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A Simplified Model of How Macroeconomic Changes Affect the Federal Budget

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Abstract

The Congressional Budget Office's conventional analysis of changes in federal policy incorporates the behavioral responses by individuals and businesses to incentives of the policy but does not incorporate effects on the overall economy. Thus, in a conventional analysis, the potential macroeconomic effects of policy proposals exert no feedback on the federal budget. Sometimes, however, the budgetary feedback from changes in the macroeconomy may be sizable. Incorporating the budgetary feedback from the macroeconomy into an analysis is often referred to as a dynamic analysis. (CBO conducts dynamic analyses for certain reports and, to the extent practicable, uses dynamic scoring when directed.)

The budgetary feedback model (BFM) is one tool that CBO uses to estimate how changes in the macroeconomy might affect the federal budget. The BFM approximates the budgetary feedback that would be arrived at by using a wider array of CBO's budgetary models and was built to provide a unified framework to quantify changes in projected revenues and outlays relative to CBO's baseline budget projections. This paper describes how the BFM is constructed, how it is used in CBO's dynamic analyses, and the model's limitations.

Keywords: dynamic analysis, dynamic scoring, budgetary feedback model

JEL Classification: E17, H20, H50, H68

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1 Dynamic Analysis and How CBO Estimates Budgetary Feedback

The Congressional Budget Office regularly analyzes the effects of changes in federal policy on revenues and outlays. The effect of policy on revenues and outlays can be broken into two parts:

- A conventional analysis, which consists of the policy's effect on revenues and outlays accounting for the behavioral response of consumers and businesses, all while holding macroeconomic variables fixed.
- Budgetary feedback, which considers how changes in the behavior of consumers and businesses affect the broader economy and how, in turn, those changes at the macroeconomic level affect federal revenues and outlays.

A dynamic analysis comprises both components. For example, an increase in government transfer payments to consumers, holding macroeconomic variables fixed, would increase the deficit. That increase represents the conventional component because macroeconomic variables, such as overall consumption, prices, and business income, are fixed. Thus, the conventional component does not consider any change in economic activity that might arise from such a policy change. However, the budgetary feedback component in a dynamic estimate would include those changes. Continuing with the example: Many consumers may choose to spend a portion of their transfer payment on goods and services. In the short run, that increase in overall demand would tend to increase income, employment, and prices. In the long run, however, the higher deficits would reduce the amount of resources available for private investment and could reduce output. The short-run macroeconomic effects would increase the collection of income and payroll taxes from businesses and individuals, whereas the long-run macroeconomic changes could have the opposite effect. In addition, the short-run macroeconomic changes would have partially offsetting effects on the spending side: The increase in prices would cause federal outlays (and the deficit) to increase because several government programs are indexed to inflation. In that example, the budgetary feedback may increase or decrease the conventional cost of the increase in transfer payments.

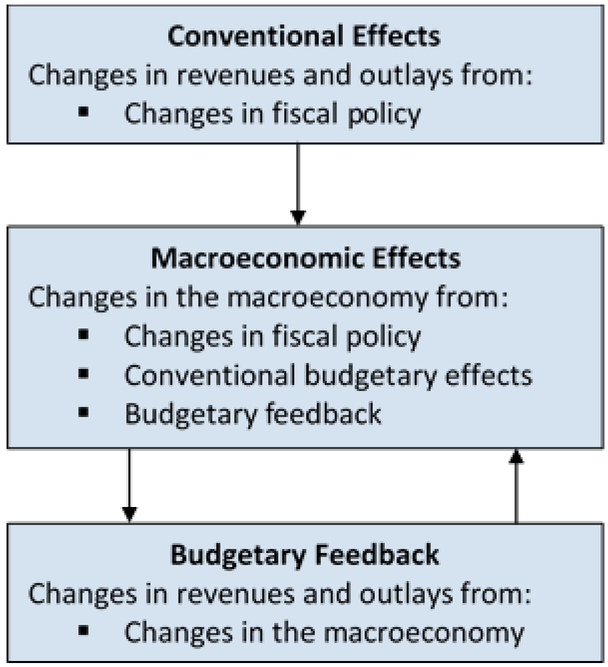

Figure 1: The Three-Step Process of a Dynamic Analysis

A dynamic analysis requires a three-step process, as outlined in Figure 1. The first step, a conventional analysis, is conducted by CBO analysts with expertise in the subject areas affected by the specific policy change. The second step requires economists to determine how the policy change affects the macroeconomy.[1] The final step is to determine the budgetary feedback due to changes in the macroeconomy. Although various methods may be used in that step, analysis using the CBO model known as the budgetary feedback model (BFM) usually plays a prominent role. The BFM approximates how projected nominal revenues and outlays provided by CBO's baseline budget projection models would change given alternative paths of macroeconomic variables relative to CBO's current-law baseline. (That baseline includes the paths of macroeconomic variables, revenues, and outlays under the assumption that the current laws governing taxes and spending generally will remain unchanged.) To compute the changes in revenues by source and outlays by expenditure type, the BFM requires three types of inputs.[2]

[1]The macroeconomic effects resulting from a policy change take into consideration not only the policy itself and the conventional budgetary effects but also the effect on deficits from the budgetary feedback itself. For a discussion of how deficits affect investment, see Congressional Budget Office, *The Long-Run Effects of Federal Budget Deficits on National Saving and Private Domestic Investment: Working Paper 2014-02* (February 2014), www.cbo.gov/publication/45140. For a discussion of how fiscal policy affects the macroeconomy, see Congressional Budget Office, *How CBO Analyzes the Effects of Changes in Federal Fiscal Policies on the Economy* (November 2014), www.cbo.gov/publication/49494.

