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Macroeconomic Impacts of Stylized Tax Cuts in an Intertemporal Computable General Equilibrium Model

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Abstract

What are the consequences of stylized cuts in federal personal income tax rates when applying alternative options for financing changes in fiscal policy? This analysis uses an intertemporal computable general equilibrium (CGE) model, with the Ramsey optimal-growth framework at its core, to explore the answer to this question. One such financing option pays for cuts in marginal income tax rates by adjusting government spending, the other by adjusting future taxes. Both equate a primary deficit with net government interest payments, so that the ratio of government debt to gross domestic product (GDP) is constant in the long run.

Tax cuts can have distinctly different economic effects under these different financing options, particularly in the long run. For example, cuts in effective marginal tax rates financed with lower future government spending can lead to higher real activity—and, thus, to higher taxable incomes. In contrast, the same tax cuts paid for with higher marginal rates in the future can result in lower economic activity and incomes.

These conclusions are sensitive, however, to the way the model represents economic decisions, and particularly to the way it characterizes a household's willingness to substitute between personal consumption and leisure. A high intratemporal elasticity of substitution increases the household's willingness to trade leisure for consumption today, boosting the labor supply response to a change in after-tax wages. Conversely, a low elasticity dampens the labor supply response. Thus, even under the same financing option, different reasonable elasticity assumptions can lead to different simulated effects of a tax cut on GDP.

Section 1: Introduction

Cuts in marginal tax rates can benefit the economy. The resulting increases in people's after-tax marginal wages and returns to capital can expand the supply of labor and encourage greater saving and investment, thus potentially boosting economic growth. But the government must pay for these cuts by reducing its spending, raising other taxes, or initiating new borrowing. Tax cuts financed with new borrowing must ultimately be balanced in the long term with future tax hikes or spending cuts.

How people believe the government will pay for those cuts and—equally important—how they act on those beliefs can influence the tax cut's long-run effect on the economy. As a result, the impact of a short-term change in fiscal policy cannot be fully understood without taking into account people's expectations about its long-term implications.

This paper explores the consequences of a stylized cut in federal personal income tax rates when applying three alternative options for financing changes in fiscal policy. These financing options impose the government's intertemporal budget constraint by specifying what actions the government will take to pay for tax cuts in the long run. In the first option—a balanced budget rule—the government contemporaneously matches tax cuts with spending cuts; as a result, tax cuts require no new borrowing.

In the second and third options, the government instead temporarily pays for tax cuts with new borrowing. The government cannot borrow without limit, however, if it wishes to ensure the long-run sustainability of its fiscal policies. To restrict the long-run rate of public-debt accumulation to the rate of economic growth, the government must at some point adjust future spending or taxes. Thus, the second financing option targets the rate of growth in the debt stock by raising taxes some 10 to 20 years in the future; the third achieves the same result by cutting future government spending with a similar delay. All three financing options are implemented in an intertemporal computable general equilibrium (CGE) model with a Ramsey framework.

Tax cuts can have distinctly different economic effects under these different financing options. In the long run, tax cuts financed with lower future government spending lead to higher real activity—and, hence, to higher taxable incomes. But in the short run, they do not necessarily boost gross domestic product (GDP). Within the first few periods, the promise of lower future government spending leads people to consume more goods and services as well as leisure—and possibly to reduce their labor supply, investment, and capital accumulation.

Conversely, in the long run, tax cuts paid for with higher future levies create a disincentive for labor and capital, thus reducing output. But, in the short run, they initially raise economic activity and incomes, as the household's anticipation of higher future marginal rates yields a marked increase in hours worked, private saving, and investment, and a rapid build-up of net produced assets.

These conclusions are sensitive to the way the model represents economic decisions, and particularly to the way it characterizes a household's preferences between personal consumption and leisure. A high intratemporal elasticity of substitution between the two implies a strong labor supply response to higher after-tax wages. A low elasticity dampens or even reverses that response. Thus, under different elasticity assumptions, the effect of tax cuts on GDP can differ not only in magnitude but also in sign.

The paper proceeds as follows: Sections 2 and 3 outline key elements of this model, its options for financing fiscal policy, and its calibration to national accounting data. Sections 4 and 5 explore a range of possible macroeconomic—and fiscal—impacts from stylized cuts in marginal income tax rates, with section 4 giving simulation results and section 5 summarizing their sensitivity to changes in model parameterization. Section 6 offers concluding remarks.

Section 2: Key Model Features

The model, a standard intertemporal CGE model based on the Ramsey framework, has at its core a representative household that chooses to divide its time between leisure and labor, and to divide the returns to its labor and capital between consumption and investment.[1] The household is assumed to have perfect foresight and to be infinitely lived—or, more realistically, to be a dynasty in which each generation behaves as though it cares as much about the well-being of future generations as it does about its own.

The model extends the basic Ramsey framework to include a government sector. The government purchases goods and services, makes transfer payments to the household, and pays interest on any public debt accumulated. Those expenditures are financed through levies on labor and capital income, lump-sum taxes, and borrowing. Government spending on

[1] The Ramsey model is a benchmark for studying optimal resource allocation as well as optimal consumption and investment decisions. See Ramsey (1928).

goods and services contributes to the household's utility, but it does not directly affect the household's consumption and leisure decisions.[2] This is because, in the household's utility, public goods are separable from private consumption and leisure. As a result, simulation results would be the same if government spending were excluded from the household's utility function.

The model imposes an intertemporal budget constraint to ensure that the government does not accumulate debt without limit. In its baseline, the stock of debt expands at the same steady-state rate as GDP, implying positive overall deficits. Under a balanced-budget rule, losses in government revenue from reducing marginal tax rates on labor and capital income are contemporaneously offset by equivalent cuts in government spending on goods and services, ensuring no additional debt accumulation.

Under debt-to-GDP targeting, marginal rate cuts are initially financed by new borrowing, leading to an increase in government debt. After an initial delay, the government brings its accounts back into long-term balance by reducing spending or increasing marginal rates, either of which leaves the stock of debt once again growing at the same rate as GDP.

Because the household has perfect foresight, it fully anticipates any such changes in fiscal policy and adjusts its consumption and saving accordingly. For example, if the household receives a lump-sum tax cut from the government, it saves rather than consumes the full

[2] See Barro (1981), Aschauer (1985), Baxter and King (1993), and Cardia et al. (2003) for examples of consumer preferences that depend on government spending.

increase in its after-tax income—completely offsetting any current deficits. As a result, the lump-sum tax cut has no effect on the household's consumption.

However, cuts in marginal tax rates do affect the household's consumption. For example, under debt-to-GDP targeting, private saving does not expand by enough to offset initial deficits if the household anticipates that cuts in government spending—although delayed—are likely to pay for current deficits and debt accumulation attributable to marginal rate cuts. Alternatively, private saving is likely to expand by more than enough to offset initial deficits if the household anticipates that the government is likely to raise marginal rates in the future to pay for current deficits and debt accumulation.

Firm. A representative firm maximizes profits subject to Cobb-Douglas production function:

(1) $$Y_t = (K_t)^{\alpha} \cdot (A_t N_t)^{1-\alpha},$$

where Y_t is output, K_t the total stock of capital, N_t the total hours of labor demanded by the firm, and α the capital share parameter. The vector A_t denotes labor-augmenting technological change; its product with N_t gives the firm's total labor input. In the model, A_t is exogenous and expands at an exogenous rate of a_t in each period.

Solving the firm's short-run optimization problem subject to (1) gives the firm's demand for labor hours at wage rate (w_t) and domestic price level (p_t) as:

(2a) $$N_t = \left[\frac{w_t}{p_t} \right]^{-1} \cdot (1-\alpha) \cdot A_t^{-1} \cdot Y_t$$

and its marginal product of capital (mpk_t) as:

(2b) $$mpk_t = \alpha \cdot \left[\frac{K_t}{Y_t} \right]^{-1}.$$

The total capital input is fixed in any given period. The build-up in the stock of capital between any two periods is determined by

(2c) $$K_t = (1-\delta) \cdot K_{t-1} + I_t ,$$

where K_{t-1} denotes the beginning-of-period stock of capital, δ the depreciation rate, and I_t the flow of private investment.

In steady state, Y_t, A_t, and K_t all grow at the same rate, and both the wage rate and the marginal return to capital are constant. Thus, the model attributes steady-state growth in total labor compensation not to rising factor returns but rather to progress in producing labor services per unit of time. To ensure a tractable solution for the steady state, productivity growth A_t applies to leisure hours as well as to labor hours.[3] Otherwise, the ratio of the labor supply to the total time endowment would not be constant in steady state.

Output measured at factor prices is combined in fixed proportions with taxes on production and imports, along with other national income and product account (NIPA) line items excluded from factor incomes. The resulting aggregate gives GDP as the output of the firm's one good. The domestic price of that one good serves as model numeraire.

Household. A representative household maximizes discounted constant elasticity of substitution (CES) utility:

$$(3) \qquad \sum_{t=0}^{\infty} A_t^{\gamma} \cdot \left(\frac{1}{1+\rho}\right)^{t+1} \cdot \frac{\left\{\left[\omega^{1/\varepsilon} \cdot C_t^{(\varepsilon-1)/\varepsilon} + (1-\omega)^{1/\varepsilon} \cdot L_t^{(\varepsilon-1)/\varepsilon}\right]^{\varepsilon/(\varepsilon-1)}\right\}^{1-\gamma}}{1-\gamma} + v(G_t)$$

by choosing its personal consumption of goods and services (C_t) and leisure (L_t), where L_t is a function of the difference between the total time endowment and hours worked. In (3), ρ is the rate of time preference, ω is the consumption share parameter, γ is the coefficient of relative risk aversion (CRRA), and ε is the intratemporal elasticity of substitution between private consumption and leisure.

Government spending (G_t) on public goods and services appears in (3) but is separable from leisure and private goods and services consumption. As a result, in the model, government

[3] See Altig et al. (2001) and Goulder and Thalman (1993).

spending increases utility but does not directly influence decisions about private consumption and leisure. This approach is common in the macroeconomics literature because of the difficulty inherent in assessing the substitutability of government spending for private consumption.

In steady state, private goods and services consumption and leisure expand at the same rate as capital and labor incomes. The vector A_t from equations (1) and (2a) appears in the utility function so that an upward trend in factor prices does not drive that growth.

