representative household. (That type of model is often called a "representative agent" model.) Also, unlike the life-cycle model, there is no uncertainty about mortality or individual earnings ability; the household is assumed to know all future developments with certainty.

The most important difference between the models is that the household in the infinite-horizon model behaves as if it expects to live forever, whereas the households in the life-cycle model expect to live only for a fixed period of time. That assumption of an infinite horizon is equivalent to an assumption that the household values its descendants' consumption as much as its own.

CBO calibrated the share parameters on the Cobb-Douglas production function to match the capital and labor shares of income in the agency's forecast for 2003 and adjusted the discount rate to match the projected capital/output ratio.

As with the life-cycle model, solving the infinite-horizon model requires that the tax cuts and spending increases in the President's budget be financed at some point in order to stabilize the debt/GDP ratio and return the economy to a balanced growth path. CBO assumed that that financing occurred through either a lump-sum tax increase or a cut in government spending in the 11th year of the projection.

In order to stabilize the ratio of debt to GDP in the model, government consumption has to be cut by about 3.9 percent of GDP between 2013 and 2014, from about 0.6 percent of GDP above its baseline level in 2013 to about 3.3 percent below its baseline level in 2014. Alternatively, lump-sum taxes must be raised by about 3.5 percent of GDP between 2013 and 2014, from about 0.6 percent of GDP below their baseline level in 2013 to about 2.9 percent above their baseline level in 2014. The adjustments to stabilize the debt/GDP ratio are larger than in the life-cycle model because in the infinite-horizon model, the changes in marginal tax rates under the President's proposals, which are continued permanently after the 10th year of the projection, result in larger projected revenue losses than in the life-cycle model.

The response of the labor supply to after-tax wages in the model depends on how the lost revenue is assumed to be financed outside the 10-year projection period. The effective long-run wage elasticity of labor supply is 0.15 when the tax cut is financed by a cut in government consumption and 0.35 when it is financed by a lump-sum tax increase. Those elasticities are based on the change in the steady-

state quantity of labor supplied relative to the change in after-tax wages from an across-the-board 10 percent tax cut.

There is no external sector in the infinite-horizon model; all of its projections assume a closed economy.

As in the life-cycle model, in the infinite-horizon model the President's budgetary policies affect output mainly through reductions in marginal tax rates, increases in after-tax income, increases in government consumption, and changes in expected budgetary policies outside the 10-year projection period. The decreases in marginal tax rates tend to encourage the household to work and save more, which increases output and the capital stock, while the increases in after-tax income and government consumption tend to reduce saving and the capital stock. The infinite-horizon model uses the same values for changes in marginal tax rates, transfers, and government consumption as does the life-cycle model. After the new marginal tax rates are imposed, adjustments in lump-sum taxes are used to align the total change in revenues with the Administration's estimates.

Macroeconomic Advisers' and Global Insight's Models

The models by Macroeconomic Advisers and Global Insight are econometrically estimated models of the U.S. economy that combine demand-side (Keynesian) and supply-side features. The demand-side features of those macroeconometric models are more obvious, especially in the short run: in both models, total output is always determined by demand for the components of output. Utilization of the factors of production adjusts to achieve that level of output.

Supply-side features of the models affect output insofar as they affect demand. The full effects do not occur immediately but only gradually, through the unemployment rate, prices, and interest rates. Suppose, for example, that a policy raises aggregate supply more than it does aggregate demand. In Macroeconomic Advisers' and Global Insight's models, that change will push the unemployment rate higher than what it would otherwise have been. All else being equal, that scenario puts downward pressure on inflation. Higher unemployment rates and lower inflation may lead the Federal Reserve to lower interest rates. Lower interest rates then increase demand for interest-sensitive items like consumer durables, business fixed investment, residential investment, and net exports (through a weaker dollar).

To isolate the supply-side impacts of policies in the macroeconometric models, CBO eliminated the Keynesian demand effects by changing interest rates so that the unemployment rate was brought back to baseline levels. Given that the models achieve supply-side effects through changes in interest rates, that approach seemed reasonable. However, when CBO divided the estimated budgetary effects from the macroeconomic impacts of the President's proposals into supply-side and demand-side portions, the interest rates in the supply-side estimates changed only enough to reflect the impact of changes in the ratio of capital to output on the rate of return to

capital, rather than at the high levels necessary to maintain baseline unemployment. Those high interest rates reflected demand-side pressures, so it made little sense to ascribe their budgetary effects to supply-side effects.