[2]The three types of inputs that the BFM uses are generated outside the model. The procedures used to create those inputs go beyond the scope of this paper.

1. CBO's baseline budget and economic projections.

2. The alternative projection of macroeconomic variables, which includes the effects of a change in policy.

3. The year-by-year parameters that measure the estimated sensitivities of specific components of revenues and outlays to changes in a set of macroeconomic variables. CBO's analysts estimate the sensitivity of specific nominal revenues and outlays to changes in certain measures of the economy, including changes to gross domestic product (GDP), unemployment, inflation, interest rates, and other key macroeconomic variables. The sensitivities are updated at least annually to reflect modeling improvements and new information, including policy changes as well as updated projections of the economy that form the baseline against which the BFM estimates changes.[3]

CBO uses the BFM whenever an analysis of the budgetary effects from a change in the macroeconomy is needed, including for the analysis of alternative fiscal scenarios and pending or passed legislation. Sometimes only a portion of the model is used, as in the analysis of the 2017 tax act (P.L. 115-97). Because the 2017 tax act directly changed effective tax rates, CBO used its more specialized revenue models (adjusted to reflect the new tax law) to generate the feedback from economic changes on revenues. However, the agency used the BFM to estimate the budgetary feedback on outlays.[4] The BFM also is used for scenarios to illustrate how variations in macroeconomic conditions alone, such as slower growth of productivity or higher inflation, might affect the federal budget over the next decade.

2 Revenues

The BFM segments revenues into seven categories that correspond to different sources of revenue: individual income taxes, payroll taxes, corporate income taxes, Federal Reserve remittances, customs duties, estate and gift taxes, and excise taxes.

When CBO considers the macroeconomic effects of a change in policy, the agency generally estimates changes to macroeconomic variables as measured in the national income and product accounts (NIPAs). Therefore, both in baseline projections and for dynamic analysis that uses more specialized models, CBO uses NIPA data and concepts of income as inputs to estimates of taxable income. The relationship between certain NIPA measures and their consequences for revenues may be straightforward. For example, as wages and salaries, corporate profits, and imports increase, so do the receipts from income and payroll taxes

[3]The parameters in this paper represent the most recent sensitivity estimates as of November 2019.
[4]For more details on the BFM's limitations, see section 4.

and customs duties. The BFM applies estimated marginal tax rates appropriate for NIPA measures, which are different from the effective marginal tax rates on corresponding taxable income used in CBO's specialized models.

When a component of taxable income is not directly measured in the NIPAs, an alternative NIPA measure is used as a proxy. Certain taxes, such as those on capital gains or inherited property, are sensitive to changes in the stock market and other asset values, but those macroeconomic changes are not directly measured in NIPA accounting. The BFM uses changes in nominal GDP to approximate how macroeconomic changes would affect revenue from the estate tax and capital gains. The following presentation lists each major revenue source, followed by discussion of how a change in a NIPA measure would affect tax liabilities for that source. A final step is to convert calendar year liabilities into fiscal year revenue effects by using a simple fiscal year conversion formula where applicable. For notational clarity, that step is not included in the formulas below. In addition, the following notation is used in this paper:

X_t = variable X value in year t

$\overline{X}_t$ = CBO's baseline projection under current law

$\widehat{X}_t$ = CBO's alternative projection

ΔRevenue = The budgetary feedback on a revenue category

2.1 Individual Income Tax Liabilities

The budgetary feedback on individual income tax liabilities is divided into 10 subcomponents. The first eight components are different sources of individual income: wages and salaries, monetary interest income, interest payments on owner-occupied housing, dividend income, capital gains, taxable retirement income, business income, and private group health insurance benefits. Those components require the estimation of the effective marginal tax rate on relevant macroeconomic variables. The last two components affect revenues through nonincome channels: price indexing and changes in employment. How those last two components affect revenues depends on the estimated sensitivities of individual income tax liabilities to changes in the price level and employment.

Marginal tax rates and revenues sensitive to changes in the economy are estimated using CBO's microsimulation model for individual income taxes.[5] The microsimulation model uses a sample of administrative tax records that are aged to reflect demographic and eco-

[5] See "An Overview of CBO's Microsimulation Tax Model" (presentation, June 22, 2018), www.cbo.gov/publication/54096.

nomic changes, and then it calculates each household's tax liability. The model captures the applicable rate structures, phase-ins and phase-outs, credits, and deductions, as well as estimated taxpayer behavior. Changes in income affect consumption choices and therefore tax deductions and other factors that determine tax liability. Generally, deductions rise with income. The marginal rates reported below differ from statutory rates (sometimes significantly) not only because the NIPA income measures used differ from taxable income but also because they incorporate those changes in taxpayer behavior.