The household maximizes its utility subject to a budget constraint, given by:

$$(4) \qquad \Delta K_{t+1} + \Delta B_{t+1} = \left(1 - \tau_{k_t}\right) \cdot r_t \cdot K_t + \left(1 - \tau_{l_t}\right) \cdot \frac{w_t}{p_t} \cdot N_t + TR_t - C_t ,$$

where τ_{l_t} and τ_{k_t} are effective tax rates on labor and capital incomes, respectively. The before-tax rate of return (r_t) is the marginal product of capital less the depreciation rate. The household's total non-financial income is the sum of its after-tax income from labor and its net transfer and interest income from the government (TR_t).

The amount of the government's overall deficit, or, equivalently, the change in outstanding public debt (ΔB_{t+1}), reconciles the household's implied wealth accumulation with the national accounting identities. Successively solving (4) forward gives:

(5) $$W_0 = \sum_{t=0}^{\infty}\left(\prod_{s=0}^{t}\left(1+\left(1-\tau_{k_s}\right)\cdot r_s\right)^{-1}\right)\cdot C_t .$$

Initial wealth (W_0), consistent with (4), is the sum of the initial capital stock—net of the present value of government deficits—and the present value of non-financial income. It equals the discounted flow of personal consumption, or, equivalently, the present value of GDP net of gross investment and government spending. Because the household finances not only all private investment but also all government deficits, any build-up in public debt is reflected in the household's optimal decision making.

Solving the household's intertemporal optimization problem subject to (4) gives the contemporaneous ratio of leisure to goods and services consumption as:[4]

(6a) $$\frac{L_t}{C_t} = \left(\frac{1-\omega}{\omega}\right)\cdot\left[\frac{w_t \cdot \left(1-\tau_{l_t}\right)}{p_t}\right]^{-\varepsilon};$$

it gives the forward change in private consumption as:

(6b) $$C_{t+1} = f\left(\frac{\Gamma_{t+1}}{\Gamma_t}\right)\cdot\left(\frac{1+\left(1-\tau_{k_{t+1}}\right)\cdot r_{t+1}}{1+\rho}\right)^{1/\gamma}\cdot\left(1+a_t\right)\cdot C_t$$

and the forward-change in leisure as:

[4] The intratemporal elasticity of substitution in (3) is between 0 and 1. Forward-looking equations consistent with an ε of 1 are also derived.

$$L_{t+1} = g\left(\frac{\Gamma_{t+1}}{\Gamma_t}\right) \cdot \left(\frac{1 + \left(1 - \tau_{k_{t+1}}\right) \cdot r_{t+1}}{1 + \rho}\right)^{1/\gamma} \cdot \left(1 + a_t\right) \cdot L_t, \tag{6c}$$

where Γ_{t+1} and Γ_t are functions of after-tax wage rates, given by $\Gamma_t = f\left(\left(1 - \tau_{l_t}\right) \cdot w_t / p_t\right)$. In (6a), an increase in the intratemporal elasticity, for a given increase in after-tax wages, boosts current consumption at the expense of current leisure. In (6b), an increase in the after-tax return to capital, or $\left(1 - \tau_{k_{t+1}}\right) \cdot r_{t+1}$, reduces current consumption in favor of current saving and future consumption. With the ratio of C_{t+1} to $C_t \cdot \left(1 + a_t\right)$ and of L_{t+1} to $L_t \cdot \left(1 + a_t\right)$ equal to 1, and, with factor prices constant in steady state, (6b) and (6c) each reduce to $\rho = \left(1 - \tau_{k_{t+1}}\right) \cdot r_{t+1}$, or the model's Euler condition.

Government. The government can initially—but not indefinitely—finance tax cuts with deficits and new borrowing. In any given year, the sum of the government's spending on goods and services, lump-sum transfer payments to the household, and before-tax net interest payments $\left(r_t^{gov} \cdot B_t\right)$ on the existing stock of public debt can exceed total revenues from levies on labor, capital, and net government interest incomes. The amount by which expenditures exceed revenues—the overall deficit—determines the build-up of new debt.

However, over an infinite horizon, the government's overall deficit cannot grow faster than GDP forever. Rather, the government's intertemporal budget constraint requires that the government run a compensating budget surplus in the future. The government's intertemporal budget constraint is:

$$(7) \qquad \sum_{t=0}^{\infty}\left(\prod_{s=0}^{t}\left(1+r_t^{gov}\right)^{-1}\right)\cdot T_t = \sum_{t=0}^{\infty}\left(\prod_{s=0}^{t}\left(1+r_t^{gov}\right)^{-1}\right)\cdot S_t + B_0 ,$$

where $T_t = \tau_{l_t} \cdot \frac{w_t}{p_t} \cdot N_t + \tau_{k_t} \cdot r_t \cdot K_t + TAX_t$ gives the government's total tax collections and where TAX_t summarizes all lump-sum and other taxes. Equation (7) enforces the sustainability of the government's fiscal policies by equating the initial stock of outstanding debt obligations (B_0) with the present value of the government's primary surpluses—defined as the difference between the government's total tax collections and S_t, its total non-interest spending.

A policy rule targeting the ratio of debt to GDP is one alternative for setting any future change in fiscal policy.[5] In the baseline steady state, the stock of debt expands at exactly the same pace as GDP; thus, $B_{t+1}/GDP_{t+1} - B_t/GDP_t = 0$. In the transition to any new steady state, debt can expand at a faster pace than GDP if deficits and new borrowing initially pay for marginal rate cuts.

But, in the long run, effective marginal tax rates on capital and labor incomes must rise or government spending must fall to finance higher net interest obligations.[6] The magnitude of

[5] If the government instead follows a balanced-budget rule, its spending contemporaneously adjusts with a change in effective tax rates. For example, government spending falls in the event of a cut in tax rates. An overall government deficit of zero results.
[6] Such a rule mimics the policy reaction functions for debt-to-GDP targeting in Bryant and Zhang (1996a, 1996b).

those changes in taxes and spending depends on the speed with which the government acts to limit the growth of the debt stock.

Equilibrium Conditions. The model satisfies two broad equilibrium conditions. First, markets clear in every period. Thus, an endogenous wage rate equates the household's labor supply with the firm's labor demand. The supply of the firm's one good always equals the sum of its NIPA final demands, and gross saving always sums to investment.

Second, the government's fiscal policy is sustainable in steady state. Therefore, if the government targets a ratio of debt to GDP, marginal income tax rates rise or spending falls until primary surpluses cover the government's net interest obligations. The outstanding stock of public debt subsequently expands at the same steady-state rate as GDP.

Section 3: Calibration to Base-Year Data

The model is calibrated to a base year of 2004, using Congressional Budget Office (CBO) forecasts of NIPA income and expenditure flows and CBO projections of net produced asset stocks (fixed and inventory). Construction of an initial steady-state baseline broadly consistent with both CBO data sets proceeds in three steps. Table 1 summarizes the calibration to the base year.

Share Parameter Calibration. First, the share parameters in the firm's Cobb-Douglas production function (see equation (1)) and the household's CES utility function (see equation (3)) are calculated so that the model exactly reproduces base-year NIPA data. For instance, the firm's capital share parameter (α) is total capital income divided by output at factor prices.[7] Total labor income is, in turn, a product of initial (2004) values for average yearly hours per employee, average compensation per hour, projected payroll employment, and the vector A_t. In 2004, A_t equals 1; it trends upward at an exogenous steady-state rate of 2.9 percent per year.[8]

Rearranging the contemporaneous relationship between leisure and personal consumption, shown in (6a), gives:

$$\text{(9b)} \qquad \omega = \left[1 + \left(\frac{w_t \cdot (1 - \tau_{l_t})}{p_t} \right)^{\varepsilon} \cdot \left(\frac{L_t}{C_t} \right) \right]^{-1}.$$

In (9b), private consumption's share (ω) of the household's total goods, services, and leisure consumption depends not only on the coefficient of relative risk aversion (γ) and the intratemporal elasticity of substitution (ε) between leisure and private consumption, but also on leisure (L_t). Leisure consumption—consistent with calibration of the firm's production function—depends on average yearly leisure hours per employee in the base year.

The model is calibrated using values of γ and ε commonly found in the literature. For example, Hall (1988), Campbell and Mankiw (1989), and Zeldes (1989) put the inverse of the

[7] See Shoven and Whalley (1992).

[8] Hence, the economy expands by 2.9 percent per year, where 2.9 percent is the sum of average annual percentage changes in the labor force (0.9) and its productivity (2.0). See Congressional Budget Office (2003), Table 2-4.

CRRA, or the intertemporal elasticity of substitution, between roughly 0.1 and a value over 1. Later studies find this elasticity to be generally under 0.5 or between 0.3 and 0.4.[9] The intertemporal elasticity here is set to 0.5, giving a CRRA of 2. With fewer empirical estimates available, the intratemporal elasticity of substitution is simply set to the base value of 0.8 used in Auerbach and Kotlikoff (1987), Altig et al. (2001), and Auerbach (2002).

The household's total time endowment is calibrated to limit the responsiveness of the labor supply to a change in the after-tax wage rate. Dividing an economy-wide total time endowment by projected payroll employment gives an average yearly endowment $(endow_t)$. In the baseline, the ratio of the average yearly endowment to the household's hours worked is 1.75, implying that the household allocates some 60 percent of its total endowment to labor.[10] With an average yearly endowment of roughly 2700 hours, a γ of 2, and an ε of 0.8, ω is almost 0.7.

That combination of γ, ε, $endow_t$, and ω puts the simulated, implied labor-supply elasticities between 0 and 0.3 in steady state and between 0.1 to 0.4 in the transition to steady state (see Table 2). Both ranges roughly correspond to empirical estimates of total wage labor-supply elasticities for all persons, which fall between 0 and 0.3.[11]

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[9] See Elmendorf (1996) and Gravelle (2003) for surveys of the empirical literature on the intertemporal elasticity of substitution.
[10] See Ballard et al. (1985), pp. 122-132.
[11] See CBO (1996), Table 2, p. 11.

Closed Economy Assumption. Second, a closed economy is assumed. Net exports are therefore eliminated as a source of final demand, and net foreign saving is removed as a source of investment finance. To ensure that the sum of the remaining final demands (personal consumption, government spending, and private investment) equals NIPA GDP, net imports are subtracted from government spending. So that the household is the source of saving otherwise originating overseas, its income is increased using a lump-sum transfer from the government equal to the amount of the U.S. trade deficit.