Another difference between the macroeconometric models and the life-cycle and infinite-horizon models is their treatment of expectations. While the life-cycle and infinite-horizon models are forward-looking, the macroeconometric models assume that people respond to economic changes in the same way as they have in the past, regardless of the source of those changes. So, for example, long-term interest rates are set according to the current state of the economy and do not take account of expected changes in the budget that will alter the state of the economy in the future. Thus, the financing assumption crucial to results from the life-cycle and infinite-horizon models is irrelevant in the macroeconometric models. CBO made no adjustments for that feature of the macroeconometric models. To the extent that expectations about future financing decisions play a role in economic outcomes, that may or may not have been a bad assumption.

In the models by Macroeconomic Advisers and Global Insight, aggregate supply at full employment is determined by labor and capital in much the same way as in the textbook growth model. To estimate the labor supply response, CBO used the same calculation as in the textbook growth model. CBO then used that estimate in place of a smaller response built into Global Insight's model and no response in Macroeconomic Advisers' model. Capital responds through changes in investment. The supply-side portion of changes in investment comes from changes in the cost of capital. Higher interest rates boost the cost of capital, reducing investment, while the tax provisions for dividends reduce the cost of capital, increasing investment.

While budget policy can affect international capital flows in the macroeconometric models, those effects are probably incomplete. In both models, reduced national saving leads to higher interest rates, causing the dollar to appreciate, thus raising the trade deficit. Capital inflows rise to finance the higher deficit. Reduced national saving thus ultimately leads to capital inflows, just as in the textbook growth model. However, the models do not capture the fact that foreign taxpayers do not benefit from the proposal to reduce double taxation of corporate income and would therefore probably reduce their holdings of U.S. equities.

CBO made two other changes to Global Insight's model. In the version of the model that was the starting point for CBO's estimates (the one that Global Insight used to produce its February forecast), growth in wages did not depend on the level of the unemployment rate, but only on its change. Thus, a permanent reduction in the unemployment rate produced only a temporary rise in wage inflation. Supply-side effects on output were minimal. Therefore, CBO substituted a wage equation very close to the one included in the version of the model that Global Insight used to produce its March forecast, one in which wage growth depends on both the level of and change in the unemployment rate. A permanent reduction in the unemploy-

ment rate produces a continuous acceleration in wage and price inflation, restoring the importance of supply-side effects.

Also, in Global Insight's model, capital gains taxes depend on changes in stock prices. However, the model assumes that people treat higher capital gains taxes from a one-time rise in stock prices as if they will be permanent, and not as one-time events, and so reduce their consumption. Instead, CBO assumed that changes in receipts from capital gains taxes affect consumption only 10 percent as much as changes in receipts from other personal taxes.

CBO constructed baselines for both models in which levels for GDP, aggregate price indexes, unemployment and interest rates, stock market appreciation, and the sunset provisions of tax legislation closely matched CBO's January 2003 forecast. In the baseline in Global Insight's model, CBO also aligned most incomes, taxes, and spending with CBO's forecast levels.

To implement the President's proposals in the models, CBO changed tax rates and spending levels in line with the cost estimate from the *Fiscal Year 2004 Budget of the U.S. Government* and the *General Explanations of the Administration's Fiscal Year 2004 Revenue Proposals*, because CBO had not yet completed its *Analysis of the President's Budgetary Proposals*. Within the simulation, CBO changed tax rates by the same amount in every quarter of the year since income taxes are paid by calendar year, and it implemented higher spending by raising the appropriate categories of spending in each model.

In both models, the extension of the research and experimentation credit reduces corporate income taxes. In Global Insight's model, that change boosts research and development spending, which raises productivity with a lag.

CBO assumed that the proposals for lifetime savings accounts and retirement savings accounts would induce changes in consumption according to their estimated income and substitution effects. CBO spread the large income effect in 2003 evenly over the 10-year projection period.

Appendix A: Additional Results

This section provides some results that go beyond those shown in Tables 1, 2, and 3.

One of the important variables for estimating the budgetary effects of the President's proposals was the estimated effect on interest rates. Those rates affect both interest payments on the national debt, and, through their effect on the relative amounts of different types of income, tax revenues as well. Table 7 shows the effects of the President's proposals on interest rates, as estimated by various models.