2.1.1 Wages and Salaries

Wages and salaries constitute most taxable income. The budgetary feedback on individual income tax liabilities on wages and salaries depends on the change in the NIPA measure of wage and salary disbursements (found in NIPA Table 2.1) and on the effective marginal tax rate for that measure. In the BFM, that feedback is calculated as

$$\Delta\text{Liabilities from wages and salaries}_t = \tau_t \times (\widehat{y}_t - \overline{y}_t) \quad (1)$$

$$y_t = \text{Wage and salary disbursements (billions of dollars)}$$

$$\tau_t = \text{Effective marginal tax rate}$$

Table 1: Parameter Values for Equation 1

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t	0.188	0.190	0.192	0.194	0.195	0.197	0.198	0.215	0.217	0.219	0.220

2.1.2 Monetary Interest Income

Monetary interest income is the NIPA measure for monetary interest received by people that does not come from marketed goods and services (found in NIPA Table 7.11); the BFM uses that NIPA measure to approximate the change in interest income on individual tax returns.[6] Whereas taxable interest income is taxed at the same rate as other income, such as wages and salaries, the estimated effective marginal tax rate on NIPA monetary interest is lower. That lower effective rate is a result of certain types of interest payments' being tax-exempt or tax-deferred, such as state and local bonds and interest received by nonprofits, life insurance carriers, and pension and retirement plans. The budgetary feedback on individual income tax liabilities on monetary interest income depends on the change in monetary interest received

[6] Interest received by nonfinancial sole proprietorships and partnerships is considered interest received by persons.

and the effective marginal tax rate on that measure.

$$\Delta\text{Liabilities from monetary interest income}_t = \tau_t \times (\widehat{y}_t - \overline{y}_t) \quad (2)$$

y_t = Monetary interest income received by persons (billions of dollars)

τ_t = Effective marginal tax rate

Table 2: Parameter Values for Equation 2

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.050	0.049	0.050	0.049

2.1.3 Interest Payments on Owner-Occupied Housing

Certain mortgage interest payments on owner-occupied housing may be claimed as an itemized deduction from income, reducing individual income tax liabilities. The budgetary feedback on individual income tax liabilities on interest payments on owner-occupied housing depends on the change in the NIPA measure of monetary interest paid on owner-occupied housing by households (found in NIPA Table 7.11) and the effective marginal tax rate on that measure.

$$\Delta\text{Liabilities from interest payments on owner-occupied housing}_t = \tau_t \times (\widehat{y}_t - \overline{y}_t) \quad (3)$$

y_t = Monetary interest paid by households: owner-occupied housing (billions of dollars)

τ_t = Effective marginal tax rate

Table 3: Parameter Values for Equation 3

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t	−0.121	−0.126	−0.130	−0.133	−0.138	−0.141	−0.145	−0.214	−0.216	−0.217	−0.217

2.1.4 Dividend Income

Dividend income from individual income tax liabilities includes dividend income of people from all sources. The rate is relatively low for several reasons. A large share of the NIPA measure of personal dividend income (found in NIPA Table 2.1) represents S corporation distributions that are reflected elsewhere in the BFM as tax liabilities from S corporations. In addition, a large percentage of NIPA dividends are tax-deferred or not subject to tax. Finally, most dividends, along with long-term capital gains, are taxed at rates lower than those for ordinary income. The budgetary feedback on individual income tax liabilities on dividend income depends on the change in personal dividend income and the effective marginal tax rate on that measure.

$$\Delta\text{Liabilities from dividend income}_t = \tau_t \times (\widehat{y}_t - \overline{y}_t) \tag{4}$$

y_t = Personal dividend income (billions of dollars)

τ_t = Effective marginal tax rate

Table 4: Parameter Values for Equation 4

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.016	0.016	0.016	0.016

2.1.5 Capital Gains

The NIPA measure of national income does not include all forms of taxable income, in particular, realized capital gains. The BFM uses GDP as an input to individual income tax liabilities in order to proxy for those changes. That choice reflects the underlying structure of CBO's full modeling that capital gains realizations vary significantly from year to year but are expected to revert to a historical share of GDP. The budgetary feedback on individual income tax liabilities on capital gains therefore depends on the change in nominal GDP and the sensitivity of capital gains tax liabilities to changes in nominal GDP.

$$\Delta\text{Liabilities from capital gains}_t = \beta_t \times (\widehat{y}_t - \overline{y}_t) \tag{5}$$

y_t = Nominal GDP (billions of dollars)

β_t = Estimated sensitivity of capital gains tax liabilities to nominal GDP

Table 5: Parameter Values for Equation 5

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008

2.1.6 Income from Pensions and IRAs

Individuals' pension benefits and individual retirement account (IRA) withdrawals are subject to taxation. Because those tax-deferred incomes are not included in current NIPA incomes, the BFM's estimate depends on the percentage difference in IRA and pension values as proxied by nominal GDP relative to CBO's baseline nominal GDP projection. The BFM also relies on the amount of IRA and pension income (derived from tax returns as the total of IRA withdrawals, distributions from defined contribution plans, and defined benefit pension income), and the estimated sensitivity of pension and IRA tax liabilities to changes in income from IRAs and pensions.

$$\Delta\text{Liabilities on pensions and IRAs}_t = \beta_t \times \frac{\widehat{y}_t - \overline{y}_t}{\overline{y}_t} \times \overline{y}_t^b \tag{6}$$

y_t = Nominal GDP (billions of dollars)

y_t^b = IRA and pension income (billions of dollars)

β_t = Estimated sensitivity of pension and IRA tax liabilities to percentage changes in pension and IRA values

Table 6: Parameter Values for Equation 6

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0.187	0.190	0.191	0.193	0.194	0.196	0.198	0.215	0.217	0.218	0.220

2.1.7 Business Income

Proprietors' income and S corporations' profits are taxed as business income under the individual income tax. In the BFM, proprietors' income refers to the NIPA measure of proprietors' income (found in NIPA Table 2.1).[7] The budgetary feedback on individual income tax liabilities on proprietors' income depends on the change in proprietors' income and on the effective marginal tax rate for that measure.