Such an adjustment to base-year NIPA government spending matters little because the model is built on the Ramsey framework and because public goods and services do not contribute to the household's utility. However, it has the benefit of holding the government's primary and overall deficits to their NIPA levels. These NIPA overall and primary deficits are modified below (also using lump-sum transfer payments) to ensure the sustainability of the government's fiscal policies in the final data for the base year.

Steady-State Conditions. Four steady-state conditions complete calibration. The first two restrict the build-up of capital and debt stocks to an exogenous, steady-state rate (a_{SS}). The second two determine the rate at which the household trades current for future consumption in steady state.

Beginning with the first two conditions, the steady-state level of the capital stock satisfies:

$$\text{(9c)} \qquad \frac{I_{SS}}{K_{SS}} = \delta + a_{SS} \, ,$$

while the steady-state ratio of public debt to GDP corresponds to:

(9d) $$\left[r_{SS}^{gov} - a_{SS}\right] \cdot \frac{B_{SS}}{GDP_{SS}} = -\left(S_{SS} - T_{SS}\right) / GDP_{SS} \ .$$

Hence, base-year data are consistent with stocks that amass at the steady-state rate only if depreciation allowances exactly match private investment adjusted for growth (see equation 9c), and the government's primary surpluses cover all of its growth-adjusted net interest obligations (see equation 9d).

Satisfying steady-state conditions (9c) and (9d) requires that we further modify the base-year NIPA data. For instance, the depreciation rate consistent with NIPA capital consumption allowances and the base-year capital stock equals about 4.4 percent. That 4.4 percent combined with NIPA private investment implies that capital amasses at a rate about 1.3 percentage points below the desired steady state rate. Replacing the NIPA depreciation rate with a steady-state replacement rate obtained by subtracting a_{SS} (equal to 0.029) from the ratio of I_{SS} to K_{SS} modestly reduces capital consumption and boosts the rate at which capital accumulates.

Additional adjustments to the 2004 NIPA data ensure the sustainability of the government's fiscal position. The closed-economy data consistent with base-year NIPA overall and primary deficits imply a build-up of government debt that exceeds 16 percent over 2004. Cutting the government's lump-sum transfer payments to the household limits that expansion to the steady-state rate by converting a base-year primary deficit of over $300 billion to a primary surplus of about $90 billion—an amount equal to the government's net interest obligations adjusted for growth.

The approach taken here is roughly similar to that used to construct a baseline consistent with a balanced-budget rule.[12] There, a lump-sum adjustment to the household's personal income taxes eliminates the government's overall deficit, ensuring that no debt accumulates. Here, a lump-sum adjustment to the household's transfer payments yields a primary surplus exactly equal to the government's net interest obligations, ensuring an overall deficit consistent with debt that accumulates at the same rate as GDP in steady state.

Finally, the rate at which the household transforms current consumption into future consumption reflects two separate steady-state conditions. The firm's problem gives the steady-state ratio of total capital to total labor inputs as:

(9e) $$\frac{K_{SS}}{N_{SS}} = \left(\alpha \cdot \left(mpk_{SS}\right)\right)^{1/(1-\alpha)};$$

the forward-change in the household's personal consumption (see equation 6b) puts the steady-state marginal product of capital at:

[12] See Devarajan and Go (1998) and Goulder and Eichengreen (1988).

(9e′) $$mpk_{SS} = \frac{\rho}{1-\tau_{k_{SS}}} + \delta .$$

Base-year data determine the firm's inputs of capital and labor as well as after-tax rates of return. Substituting (9e′) into (9e) then gives the rate of time preference (ρ) and, consistent with the model's Euler condition, the rate at which the household transforms current into future personal goods and services consumption and leisure.

Section 4: Stylized Model Simulations

These simulations explore the consequences of a 10-percent stylized cut in federal personal income tax rates (see Table 3). Two aspects of these stylized tax cuts deserve mention. First, cuts in current-law income tax rates fall below 10 percent because the government combines all fiscal activities at the federal, state, and local levels. Second, cuts in marginal rates on labor income are roughly twice as large as cuts in marginal rates on capital income because the policy experiment does not reduce corporate income taxes.

Whether these stylized cuts expire, or "sunset," in the simulations depends on how the government chooses to pay for lower marginal rates. Marginal income tax rates are permanently lower if the government finances tax cuts by reducing government spending. They increase after an initial period if the government instead finances current tax cuts by raising future income taxes.

The economic effects of these stylized cuts in current-law income tax rates are simulated under two broad financing assumptions.[13] Under the first—a balanced-budget rule—the government pays for tax cuts by contemporaneously reducing spending by an amount that holds the overall deficit to zero in every period. As a result, tax cuts require no new borrowing. Under the second—debt-to-GDP targeting—the government initially pays for tax cuts with new borrowing. Debt subsequently accumulates at rates exceeding the growth of GDP, and the government's ratio of debt to GDP rises.

However, the government cannot borrow without limit and still satisfy its intertemporal budget constraint. To restrict the long-run rate of public debt accumulation to the rate of economic growth, the government phases in debt-to-GDP targeting over a 10-year period beginning in 2014. Between 2013 and 2023, the government gradually lowers spending or raises taxes so that its primary surpluses rise by just enough to meet a progressively greater share of its net interest obligations. From 2024, it uses cuts in spending or hikes in marginal tax rates to equate its primary surpluses with its net interest obligations (adjusted for growth)—and, thereby, to fix the ratio of debt to GDP.

Fiscal Policy Adjustments in the Long Run. The steady-state levels of government spending and income tax revenues depend on how quickly the government adjusts its fiscal policies to ensure their long-run sustainability. For example, the steady-state ratio of government spending to GDP is largest if the government adjusts its spending contemporaneously from 2004 (see Figure 1A). The ratio is smallest if the government temporarily delays cuts in

[13] Simulations are carried out using the General Equilibrium Modeling Package (GEMPACK). See http://www.monash.edu.au/policy/gempack.htm.

spending and instead finances marginal rate reductions between 2004 and 2013 with deficits and new borrowing.

The depth of those cuts in spending depends on the duration of that delay. Here, the government phases in debt-to-GDP targeting over 10 years—equating its primary surpluses with its net interest obligations only from 2024. Between 2014 and 2023, the government reduces its spending as a share of GDP only gradually. As a result, public debt continues to build at rates that exceed the growth of GDP, and the government's debt-to-GDP ratio rises. The ratio of government spending to GDP in turn falls progressively further below base levels through 2024 before settling into a new steady-state trajectory.

Effective marginal rates climb through 2024 if the government pays for current tax cuts with future tax hikes (see Figure 1B). With debt-to-GDP targeting delayed 10 years, marginal rates gradually adjust upward between 2014 and 2023 to cover a progressively greater share of the government's net interest payments. They then settle into an above-baseline steady-state trajectory of their own, guaranteeing the long-run sustainability of the government's fiscal balance.

As a result, levies on labor and capital income as a share of GDP also rise, with labor income taxes reaching about 22.6 percent of GDP and capital income taxes reaching almost 4.4 percent of GDP in steady state (versus respective base levels of 22.2 percent of GDP and 4.2 percent of GDP).

Economic Impacts Vary Depending on the Way Tax Cuts Are Financed. If the government cuts spending to pay for permanent reductions in effective marginal tax rates, economic activity rises in the long run (see Table 4 and Figures 2 through 5). For example, under a balanced-budget rule, capital and labor inputs never contract, but instead expand until GDP is about 0.6 percent above baseline in steady state.

Conversely, if the government finances current tax cuts with future tax hikes, long-term economic activity falls. Anticipation of higher future levies initially boosts hours worked, private saving, and the capital stock. But realized increases in income tax rates ultimately reduce the supply of these same factor inputs, pushing GDP almost 0.8 percent below its base level in steady state.

Two options for financing tax cuts illustrate the effects of fiscal policy adjustments on economic impacts in the short run and long run. These options are delayed increases in marginal tax rates and delayed cuts in government spending.

Option 1—Tax Cuts Financed with Delayed Increases in Marginal Tax Rates: Tax cuts financed initially with deficits and new borrowing and later with increases in marginal tax rates boost output in the short run, but not in the long run.

Between 2004 and 2013, the household's supply of capital and labor expands in anticipation of higher future marginal rates. Hours worked, private saving, and investment all jump in response to marginal rate cuts in 2004 (see Figures 3 and 4). But tax cuts are not permanent, and the household's expectation of higher future marginal rates leads to a rapid build-up of net produced assets. Reflecting this, the after-tax return to capital, which initially jumps in response to capital tax cuts, gradually moves below baseline, and the household trades progressively more current personal consumption for future personal consumption and leisure—boosting saving and hours worked through 2013. The temporary spike in labor supply helps put GDP over 1 percent above its base level by 2013.

Beyond 2013, realized hikes in income tax rates only gradually reverse these increases in the household's supply of factor inputs. Marginal tax rates on capital and labor income rise only incrementally between 2014 and 2023, remaining below baseline for much of the period. As a result, private investment remains above its base level while the household's labor supply—which cumulatively drops almost 1.5 percent between 2014 and 2024—never falls by more than about 0.2 percent per year. GDP, in turn, remains over 0.5 percent above baseline as late as 2020.

Shortly thereafter, however, income tax rates top base levels, and GDP finally slips below baseline. GDP hovers near baseline in 2024 only because the household's net produced assets continue well above base levels. Consistent with the draw-down in the stock of capital that follows, GDP drops almost 0.8 below its base level in steady state.

Option 2—Tax Cuts Financed with Delayed Cuts in Government Spending: Tax cuts financed with delayed cuts in government spending boost output in the long run, but not necessarily in the short run.

Income effects dominate the household's short-run and long-run responses to permanent marginal rate cuts. This is because the household anticipates that cuts in government spending—although delayed until 2014—will be imposed to pay for the deficits and debt accumulation occurring between 2004 and 2013. The steeper those delayed cuts in public goods spending—which is separable from private consumption and leisure in the household's utility—the more resources the government frees for debt service and private investment in the long run and private consumption in the short run and long run.