For the life-cycle and infinite-horizon models, the Congressional Budget Office (CBO) had to make an assumption about how the revenue losses and spending increases under the President's budget would ultimately be financed in order to stabilize the debt/gross domestic product (GDP) ratio. In CBO's main estimates, those financing changes—a permanent (as a percentage of output) cut in government consumption or increase in lump-sum taxes—were assumed to be made in 2014, the year after the end of the period covered by the budget. However, that choice of year is essentially arbitrary. Table 8 shows the estimated effects on real GDP assuming that the financing changes were instead made after 2023.

Those estimates differ from the ones assuming financing in 2014 (shown in Table 1) for several reasons. In the life-cycle model, delaying the increase in lump-sum taxes results in a lower (or more negative) estimated impact on output, because current workers and retirees would not have to face the tax for as long before their death. That means they have less incentive to work harder and save more. By contrast, the timing of lump-sum taxes makes no difference in the infinite-horizon model, because the representative agent in that model (or children whose welfare he values as highly as his own) will eventually face taxes of an equivalent present value.

The direction of the effect of changes in the timing of financing through government consumption depends on the specific model. The infinite-horizon model and the life-cycle model assuming a closed economy estimate that delaying the cut in government consumption results in a more positive or less negative impact on output. That is in part because of the timing of changes in the wage rate. When the financing is delayed, there is increasing crowding out of the capital stock between 2014 and 2023, which greatly depresses the wage rate. The wage rate between 2004 and 2013 is therefore high by comparison, resulting in a shifting of more labor into that period, and therefore a higher level of output relative to that when financing occurs earlier. By contrast, in the life-cycle model assuming a small open economy the wage rate is fixed by the world economy, so there is no similar effect, and delaying financing results in a slightly lower GDP over the first 10 years.

The economic effects outside the budget window can differ substantially from those within the budget window. For the models without forward-looking behavior, the increase in the deficit under the President's budget would, if not offset, lead to

rising crowding out of investment as the budgetary imbalance continued to increase, due to rising interest payments. In the forward-looking models, a more concrete answer can be given. In those models, the economy eventually reaches a steady state, in which the economic effects are constant as a share of output. Table 9 shows the economic effects in the life-cycle and infinite-horizon models once the economy has reached a steady state.

The steady-state effects of the President's proposals with financing through an increase in lump-sum taxes tend to be more positive than those within the first 10 years for two reasons. First, in the life-cycle model within the first 10 years there are some people who will not be affected by the increased taxes because they will die before the increases occur, and therefore do not have to increase labor supply and reduce consumption in response. Second, in both models it takes time for the capital stock to grow to fully reflect the reduction in consumption and increase in labor supply that stems from the increased taxes. Note the key point that the taxes being raised are lump-sum taxes, which do not affect marginal incentives to work and save. The steady-state effects on output of finance through an increase in marginal tax rates would tend to be negative.

The steady-state effects of the President's proposals with financing through a cut in government consumption differ from the effects within the first 10 years, but the sign of the difference is uncertain. On the one hand, a cut in government consumption allows greater private consumption for any given level of work, which tends to reduce labor supply. On the other hand, more resources are available for investment for any given level of private consumption, which tends to lead to increases in the capital stock. In the life-cycle model's results, the former effect dominates, and the steady-state effects on output (GDP in the closed-economy case and GNP in the open-economy case) are more negative than those within the 10-year window. In the infinite-horizon model results, the latter effect dominates, and the steady-state effects on output are more positive than those within the 2004-2013 period.

Table 7.

Long-Term Effects of the President's Budget on Three-Month Treasury Bill Rates

(Average percentage-point difference from CBO's baseline)

	2004-2008	2009-2013
Supply-Side Model Without Forward-Looking Behavior		
Textbook Growth Model	0.1	0.4
Supply-Side Models with Forward-Looking Behavior		
Closed-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	0	0.2
Higher taxes after 2013	0	0.1
Open-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	0	0
Higher taxes after 2013	0	0
Infinite-Horizon Growth Model		
Lower government consumption after 2013	0	0.1
Higher taxes after 2013	0	0

(Continued)

Table 7.

Continued

	2004-2008	2009-2013
Macroeconometric Models, Supply-Side Contribution		
Macroeconomic Advisers	0.2	n.a.
Global Insight	0.3	n.a.
Macroeconometric Models, Supply-Side and Cyclical Contributions		
Macroeconomic Advisers	1.5	n.a.
Global Insight	0.9	n.a.