S corporations' profits are taxed as personal income to shareholders. The BFM derives an estimate of the change in profits from S corporations from a combination of the NIPA measures for proprietors' income, domestic corporate profits, and estimates from CBO's full modeling of the share of domestic corporate profits that represents S corporations' profits.[8]

[7] Adjusted for inventory valuation and capital consumption so that income is accurately measured. For more information, see "Chapter 11: Nonfarm Proprietors' Income," in *NIPA Handbook* (Bureau of Economic Analysis, December 2015), https://go.usa.gov/xypj6 (PDF, 3.6 MB).

[8] Domestic corporate profits are defined here as NIPA corporate profits with inventory valuation and capital consumption adjustments less corporate profits from the rest of the world (found in NIPA Table 6.16D).

The budgetary feedback on individual income tax liabilities from the change in S corporations' profits depends on the change in S corporations' profits and the effective marginal tax rate on those profits. In addition, with total profits held constant, an increase in S corporate income reduces corporate income tax liabilities.

$$\begin{aligned}\Delta\text{Liabilities from business income}_t =& \Delta\text{Liabilities from proprietors' income}_t \\ &+ \Delta\text{Liabilities from S corporations' profits}_t \end{aligned} \quad (7)$$

$$\Delta\text{Liabilities from proprietors' income}_t = \tau_t^p \times (\widehat{y}_t^p - \overline{y}_t^p)$$

$$\Delta\text{Liabilities from S corporations' profits}_t = \tau_t^{\text{S-corp}} \times \phi_t \times (\widehat{y}_t^{\text{biz}} - \overline{y}_t^{\text{biz}})$$

y_t^p = Proprietors' income (billions of dollars)

y_t^{biz} = Domestic corporate profits + Proprietors' income (billions of dollars)

ϕ_t = Share of domestic profits and proprietors' income attributed to S corporations' profits

τ_t^p = Effective marginal tax rate on proprietors' income

$\tau_t^{\text{S-corp}}$ = Effective marginal tax rate on S corporations' profits

Table 7: Parameter Values for Equation 7

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
ϕ_t	0.128	0.129	0.13	0.131	0.132	0.133	0.133	0.134	0.135	0.136	0.136
τ_t^p	0.086	0.088	0.089	0.091	0.092	0.094	0.094	0.117	0.118	0.118	0.118
$\tau_t^{\text{S-corp}}$	0.298	0.298	0.298	0.299	0.301	0.303	0.304	0.383	0.385	0.386	0.386

2.1.8 Private Group Health Insurance Benefits

Employee contributions for employment-based health insurance (EHI) plans are tax-exempt. Therefore, the BFM must adjust for changes in such contributions, holding wage and salary disbursements constant, with a negative marginal rate. Employee spending on EHI plans is not deducted from the NIPA measure of wages and salaries. As a result, the BFM must use the larger value of employer spending on EHI plans with a marginal rate lower than that on employee spending as a way of estimating changes in the employee share of such contributions. The budgetary feedback depends on the change in the NIPAs' measure of private group health insurance benefits (found in NIPA Table 7.8) and the effective marginal tax rate on that measure.

$$\Delta\text{Liabilities on private group health insurance benefits}_t = \tau_t \times (\widehat{y}_t - \overline{y}_t) \tag{8}$$

y_t = Private group health insurance benefits (billions of dollars)

τ_t = Effective marginal tax rate

Table 8: Parameter Values for Equation 8

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t	−0.060	−0.061	−0.061	−0.062	−0.062	−0.062	−0.063	−0.075	−0.075	−0.075	−0.075

2.1.9 Price Indexing

Several parameters of the individual income tax system are indexed to the price level, meaning that they automatically adjust with inflation. Many of those components, such as the tax brackets and the standard deduction, tend to reduce individual income taxes as they increase with inflation. Thus, when prices increase but national income is held constant, revenues decrease. The BFM captures that effect by applying a negative estimated sensitivity to a NIPA measure of the tax base (defined here as the sum of wages and salaries disbursed, proprietors' income with inventory valuation and capital consumption adjustments, rental income of persons with capital consumption adjustment, personal interest income, and personal dividend income, all found in NIPA Table 2.1) to total individual income tax liabilities. The budgetary feedback on the price indexing depends on the percentage difference in the price level (as measured by the chained consumer price index for all urban consumers, or C-CPI-U) relative to CBO's baseline price level projection, the size of the tax base in CBO's baseline projection, and the estimated sensitivity of individual income tax liabilities to changes in the price level.

$$\Delta\text{Liabilities from price indexing}_t = \beta_t \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} \times \overline{y}_t \tag{9}$$

p_t = Chained consumer price index for all urban consumers

y_t = Tax base = Wage and salary disbursements + Interest income + ...
Dividend income + Proprietors' income + Rental income
(billions of dollars)