Thus, between 2004 and 2024, the household does not increase private saving and investment by enough to fully offset the government's initial, overall deficits. Instead, it smoothly expands personal goods and services consumption (see Figure 5) and leisure. The subsequent drop-off in hours worked (see Figure 3) and draw-down in capital relative to baseline (see Figure 4) work against short-run gains in GDP.

Beyond 2024, however, cuts in government spending generate accelerated gains in GDP. The government fully adopts debt-to-GDP targeting after 2023. Cuts in government spending then allow for above-baseline private consumption and investment spending. As a result, capital accumulates with a lag after roughly 2023, and GDP expands over the transition to a new steady state.

In that steady state, however, the cuts in government spending are steeper (see Figure 1A) and the income effects more pronounced than under a balanced-budget rule. For example, with delayed cuts in government spending, steady-state hours worked hover just above baseline, making the capital stock almost solely responsible for raising GDP above base levels; in turn, gains to personal consumption are nearly 3 percent. By comparison, under contemporaneous cuts in government spending, steady-state hours worked are about 0.3 percent above baseline and personal consumption climbs only about 2.5 percent.

Section 5: Sensitivity Analysis

In sum, tax cuts can have distinctly different economic effects under different financing options. For example, cuts in effective marginal rates can in the long run lead to higher real activity and taxable incomes if they are accompanied by lower future government spending. In contrast, the same tax cuts can ultimately yield lower economic activity and incomes if they are paid for with higher future marginal rates.

But these conclusions are sensitive to the way the model characterizes the household's preferences. The results in Table 4 reflect only one in a broad continuum of possible outcomes because the empirical estimates of two key model elasticities are highly uncertain. The first—the intratemporal elasticity (ε)—determines the household's preference for substituting leisure for personal consumption within a single period. The second—the intertemporal elasticity—determines its preference for smoothing personal consumption and leisure over time.

The values assigned to both elasticities help determine the household's response to tax cuts. A small ε implies less willingness to substitute current leisure for current personal consumption. The household is therefore less inclined to increase hours worked today to take advantage of cuts in marginal rates. Alternatively, a higher intertemporal elasticity suggests a greater willingness to reallocate total spending on goods, services, and leisure over time and, hence, to forego current personal consumption and leisure for future personal consumption and leisure. The household is thus more likely to boost private saving and hours worked today in response to tax cuts.

This section presents a limited analysis of the sensitivity of the model's results to changes in the values of both elasticities.[14] To begin, the intertemporal elasticity of substitution is halved from its base value of 0.5 to 0.25, doubling the CRRA from 2 to 4 (see Table 5 and Figures 6A and 6B). The model is subsequently recalibrated so that the ratios of capital to labor and capital to output, as well as all NIPA income and expenditure flows, remain at their baseline levels.

Two broad conclusions flow from this analysis—the first concerning the short run, the second the long run. First, in the short run, halving the intertemporal elasticity mutes the household's response to lower marginal rates and increases the initial costs of tax cuts to the government. Between 2004 and roughly 2023, the impact of lower tax rates on labor supply, saving, and, hence, GDP is less positive if the intertemporal elasticity equals 0.25 (see Figures 6A and

[14] Limited sensitivity analysis (Shoven and Whalley, 1984; Bernheim et al., 1991) involves an ad hoc look at variations in simulation results when a key parameter is changed a discrete number of times over a range of alternative values. See DeVuyst and Preckel (1997) and Abdelkhalek and DuFour (1998) for more systematic methods of assessing with confidence intervals the simulation uncertainty arising from parameter uncertainty.

6B). Initial gains in taxable incomes are therefore smaller, and the drop in income tax revenues is greater with the lower elasticity. Under debt-to-GDP targeting, the government must initially borrow more to finance tax cuts, and the ratio of debt to GDP is subsequently higher in steady state.

In that steady state, however, the GDP effects of tax cuts are similar regardless of whether the intertemporal elasticity is set to 0.25 or 0.5. Beyond 2023, a household with an intertemporal elasticity of 0.25 responds to fiscal policy in ways that offset lower GDP in the short run. For example, with delayed tax hikes, labor supply falls by less in response to higher realized marginal rates. GDP losses are therefore smaller than they would be with an intertemporal elasticity of 0.5. In contrast, with delayed cuts in government spending, private saving increases by more to offset higher overall deficits. The capital stock thus builds, and GDP expands at a faster pace than it would with the intertemporal elasticity at 0.5.

In the next case, the intratemporal elasticity of substitution (ε) is halved from 0.8 to 0.4 (see Tables 2 and 6 and Figures 7 and 8).[15] A lower willingness to trade leisure for goods and services makes the household's labor supply less responsive to changes in tax rates. This muted labor supply response offsets the effects of marginal rate changes on investment and capital accumulation.

For example, permanent tax cuts financed by reducing government spending imply more pronounced income effects and less—not more—economic activity in the long run. Under a

[15] Altig et al. (2001) also consider an alternative intratemporal elasticity of 0.4. Auerbach (2002) reduces the value of the same parameter to 0.3 in conducting sensitivity analysis.

balanced-budget rule, the household's hours worked are below—not above—baseline with ε at 0.4. Under debt-to-GDP targeting with delayed cuts in spending, the household's supply of labor initially rises under both values of the intratemporal elasticity. But, mirroring the household's reduced willingness to swap leisure for personal consumption, the initial gain in the labor input is smaller and its decline more pronounced with ε at 0.4.

GDP is therefore lower—not higher—in steady state with the smaller ε. Under a balanced-budget rule, the labor supply slips about 0.4 percent below baseline with an ε of 0.4, but climbs about 0.3 percent above it with an ε of 0.8. Under debt-to-GDP targeting with delayed cuts in government spending, hours worked in steady state are almost 1 percent below baseline with ε at 0.4, but hover just above baseline with ε at 0.8. Under both financing options, such below-baseline labor at the lower intratemporal elasticity offsets rather than reinforces above-baseline capital stock accumulation, and GDP slips below baseline rather than rising above it in steady state.

Conversely, temporary marginal rate cuts paid for with future marginal rate hikes imply more—not less—economic activity in the long run. With ε at 0.8, steady-state hours worked are about 0.4 percent below baseline. With the willingness to substitute leisure for goods and services consumption halved to 0.4, they are instead only 0.1 percent below base levels. Consistent with that muted drop in hours, the capital stock does not slip as far below baseline with the lower intratemporal elasticity, and the percentage point loss in steady-state GDP is therefore smaller. For example, GDP is almost 0.8 below baseline with ε at 0.8, but is only 0.5 percent below baseline with ε halved to 0.4.

Increasing ε to 1 instead augments the effects of changes in marginal rates on hours worked and, hence, GDP (see Tables 2 and 7 and Figure 9). For example, the household's steady-state hours worked climb about 0.4 percent above baseline in response to permanent marginal rate cuts under both delayed and contemporaneous cuts in government spending. An equivalently positive response from private saving pushes capital accumulation well over 1 percent above base levels in steady state. As a result, long-run gains in GDP under both types of spending cuts are within a few percentage points of each other.

On the other hand, the household's labor supply and private saving respond more negatively if current tax cuts are paid for with future tax hikes. Hours worked and the capital stock are well below baseline in steady state, and the resulting percentage point loss in GDP is subsequently more than 20 percent greater than that reported for an ε of 0.8.

Section 6: Conclusion

Tax cuts can have distinctly different economic effects under different financing options, particularly in the long run. Cuts in effective marginal rates paired with less government spending lead to higher real activity—and taxable incomes—in steady state. In contrast, the same tax cuts paid for with higher future marginal rates generate lower economic activity and incomes in steady state.

Thus, if the government cuts both current taxes and future spending, GDP and taxable incomes rise in the long run. But if it cuts taxes now but raises marginal rates later to pay for those same cuts, GDP and taxable incomes fall in steady state.

However, these conclusions are sensitive to the way the model characterizes the household's preference for leisure, particularly relative to current personal consumption. A high intratemporal elasticity of substitution increases the household's willingness to trade leisure for consumption, raising the labor supply response to a change in after-tax wages. In contrast, a low elasticity depresses the labor supply response and ultimately the supply-side impacts of tax cuts. Hence, even under the same option for financing changes in fiscal policy, different reasonable elasticity assumptions can dramatically alter the simulated effects of a tax cut on GDP.

Table 1.

2004 Calibrated Model Parameters		
Firm's Production Function		
Capital Share Parameter (α)	0.34	Calculated from base data[a]
Depreciation Rate (δ)	0.03	Set equal[b] to I_{2004}/K_{2004} less a_t
Household's Utility Function		
Coefficient of Relative Risk Aversion (γ)	2.00	Literature Search[c]
Elasticity of Substitution between C_t and L_t (ε)	0.80	Literature Search[d]
Consumption Share Parameter (ω)	0.67	Calculated from base data[e]
Total Yearly Time Endowment, Hours $(endow_t)$ per worker	2687	Calibrated so that implied labor supply elasticities fall within an estimated range in steady state[f]
Rate of Time Preference (ρ)	0.06	Calculated from base data[g]

Note: I_{2004} = 2004 gross investment, K_{2004} = 2004 stock of capital, and a_t = exogenous steady-state growth rate.

a. See equation (9a).
b. See equation (9c).
c. See Elmendorf (1996) and Gravelle (2003).
d. See Auerbach and Kotlikoff (1987), Altig et al. (2001), and Auerbach (2002).
e. See equation (9b).
f. See CBO (1996), Table 2, p. 11. Empirical estimates put total wage labor-supply elasticities between 0 and 0.3 for all persons.
g. See equation (9e′).

Table 2.

Implied Labor Supply Elasticities under Alternative Values of the Intratemporal Elasticity

Financing Options	**2004**	**2006**	**2008**	**2012**	**2013**	***SS***
Lower Intratemporal Elasticity $(\varepsilon = 0.4)$						
Cut G_t **Contemporaneously**	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1
Raise τ_{l_t} and τ_{k_t} **After 2014**	0.2	0.2	0.2	0.2	0.2	0.1
Cut G_t **After 2014**	0.1	0.1	0.1	0.1	0.1	-0.2
Baseline Intratemporal Elasticity $(\varepsilon = 0.8)$						
Cut G_t **Contemporaneously**	0.1	0.1	0.1	0.1	0.1	0.1
Raise τ_{l_t} and τ_{k_t} **After 2014**	0.4	0.4	0.4	0.4	0.4	0.3
Cut G_t **After 2014**	0.3	0.3	0.3	0.3	0.3	0.0
Higher Intratemporal Elasticity $(\varepsilon = 1.0)$						
Cut G_t **Contemporaneously**	0.1	0.1	0.1	0.1	0.2	0.1
Raise τ_{l_t} and τ_{k_t} **After 2014**	0.5	0.5	0.5	0.5	0.5	0.3
Cut G_t **After 2014**	0.4	0.4	0.4	0.4	0.4	0.1

Note: *SS* = steady state, G_t = government spending on goods and services, τ_{l_t} = marginal labor income tax rate, and τ_{k_t} = marginal capital income tax rate.