Source: Congressional Budget Office.

Notes: n.a. = not applicable.

The "textbook" growth model is an enhanced version of a model developed by Robert Solow. The life-cycle growth model, developed by CBO, is an overlapping generations general-equilibrium model. The infinite-horizon growth model is an enhanced version of a model first developed by Frank Ramsey. The models by Macroeconomic Advisers and Global Insight, which are available commercially, are designed to forecast short-term developments. The various models reflect a wide range of assumptions about the extent to which people are forward-looking in their behavior: in the textbook model and those by Macroeconomic Advisers and Global Insight, their foresight is the least, while in the infinite-horizon model, it is perfect and extends infinitely to include a full consideration of effects on descendants.

In models with forward-looking behavior, CBO had to make assumptions about how the President's budget would be financed after 2013. CBO chose two alternatives—cutting government consumption or raising taxes.

For the models by Macroeconomic Advisers and Global Insight, the supply-side contribution to interest rate changes shown in the table reflects only the effect of changes in the ratio of capital to output on the rate of return to capital. In fact, the interest rates in the "supply-side" projections had to be increased by much more to keep the unemployment rate at its baseline level. Those large increases stem from demand-side pressures, so categorizing them as supply-side effects would make little sense. The numbers shown are the ones that were used in generating the budgetary effects shown in Table 1.

Table 8.

Effect of the President's Budgetary Proposals on Real Gross Domestic Product, Assuming They are Financed After 2023 Rather Than 2013

(Average percentage change from CBO's baseline)

	2004-2008	2009-2013
Supply-Side Models with Forward-Looking Behavior		
Closed-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-0.2	-1.0
Higher taxes after 2013	0.1	-0.4
Open-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-0.7	-0.6
Higher taxes after 2013	-0.3	-0.1
Infinite-Horizon Growth Model		
Lower government consumption after 2013	0.8	0.9
Higher taxes after 2013	0.9	1.4
Memorandum: Effect on Real Gross National Product		
Open-Economy Life-Cycle Growth Model		
Lower government consumption after 2013	-0.9	-2.2
Higher taxes after 2013	-0.4	-1.3

Source: Congressional Budget Office.

Notes: In models with forward-looking behavior, CBO had to make assumptions about how the President's budget would be financed beyond the period covered by the budget. These results show the estimated economic effects of the President's proposals if they were financed by cutting government consumption or raising taxes after 2023, rather than after 2013 as in most of CBO's other published results. Results are shown only for the life-cycle and infinite-horizon models, because only in those models does the timing of financing affect the results.

The life-cycle growth model, developed by CBO, is an overlapping generations general-equilibrium model. The infinite-horizon growth model is an enhanced version of a model first developed by Frank Ramsey.

Table 9.

Long-Run Steady-State Effect of the President's Budgetary Proposals on Real Gross Domestic Product

(Average percentage change from CBO's baseline)

	Effect on Real GDP
Supply-Side Models with Forward-Looking Behavior	
Closed-Economy Life-Cycle Growth Model	
Lower government consumption after 2013	-1.8
Higher taxes after 2013	0.7
Open-Economy Life-Cycle Growth Model	
Lower government consumption after 2013	-0.2
Higher taxes after 2013	1.6
Infinite-Horizon Growth Model	
Lower government consumption after 2013	0.6
Higher taxes after 2013	2.5
Memorandum: Effect on Real Gross National Product	
Open-Economy Life-Cycle Growth Model	
Lower government consumption after 2013	-2.4
Higher taxes after 2013	0.3

Source: Congressional Budget Office.

Notes: The life-cycle growth model, developed by CBO, is an overlapping generations general-equilibrium model. The infinite-horizon growth model is an enhanced version of a model first developed by Frank Ramsey. In those models, the effect of the President's proposals on the economy eventually (after several decades) stabilizes at a permanent level as a percentage of GDP. This table shows those long-run, permanent effects, which can differ substantially from the effects within the 10-year period covered by the budget.

In models with forward-looking behavior, CBO had to make assumptions about how the President's budget would be financed after 2013. CBO chose two alternatives—cutting government consumption or raising taxes.

This publication and others by CBO
are available at the agency's Web site:
www.cbo.gov