β_t = Estimated sensitivity of individual income tax liabilities to changes in the price level

Table 9: Parameter Values for Equation 9

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	−0.050	−0.049	−0.049	−0.049	−0.049	−0.049	−0.049	−0.055	−0.055	−0.055	−0.056

2.1.10 Employment

In the BFM, an increase in employment, all else equal, lowers total individual income tax liabilities. That effect occurs because an increase in employment, holding national income constant, causes total income to be distributed across additional taxpayers. That reduction in income per taxpayer lowers the effective marginal tax rates and, in turn, tax liabilities. The budgetary feedback from a change in employment depends on the percentage difference in the level of employment relative to CBO's baseline employment projection, the size of the NIPA measure of the tax base in CBO's baseline projection, and the estimated sensitivity of individual income tax liabilities to changes in employment.

$$\Delta\text{Liabilities from employment}_t = \beta_t \times \frac{\widehat{n}_t - \overline{n}_t}{\overline{n}_t} \times \overline{y}_t \tag{10}$$

n_t = Civilian Employment: age 16 or over

y_t = Tax base = Wage and salary disbursements + Interest income + ... Dividend income + Proprietors' income + Rental income (billions of dollars)

β_t = Estimated sensitivity of individual income tax liabilities to percentage changes in employment

Table 10: Parameter Values for Equation 10

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	−0.024	−0.024	−0.024	−0.024	−0.024	−0.025	−0.025	−0.026	−0.027	−0.027	−0.027

2.2 Payroll Tax Liabilities

Payroll taxes fund specific programs such as Social Security's Old-Age, Survivors, and Disability Insurance (OASDI); Medicare Hospital Insurance (Part A); and unemployment insurance (UI). The Federal Insurance Contributions Act (FICA) tax component of the BFM uses several macroeconomic variables as inputs. Unlike the preceding individual income tax section, those variables are presented below as a single equation.

2.2.1 Old-Age, Survivors, and Disability Insurance and Medicare Part A

The budgetary feedback on FICA tax liabilities, which fund OASDI and Medicare Part A, depends on the changes in NIPA wage and salary disbursements, the NIPAs' measure of EHI benefits, civilian employment for workers age 16 or older, and the average wage as measured by the NIPAs' wage and salary disbursements per employed person. CBO uses an estimated marginal tax rate on NIPA wages and salaries that is different from the statutory payroll tax rate. The estimated marginal tax rate differs from the statutory payroll tax rate because of the proportion of wages that exceed the taxable maximum ($132,900 in 2019).

Because EHI benefits are excluded from taxable income, the effective marginal tax rate on EHI benefits is negative.

Under the provisions of the Social Security Act, a change in average wages and salaries affects FICA liabilities because the maximum amount of earnings subject to the Social Security tax increases with average wages. Therefore, higher average wage growth leads to an increase in payroll tax revenues. However, that change occurs with approximately a two-year lag.

Finally, FICA tax liabilities are affected by the percentage difference in employment relative to CBO's baseline employment projection. An increase in the number of people employed while the level of total wages and salaries is held constant implies a reduction in wages earned per worker. Consequently, a greater share of wages would fall below the maximum earnings subject to the Social Security taxable maximum, and revenues would increase. The BFM uses an estimate of FICA liabilities' sensitivity to changes in employment to compute its effect on revenues. The cumulative effect on FICA liabilities is calculated using the following equation:

$$\Delta\text{Liabilities from FICA}_t = \tau_t^y \times (\widehat{y}_t - \overline{y}_t) + \tau_t^b \times (\widehat{b}_t - \overline{b}_t) + \beta_t^w \times \left(\frac{\widehat{y}_{t-2}}{\widehat{n}_{t-2}} - \frac{\overline{y}_{t-2}}{\overline{n}_{t-2}}\right) + \beta_t^e \times \left(\frac{\widehat{n}_t - \overline{n}_t}{\overline{n}_t}\right) \tag{11}$$

y_t = Wage and salary disbursements (billions of dollars)

b_t = Private group health insurance benefits (billions of dollars)

n_t = Civilian employment: age 16 or over

τ_t^y = Effective marginal tax rate on wage and salary disbursements

τ_t^b = Effective marginal tax rate on employment-based health insurance benefits

β_t^w = Estimated sensitivity to level changes in average wages (lagged two years)

β_t^e = Estimated sensitivity of FICA tax liabilities to percentage changes in employment

Table 11: Parameter Values for Equation 11

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t^y	0.102	0.102	0.102	0.102	0.102	0.102	0.102	0.102	0.102	0.102	0.102
τ_t^b	−0.050	−0.050	−0.050	−0.049	−0.049	−0.049	−0.049	−0.048	−0.048	−0.048	−0.048
β_t^w	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
β_t^e	65.80	70.20	73.3	75.50	78.90	81.30	84.50	86.70	91.70	94.30	97.50

2.2.2 Old-Age, Survivors, and Disability Insurance and Medicare Part A for the Self-Employed

Liabilities from Self-Employment Contributions Act (SECA) taxes, which provide funding for OASDI and Medicare Part A, depend on the effective marginal tax rate on proprietors' income and the change in the NIPAs' measure of proprietors' income adjusted for inventory valuation and capital consumption. Proprietors' income captures the tax base for self-employment's contribution to social insurance taxes. The effective marginal tax rate is lower than the statutory rate because a large percentage of NIPA proprietors' income is not reported by its recipients to the Internal Revenue Service and because some proprietors' income is not subject to SECA, such as nonguaranteed payments to limited partners.