The implied labor supply elasticity is the percent change in the labor supply divided by the percent change in the after-tax wage rate.

In the base case, the intratemporal elasticity (ε) equals 0.8 (see Table 1). In the lower-intratemporal-elasticity case, ε is halved to 0.4; in the higher-intratemporal-elasticity case, it is increased to 1.0.

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

Table 3.

Marginal Labor and Capital Income Tax Rates over the First 10 Years (in Percent)[a]

	Current-Law Marginal Tax Rates[b]		**Marginal Tax Rates after Tax Cuts**		**Percent Difference**	
	Labor	**Capital**	**Labor**	**Capital**	**Labor**	**Capital**
2004	32.0	16.8	30.3	16.4	-5.3	-2.6
2005	32.8	16.9	31.0	16.4	-5.4	-2.7
2006	32.9	16.9	31.1	16.5	-5.4	-2.7
2007	33.1	17.0	31.3	16.5	-5.6	-2.7
2008	33.3	16.9	31.5	16.5	-5.6	-2.6
2009	33.6	17.8	31.7	17.3	-5.5	-3.0
2010	33.8	17.8	31.9	17.3	-5.5	-3.1
2011	35.5	18.4	33.5	17.8	-5.7	-3.3
2012	35.8	18.4	33.7	17.8	-5.8	-3.3
2013	35.8	18.4	33.6	17.8	-6.1	-3.3

a. Marginal income tax rates are permanently lower if the government finances tax cuts by reducing government spending. Marginal income tax rates increase after 2014 if the government instead finances tax cuts by raising future taxes.

b. Under the Job Growth and Tax Relief Reconciliation Act of 2003 (JGTRRA), cuts in capital gains and dividend taxes expire in 2009. Under both JGTRRA and the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA), all other recent cuts in marginal rates on capital and labor income expire in 2011.

Table 4.

Economic Effects of a 10-Percent Cut in Federal Personal Income Tax Rates: Base Case (in Percent)

Financing Options	2004	2009	2014	2024	2044	*SS*
			GDP[a]			
Cut G_t Contemporaneously	0.1	0.1	0.4	0.5	0.6	0.6
Raise τ_{l_t} and τ_{k_t} after 2014	0.6	0.8	1.1	0.0	-0.5	-0.8
Cut G_t after 2014	0.5	0.4	0.2	-0.4	0.1	0.3
			Capital Stock[a]			
Cut G_t Contemporaneously	0.0	0.0	0.2	0.7	1.1	1.1
Raise τ_{l_t} and τ_{k_t} after 2014	0.0	0.4	0.9	0.8	-0.8	-1.5
Cut G_t after 2014	0.0	-0.2	-0.9	-1.4	0.4	0.8
			Hours Worked[a]			
Cut G_t Contemporaneously	0.1	0.2	0.4	0.4	0.3	0.3
Raise τ_{l_t} and τ_{k_t} after 2014	0.9	1.0	1.2	-0.4	-0.4	-0.4
Cut G_t after 2014	0.7	0.7	0.7	0.1	0.0	0.0
			Ratio of Debt to GDP[b]			
Raise τ_{l_t} and τ_{k_t} after 2014	31.5	36.7	42.7	50.1	50.1	50.1
Cut G_t after 2014	31.6	37.2	44.5	54.4	54.4	54.4

Note: *SS* = steady state, G_t = government spending on goods and services, τ_{l_t} = marginal labor income tax rate, and τ_{k_t} = marginal capital income tax rate.

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

a. Percentage changes from baseline in the indicated year.
b. Level of debt to GDP in the indicated year.

Table 5.

Economic Effects of a 10-Percent Cut in Federal Personal Income Tax Rates: Lower Intertemporal Elasticity (in Percent)

Financing Options	**2004**	**2009**	**2014**	**2024**	**2044**	***SS***
			GDP[a]			
Cut G_t Contemporaneously	0.1	0.1	0.3	0.4	0.5	0.6
Raise τ_{l_t} and τ_{k_t} after 2014	0.6	0.8	1.0	0.1	-0.3	-0.8
Cut G_t after 2014	0.4	0.1	-0.3	-0.9	-0.1	0.2
			Capital Stock[a]			
Cut G_t Contemporaneously	0.0	-0.1	0.1	0.5	0.9	1.1
Raise τ_{l_t} and τ_{k_t} after 2014	0.0	0.3	0.7	0.8	-0.4	-1.6
Cut G_t after 2014	0.0	-0.7	-1.8	-2.7	-0.4	0.8
			Hours Worked[a]			
Cut G_t Contemporaneously	0.1	0.2	0.4	0.4	0.3	0.3
Raise τ_{l_t} and τ_{k_t} after 2014	0.9	1.0	1.1	-0.3	-0.3	-0.4
Cut G_t after 2014	0.6	0.5	0.5	0.0	0.0	0.0
			Ratio of Debt to GDP[b]			
Raise τ_{l_t} and τ_{k_t} after 2014	31.6	36.8	42.9	50.3	50.3	50.3
Cut G_t after 2014	31.6	37.6	45.5	56.3	56.3	56.3

Note: *SS* = steady state, G_t = government spending on goods and services, τ_{l_t} = marginal labor income tax rate, and τ_{k_t} = marginal capital income tax rate.

The intertemporal elasticity is halved from 0.5 to 0.25, giving a coefficient of relative risk aversion (CRRA) of 4. This is the base value of the CRRA applied in Auerbach and Kotlikoff (1987).

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

a. Percentage changes from baseline in the indicated year.
b. Level of debt to GDP in the indicated year.

Table 6.

Economic Effects of a 10-Percent Cut in Federal Personal Income Tax Rates: Lower Intratemporal Elasticity (in Percent)

Financing Options	2004	2009	2014	2024	2044	*SS*
			GDP[a]			
Cut G_t Contemporaneously	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1
Raise τ_{l_t} and τ_{k_t} after 2014	0.3	0.5	0.6	0.0	-0.4	-0.5
Cut G_t after 2014	0.2	0.0	-0.3	-1.0	-0.6	-0.5
			Capital Stock[a]			
Cut G_t Contemporaneously	0.0	-0.2	-0.1	0.2	0.4	0.4
Raise τ_{l_t} and τ_{k_t} after 2014	0.0	0.3	0.7	0.5	-0.8	-1.2
Cut G_t after 2014	0.0	-0.4	-1.3	-2.0	-0.3	0.1
			Hours Worked[a]			
Cut G_t Contemporaneously	-0.4	-0.4	-0.3	-0.3	-0.4	-0.4
Raise τ_{l_t} and τ_{k_t} after 2014	0.5	0.6	0.6	-0.3	-0.2	-0.1
Cut G_t after 2014	0.3	0.2	0.1	-0.4	-0.7	-0.7
			Ratio of Debt to GDP[b]			
Raise τ_{l_t} and τ_{k_t} after 2014	31.6	37.2	43.8	52.0	52.0	52.0
Cut G_t after 2014	31.7	37.8	45.8	56.8	56.8	56.8

Note: *SS* = steady state, G_t = government spending on goods and services, τ_{l_t} = marginal labor income tax rate, and τ_{k_t} = marginal capital income tax rate.

The intratemporal elasticity is halved from 0.8 to 0.4.

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

a. Percentage changes from baseline in the indicated year.
b. Level of debt to GDP in the indicated year.

Table 7.

Economic Effects of a 10-Percent Cut in Federal Personal Income Tax Rates: Higher Intratemporal Elasticity (in Percent)

Financing Options	2004	2009	2014	2024	2044	*SS*
			GDP[a]			
Cut G_t Contemporaneously	0.1	0.1	0.4	0.5	0.7	0.7
Raise τ_{l_t} and τ_{k_t} after 2014	0.7	1.0	1.3	0.1	-0.6	-0.9
Cut G_t after 2014	0.6	0.6	0.4	0.0	0.5	0.6
			Capital Stock[a]			
Cut G_t Contemporaneously	0.0	0.0	0.2	0.7	1.1	1.2
Raise τ_{l_t} and τ_{k_t} after 2014	0.0	0.5	1.0	0.9	-0.8	-1.7
Cut G_t after 2014	0.0	-0.1	-0.7	-1.0	0.7	1.2
			Hours Worked[a]			
Cut G_t Contemporaneously	0.1	0.2	0.5	0.4	0.4	0.4
Raise τ_{l_t} and τ_{k_t} after 2014	1.1	1.2	1.4	-0.3	-0.4	-0.5
Cut G_t after 2014	0.9	0.9	1.0	0.5	0.4	0.4
			Ratio of Debt to GDP[b]			
Raise τ_{l_t} and τ_{k_t} after 2014	31.5	36.5	42.1	49.1	49.1	49.1
Cut G_t after 2014	31.5	37.0	43.9	53.2	53.2	53.2

Note: *SS* = steady state, G_t = government spending on goods and services, τ_{l_t} = marginal labor income tax rate, and τ_{k_t} = marginal capital income tax rate.

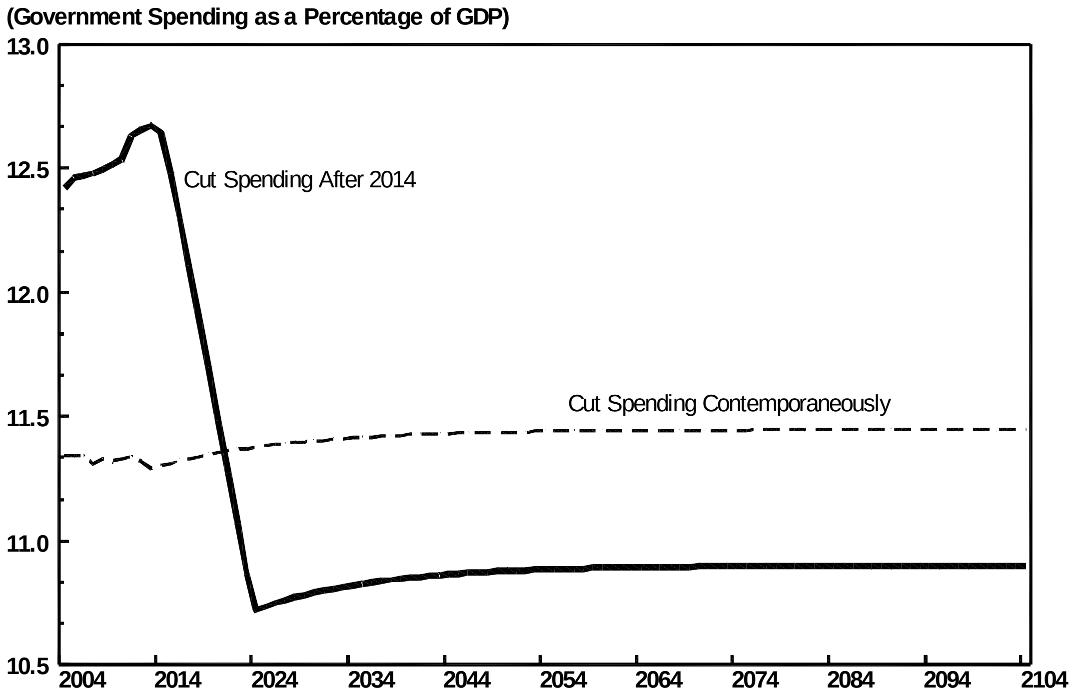
The intratemporal elasticity is increased from 0.8 to 1.0.

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

a. Percentage changes from baseline in the indicated year.
b. Level of debt to GDP in the indicated year.

Figure 1A.

Financing Tax Cuts with Reductions in Government Spending: Alternative Options



Note: The steady-state baseline ratio of government spending to GDP is about 12.8 percent.

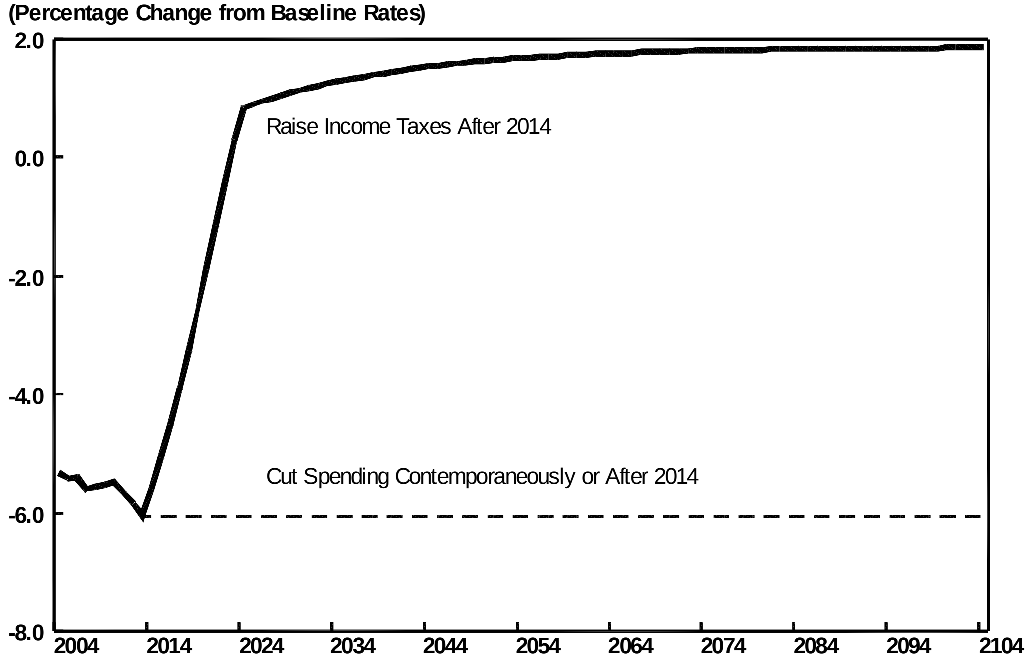
The baseline ratio of government spending to GDP falls below the roughly 20 percent implied by the original national income and product account (NIPA) data because government spending is adjusted to give a baseline consistent with a closed economy (see section 3).

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must cut spending in the future.

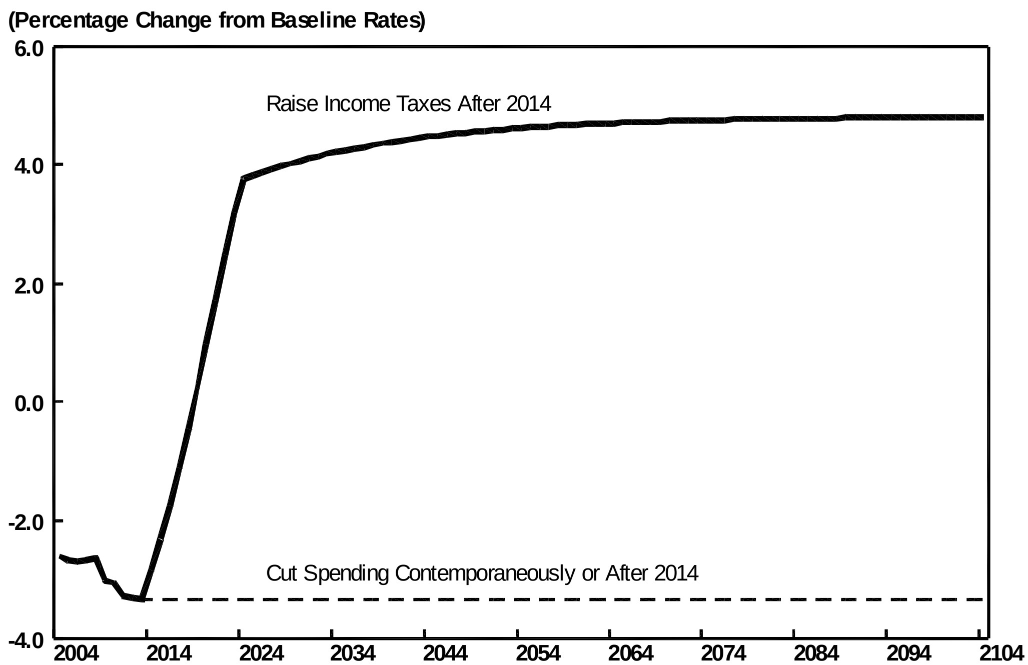
Figure 1B.

Marginal Income Tax Rates under Alternative Financing Options

Tax Rate on Labor Income



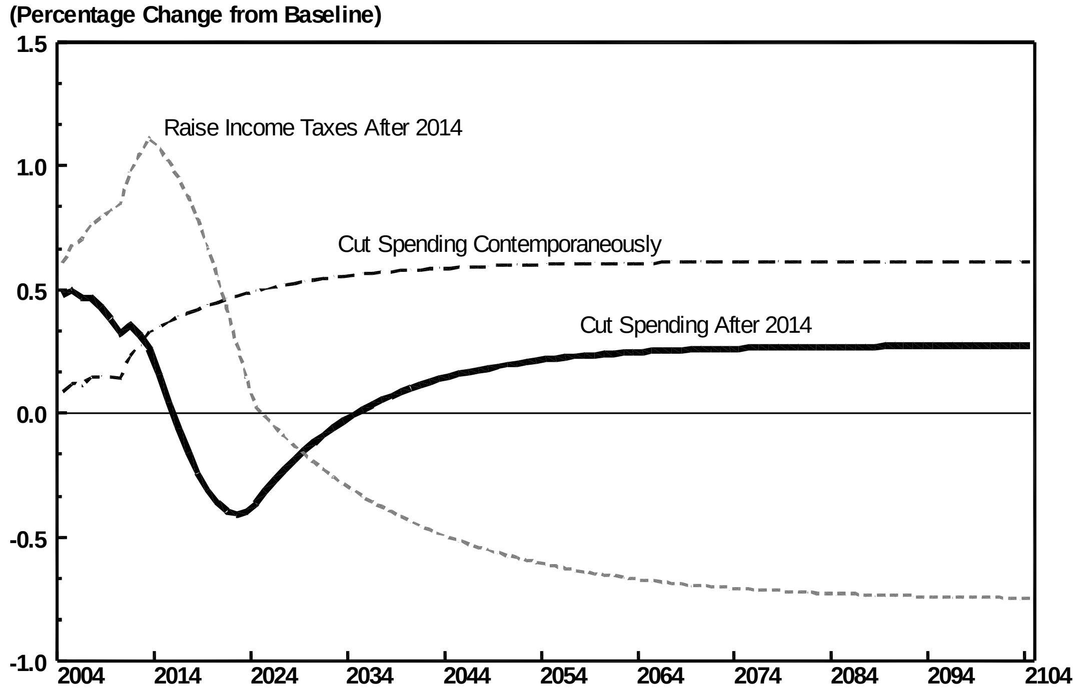
Tax Rate on Capital Income



Note: Marginal income tax rates are permanently lower after 2013 if the government finances tax cuts by reducing government spending. Marginal income tax rates increase from 2014 if the government instead finances tax cuts by raising future taxes.

Figure 2.