$$\Delta\text{Liabilities from SECA}_t = \tau_t \times (\widehat{y}_t - \overline{y}_t) \tag{12}$$

y_t = Proprietors' income (billions of dollars)

τ_t = Effective marginal tax rate

Table 12: Parameter Values for Equation 12

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t	0.038	0.038	0.038	0.038	0.039	0.038	0.038	0.038	0.039	0.038	0.039

2.2.3 Unemployment Insurance

Under the Federal Unemployment Tax Act (FUTA) and State Unemployment Tax Act (SUTA) employers' payroll taxes are deposited into accounts within the federal Unemployment Trust Fund as part of the joint federal–state UI program. The framework established by federal laws requires changes to UI benefits to eventually be recouped through the imposition of increased payroll taxes by states to replenish those accounts. Those payroll taxes depend in the BFM on the projected changes in UI outlays (see section 3) over the projection window and the estimated sensitivity to UI tax liabilities to changes in past and current changes in UI outlays. Those sensitivities were derived empirically from the historical relationship between increases in UI benefits during periods of increased unemployment and the later increases in payroll taxes. An increase in UI outlays in any period is estimated to affect UI tax liabilities for seven years starting one year after the change in benefits.

$$\Delta\text{Liabilities from FUTA}_t = \sum_{i=2019}^{t} \left[\beta_t^i(\widehat{y}_i - \overline{y}_i)\right] \tag{13}$$

y_t = Unemployment insurance outlays (billions of dollars)

β_t^i = The effect in period t from a \$1 billion dollar change in UI outlays in period i

Table 13: Parameter Values for Equation 13

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^i	2019	0	0.088	0.263	0.263	0.200	0.100	0.075	0.013	0	0	0
β_t^i	2020	0	0	0.088	0.263	0.263	0.200	0.100	0.075	0.013	0	0
β_t^i	2021	0	0	0	0.088	0.263	0.263	0.200	0.100	0.075	0.013	0
β_t^i	2022	0	0	0	0	0.088	0.263	0.263	0.200	0.100	0.075	0.013
β_t^i	2023	0	0	0	0	0	0.088	0.263	0.263	0.200	0.100	0.075
β_t^i	2024	0	0	0	0	0	0	0.088	0.263	0.263	0.200	0.100
β_t^i	2025	0	0	0	0	0	0	0	0.088	0.263	0.263	0.200
β_t^i	2026	0	0	0	0	0	0	0	0	0.088	0.263	0.263
β_t^i	2027	0	0	0	0	0	0	0	0	0	0.088	0.263
β_t^i	2028	0	0	0	0	0	0	0	0	0	0	0.088
β_t^i	2029	0	0	0	0	0	0	0	0	0	0	0

2.3 Corporate Income Tax Liabilities

The budgetary feedback on corporate income tax liabilities includes feedback from domestic corporate profits and profits from the rest of the world. In addition to those two income sources, GDP and interest rates affect corporate income tax liabilities' budgetary feedback. The sensitivity of corporate income tax liabilities to changes in domestic corporate profits, GDP, and interest rates is derived from CBO's model for corporate income taxes.[9]

2.3.1 Domestic Profits

The domestic corporate profits portion of the budgetary feedback from corporate income taxes uses NIPA corporate profits before taxes less corporate profits from the rest of the world (the difference of foreign profits of U.S. firms minus U.S. profits of foreign firms) and Federal Reserve profits (all found in NIPA Table 6.16D). That NIPA measure most closely approximates the domestic corporate income tax base, that is, profits that U.S. C Corporations earn within the United States. As noted previously in the section on individual income tax, the BFM uses an estimate of the share of profits that represent S corporation profits, which are counted above and removed from the base for the corporate income tax. In addition, the Federal Reserve's profits contribute to revenues directly through remittances (see

[9]Section 4 describes limitations pertaining to the incorporation of the 2017 tax act and the timing of corporate income tax receipts in the BFM.

section 2.4). The marginal tax rate used in the BFM measures the change in total corporate income tax liabilities resulting from a change in domestic profits, holding constant profits from the rest of the world. In other words, that component of the BFM considers only the effects of changes to the profits that U.S. corporations earn in the United States.

$$\Delta\text{Liabilities from domestic profits}_t = \tau_t^{\text{C-corp}} \times \Big((\widehat{y}_t - \widehat{FRB}_t) - (\overline{y}_t - \overline{FRB}_t)\Big) - \tau_t^{\text{S-if-C}} \times \phi_t \times \Big(\widehat{y}_t^{\text{biz}} - \overline{y}_t^{\text{biz}}\Big) \quad (14)$$

y_t = Domestic corporate profits (billions of dollars)

FRB_t = Federal Reserve Bank remittances (billions of dollars)

y_t^{biz} = Domestic corporate profits + Proprietors' income (billions of dollars)

ϕ_t = Share of domestic profits and proprietors' income attributed to S corporations' profits

$\tau_t^{\text{C-corp}}$ = Effective marginal tax rate for C corps from changes to domestic profits

$\tau_t^{\text{S-if-C}}$ = Effective marginal tax rate on S corp income if it were taxed instead as C corp