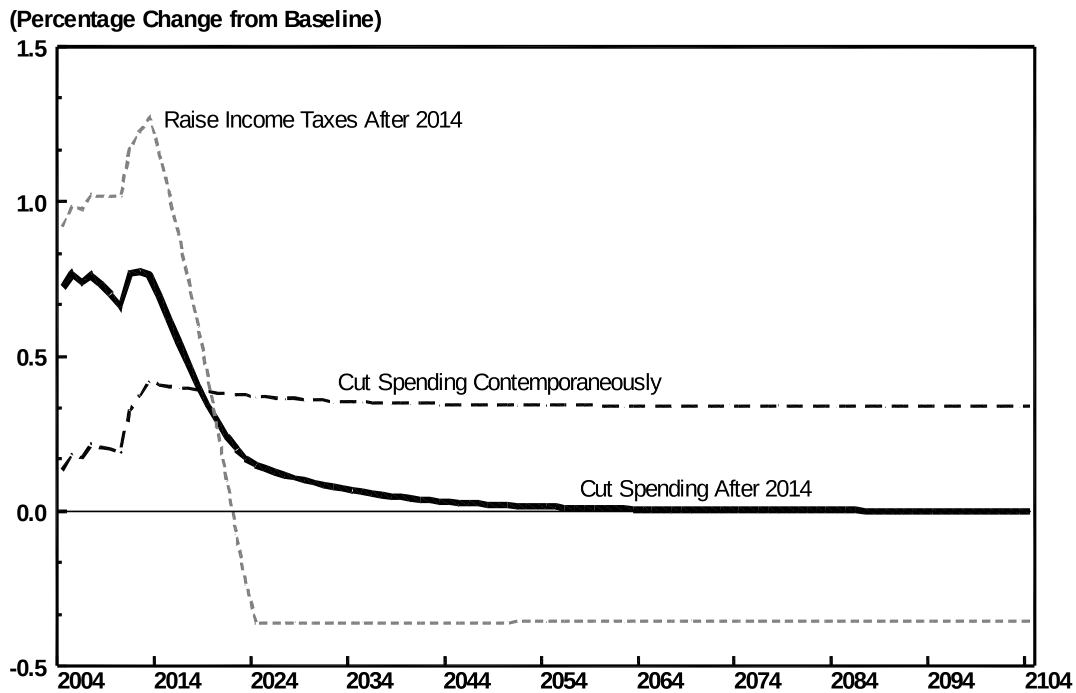
The Effect of Tax Cuts on GDP under Alternative Financing Options



Note: Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

Figure 3.

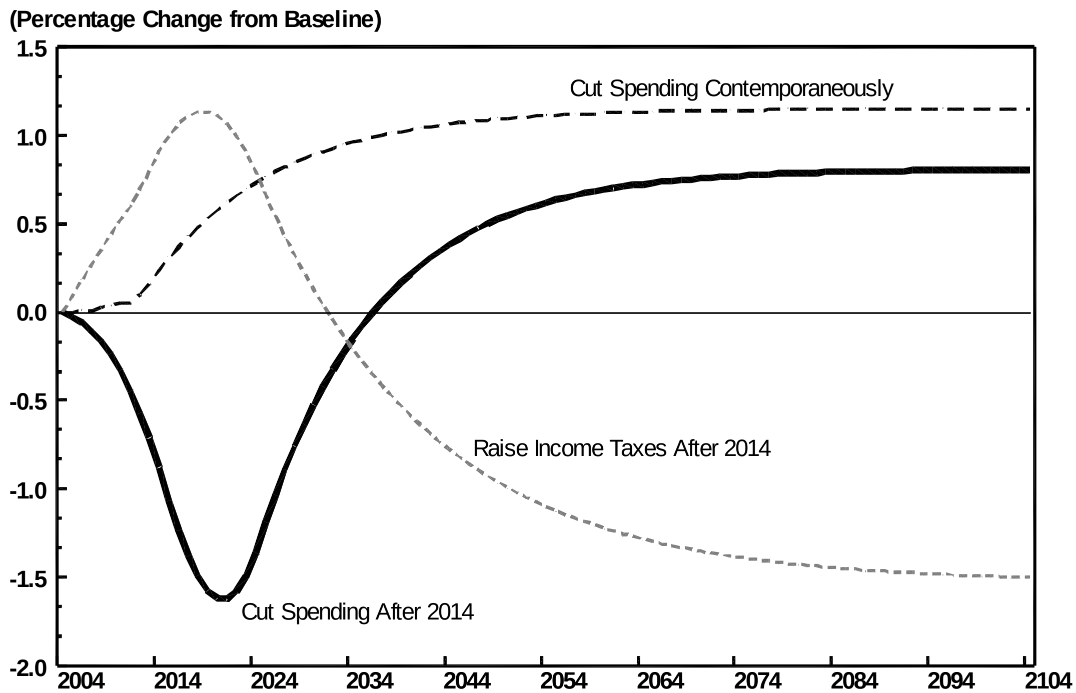
The Effect of Tax Cuts on Hours Worked under Alternative Financing Options



Note: Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

Figure 4.

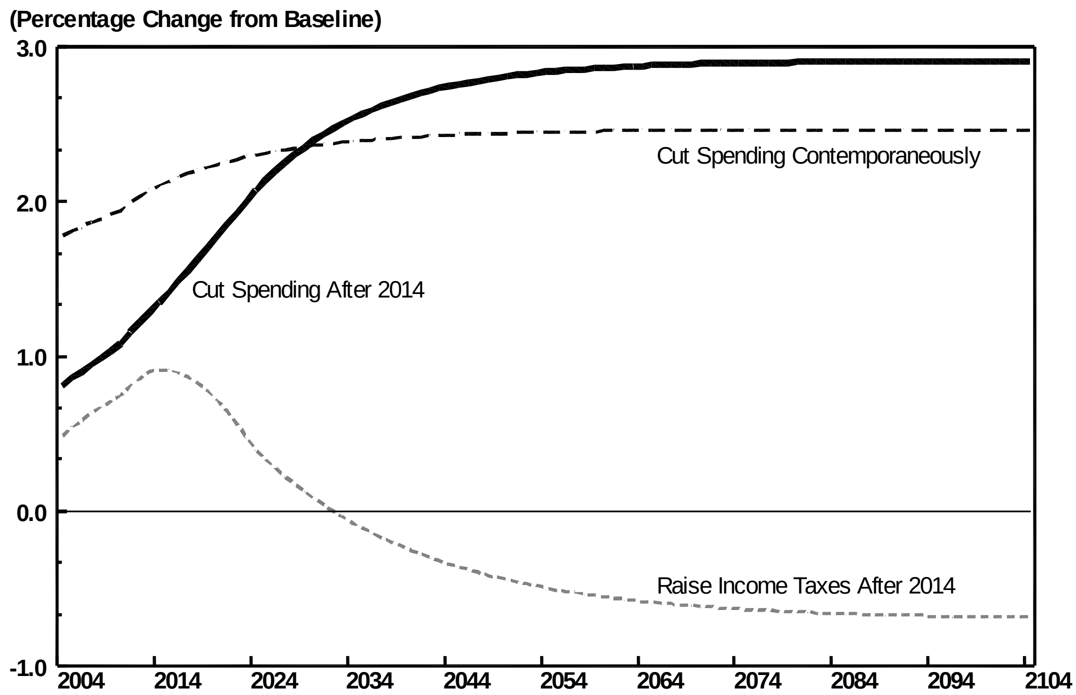
The Effect of Tax Cuts on the Stock of Capital under Alternative Financing Options



Note: Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

Figure 5.

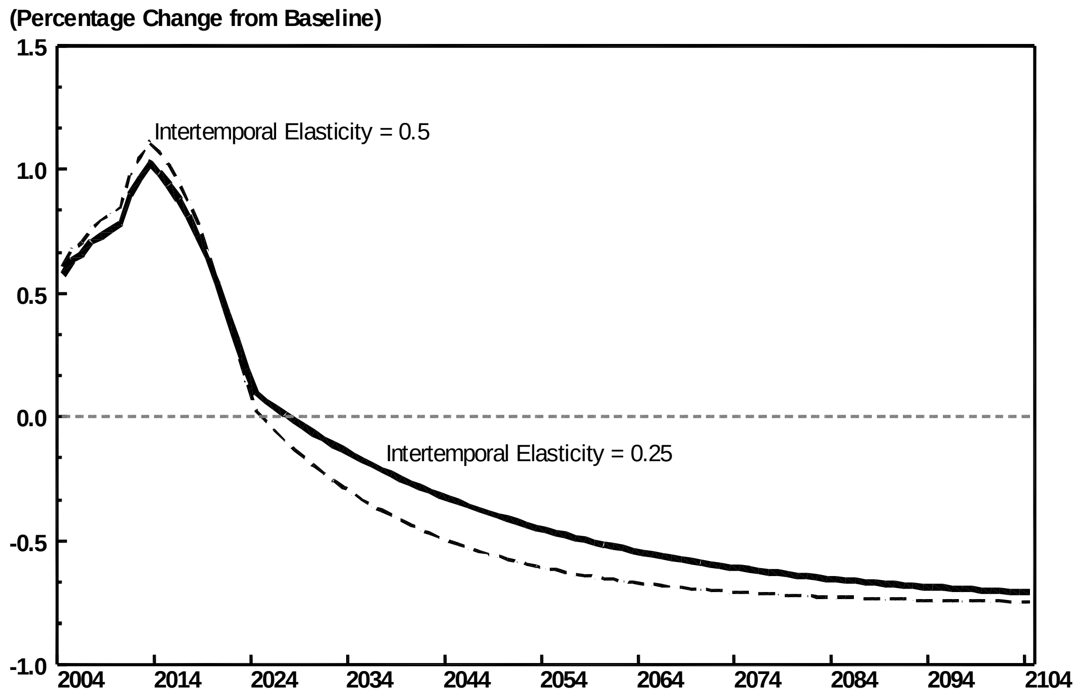
The Effect of Tax Cuts on Personal Consumption under Alternative Financing Options



Note: Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

Figure 6A.