Table 14: Parameter Values for Equation 14

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
ϕ_t	0.128	0.129	0.13	0.131	0.132	0.133	0.133	0.134	0.135	0.136	0.136
$\tau_t^{\text{C-corp}}$	0.094	0.094	0.094	0.093	0.093	0.094	0.094	0.094	0.094	0.094	0.094
$\tau_t^{\text{S-if-C}}$	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125

2.3.2 The Effect of the Rest of the World's Profits on Taxable Foreign Earnings of U.S. Firms

The foreign earnings of U.S. multinational firms fall into one of several categories and may or may not be taxable depending on the characteristics of those earnings. For categories of taxable earnings, foreign tax credits may apply, offsetting some tax liability. Sometimes when the earnings increase occurs in countries with a tax rate higher than that of the United States, the available foreign tax credits may fully offset the U.S. tax liability. The BFM models the effect of a change in the NIPA measure of rest-of-world profits arising from a change in the foreign profits of U.S. multinational firms. The NIPA rest-of-world profits measure is the difference of foreign profits to U.S. firms minus U.S. profits to foreign firms (found in NIPA Table 6.16D).

$$\Delta\text{Liabilities from taxable foreign earnings of U.S. firms}_t = \tau_t \times (\widehat{y}_t - \overline{y}_t) \tag{15}$$

y_t = Corporate profits from the rest of the world (billions of dollars)

τ_t = Effective marginal tax rate

Table 15: Parameter Values for Equation 15

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
τ_t	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

2.3.3 GDP and Potential GDP

For a given level of corporate profits in the economy, how those profits accrue to firms with positive profits (and therefore generate taxable income) versus to firms that incur net losses depends on several factors, including movements in the business cycle. In the domestic profits rule described earlier, the BFM uses marginal tax rates derived from CBO's full corporate modeling, which allocates a marginal change in corporate profits in a given year across firms with taxable income and firms in a loss position. Those allocations (and therefore rates), however, are not expected to hold over time, in part because as total profits continue to rise, eventually no firms would remain in a loss position. In reality, secular economic growth leads to increases in both profits and losses. The BFM incorporates marginal rates on GDP and potential GDP (CBO's estimate of the economy's maximum sustainable output) derived from CBO's full corporate income tax modeling to serve as proxy measures for the factors that influence the allocation of profits between firms over time and therefore better target the results of CBO's full modeling.

$$\Delta\text{Liabilities from GDP}_t = \beta_t^y \times \left(\widehat{y}_t - \overline{y}_t\right) + \beta_t^p \times \left(\widehat{y}_t^p - \overline{y}_t^p\right) \tag{16}$$

y_t = Nominal GDP (billions of dollars)

y_t^p = Potential GDP (billions of dollars)

β_t^y = Estimated sensitivity of corporate income tax liabilities to changes in nominal GDP

β_t^p = Estimated sensitivity of corporate income tax liabilities to changes in potential GDP

Table 16: Parameter Values for Equation 16

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^y	0.018	0.018	0.018	0.02	0.02	0.02	0.019	0.018	0.019	0.019	0.019
β_t^p	−0.005	−0.005	−0.005	−0.008	−0.008	−0.008	−0.007	−0.006	−0.006	−0.006	−0.006

2.3.4 Interest Deduction

Similarly to the rule on GDP and potential GDP, interest rates can affect the allocation of corporate profits between firms with taxable income and firms without tax liabilities. For large corporations with taxable income, the deduction allowed for interest payments may be limited. In CBO's full corporate modeling, when total corporate profits are held constant and interest rates increase, more total corporate debt becomes subject to the deduction limitation. The resulting effect on receipts is determined in the BFM by the percentage difference in Moody's Baa corporate bond yield relative to CBO's baseline projection and the estimated sensitivity of corporate income tax liabilities to changes in the Baa rate.

$$\Delta\text{Liabilities from interest deductions}_t = \beta_t \times \frac{\widehat{r}_t - \overline{r}_t}{\overline{r}_t} \times \overline{y}_t \tag{17}$$

y_t = Corporate profits (billions of dollars)

r_t = Corporate Baa interest rate

β_t = Estimated sensitivity of corporate income tax liabilities to percentage changes in the Baa interest rate

Table 17: Parameter Values for Equation 17

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0.005	0.005	0.005	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.005

2.4 Federal Reserve Remittances

As part of its conduct of monetary policy, the Federal Reserve buys and sells Treasury and other securities. It also pays interest on deposits that banks hold at the central bank. The interest that the Federal Reserve earns on its portfolio of securities and the interest that it pays on reserves affect its remittances to the Treasury, which are counted as federal revenues.[10] Federal Reserve remittances are determined in the BFM by a series of existing and prospective portfolio holdings and the federal funds rate (the interest rate that financial institutions charge each other for overnight loans of their monetary reserves). The Federal Reserve's portfolio holdings and their sensitivity to changes in interest rates are captured by the series of β_t^i values below. The portfolio's maturity structure and asset types affect the sensitivity of remittances to changes in interest rates over time. In the BFM, the effects of interest rates on remittances are captured through changes in the federal funds rate relative to CBO's baseline projection. Changes in the federal funds rate today affect remittances not only in the current year but also in future years.

$$\Delta\text{Federal Reserve Remittances}_t = \sum_{i=2019}^{t} \left[\beta_t^i \times (\widehat{r}_i - \overline{r}_i)\right] - \overline{y}_t \times (\widehat{r}_t - \overline{r}_t) \tag{18}$$

r_t = Federal funds rate (1 percent = 0.01)

y_t = Federal Reserve liabilities (billions of dollars)

β_t^i = The effect in year t from a 1 percentage-point change in the Federal Funds Rate in period i

[10] Federal Reserve remittances to the Treasury include all income generated by the Federal Reserve System, less the costs of generating that income, dividend payments to Federal Reserve System member banks, and changes in the amount of the surplus that the Federal Reserve holds on its books.