The Effect of Tax Cuts on GDP If the Government Raises Income Taxes after 2014: Alternative Values of the Intertemporal Elasticity

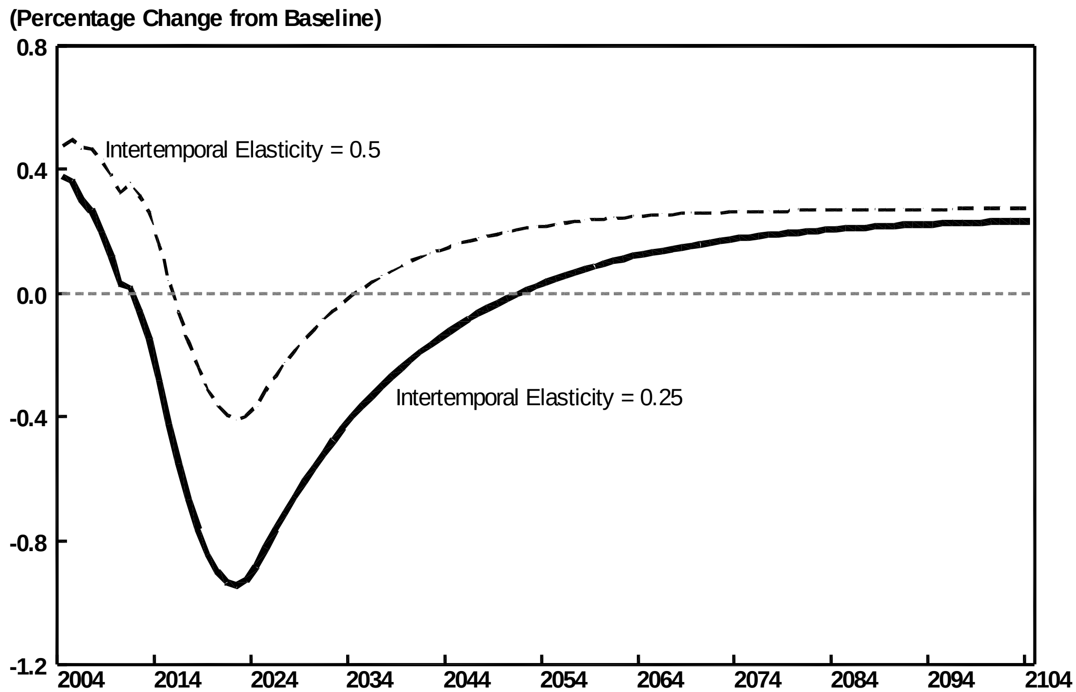


Note: The intertemporal elasticity is halved from 0.5 to 0.25, giving a coefficient of relative risk aversion (CRRA) of 4. This is the base value of the CRRA applied in Auerbach and Kotlikoff (1987).

Financing options determine the actions the government takes to pay for tax cuts in the long run. Here, the government temporarily pays for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, it raises marginal income tax rates after 2014.

Figure 6B.

The Effect of Tax Cuts on GDP If the Government Cuts Spending after 2014: Alternative Values of the Intertemporal Elasticity

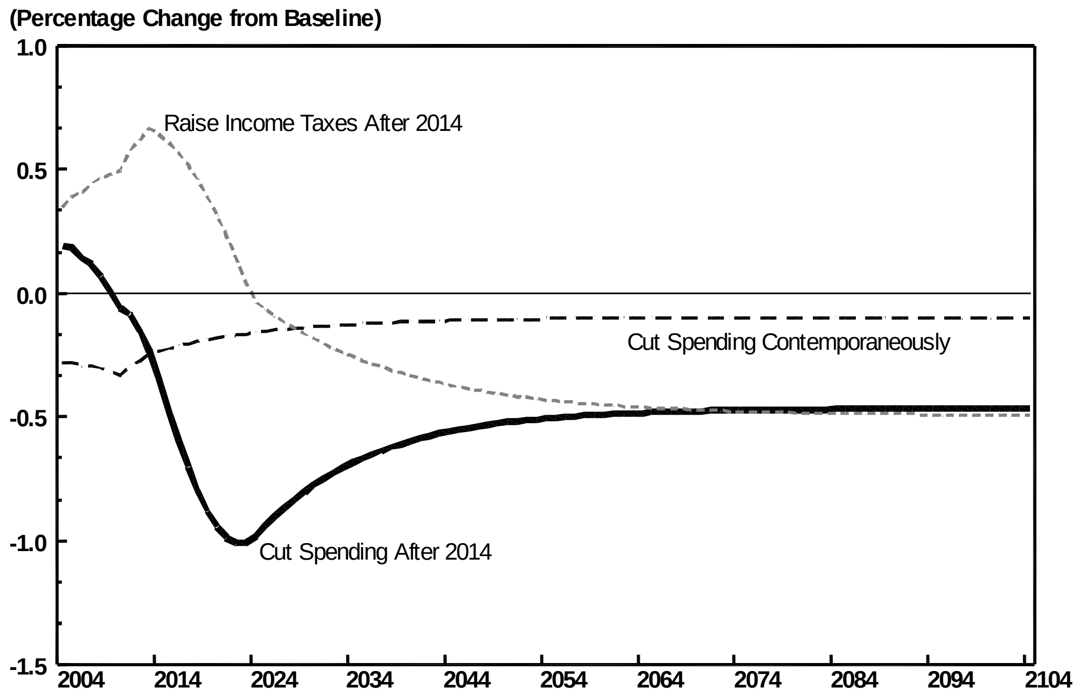


Note: The intertemporal elasticity is halved from 0.5 to 0.25, giving a coefficient of relative risk aversion (CRRA) of 4. This is the base value of the CRRA applied in Auerbach and Kotlikoff (1987).

Financing options determine the actions the government takes to pay for tax cuts in the long run. Here, the government temporarily pays for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, it cuts government spending after 2014.

Figure 7.

The Effect of Tax Cuts on GDP under Alternative Financing Options: Lower Intratemporal Elasticity

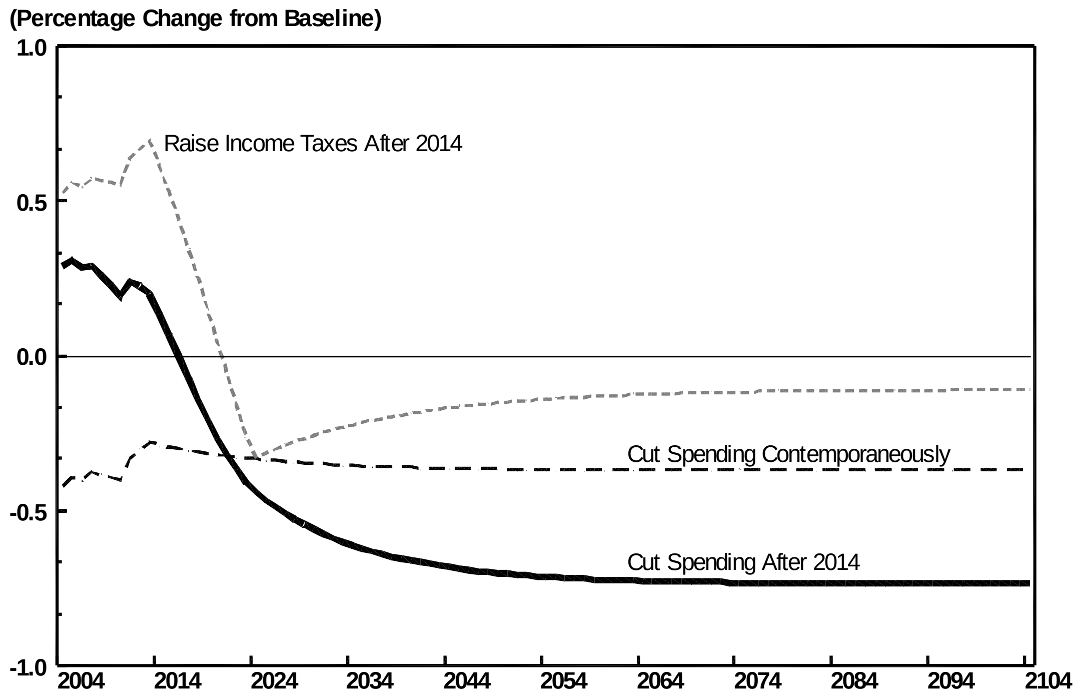


Note: The intratemporal elasticity is halved from 0.8 to 0.4.

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

Figure 8.

The Effect of Tax Cuts on Hours Worked under Alternative Financing Options: Lower Intratemporal Elasticity

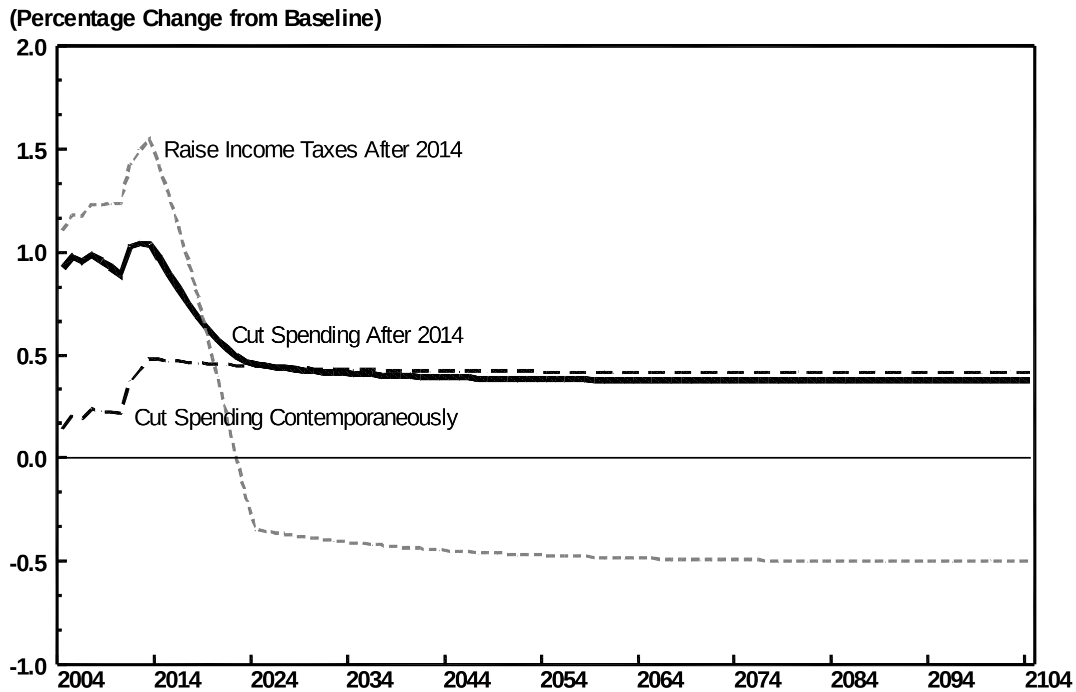


Note: The intratemporal elasticity is halved from 0.8 to 0.4.

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

Figure 9.

The Effect of Tax Cuts on Hours Worked under Alternative Financing Options: Higher Intratemporal Elasticity



Note: The intratemporal elasticity is increased from 0.8 to 1.0.

Financing options determine the actions the government takes to pay for tax cuts in the long run. The government can contemporaneously match tax cuts with spending cuts; as a result, tax cuts require no new borrowing. Alternatively, it can temporarily pay for tax cuts with new borrowing. But to limit the long-run rate of public-debt accumulation to the rate of economic growth, the government must raise marginal income tax rates or cut spending after 2014.

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