Table 18: Parameter Values for Equation 18

		Fiscal Year (t)										
Parameter*	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^i	2019	0.042	0.084	0.075	0.061	0.056	0.042	0.028	0.018	0.009	0.009	0.005
β_t^i	2020	0	0	0.307	0.390	0.301	0.211	0.179	0.141	0.103	0.087	0.071
β_t^i	2021	0	0	0.920	1.949	1.892	1.397	1.073	0.877	0.664	0.519	0.431
β_t^i	2022	0	0	0	2.339	3.912	3.486	2.528	2.011	1.620	1.211	0.971
β_t^i	2023	0	0	0	0	2.819	4.552	3.991	2.886	2.310	1.858	1.384
β_t^i	2024	0	0	0	0	0	2.905	4.698	4.124	2.983	2.387	1.919
β_t^i	2025	0	0	0	0	0	0	3.021	4.903	4.310	3.120	2.494
β_t^i	2026	0	0	0	0	0	0	0	3.194	5.211	4.593	3.324
β_t^i	2027	0	0	0	0	0	0	0	0	3.457	5.607	4.927
β_t^i	2028	0	0	0	0	0	0	0	0	0	3.641	5.923
β_t^i	2029	0	0	0	0	0	0	0	0	0	0	3.888

* All units are in billions of dollars.

2.5 Customs Liabilities

Most customs duties come from tariffs on the value of nonpetroleum imports. The budgetary feedback on customs liabilities depends on the change in imports net of petroleum (measured as the customs value of imported goods reported by the U.S. Census less imports of petroleum and products as reported in NIPA Table 4.2.5) and the estimated sensitivity of customs liabilities to changes in imports.

$$\Delta\text{Customs Liabilities}_t = \beta_t \times (\widehat{y}_t - \overline{y}_t) \tag{19}$$

$y_t =$ Imports net of petroleum (billions of dollars)

$\beta_t =$ Estimated sensitivity of customs liabilities to changes in imports net of petroleum

Table 19: Parameter Values for Equation 19

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016

2.6 Estate and Gift Tax Liabilities

The value of property transferred at death and of certain gifts made during a person's lifetime, beyond a certain cumulative dollar amount, is subject to federal estate and gift taxes. Because that value is not a component of national income, the BFM uses changes in GDP as a proxy for changes in wealth that affect the magnitude of liabilities for estate and gift taxes. The budgetary feedback on those liabilities depends on the change in nominal GDP and their estimated sensitivity to such changes.

$$\Delta \text{Estate and gift tax liabilities}_t = \beta_t \times (\widehat{y}_t - \overline{y}_t) \tag{20}$$

$$y_t = \text{Nominal GDP (billions of dollars)}$$

$$\beta_t = \text{Estimated sensitivity of estate and gift tax liabilities to changes in nominal GDP}$$

Table 20: Parameter Values for Equation 20

	Calendar Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

2.7 Excise Tax Liabilities

Most federal excise taxes are collected from sales of motor fuel, airline tickets, tobacco, alcohol, and health-related goods and services. The base for those taxes depends on the overall size of the economy, and certain taxes depend also on the price level. The budgetary feedback on excise tax liabilities depends on the percentage difference in real GDP relative to CBO's baseline real GDP projection; the percentage difference in the price level, as measured by the CPI-U relative to CBO's baseline price level projection; and the estimated sensitivity of excise tax liabilities to changes in real output and the price level.

$$\Delta\text{Excise tax liabilities}_t = \beta_t^p \times \frac{\widehat{p}_t - \overline{p}_t}{\overline{p}_t} + \beta_t^q \times \frac{\widehat{q}_t - \overline{q}_t}{\overline{q}_t} \tag{21}$$

q_t = Real GDP (billions of dollars) = $\frac{y_t}{p_t}$

p_t = Consumer price index for all urban consumers

y_t = Nominal GDP (billions of dollars)

β_t^p = Estimated sensitivity of excise tax liabilities to changes in price level

β_t^q = Estimated sensitivity of excise tax liabilities to percentage changes in real GDP

Table 21: Parameter Values for Equation 21

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^p	17.83	17.83	18.18	18.53	18.82	19.11	19.34	19.66	19.92	20.17	20.43
β_t^q	39.62	39.62	40.39	41.18	41.83	42.46	42.97	43.70	44.26	44.82	45.40

* All units are in billions of dollars.

3 Spending

Federal spending is sorted into three major categories: mandatory, discretionary, and net interest. Those broad categories respond differently to changes in macroeconomic variables. Mandatory spending is generally more sensitive to changes in prices and wages, discretionary spending is calculated according to statutory requirements, and net interest is most sensitive to interest rates. The BFM incorporates the estimated macroeconomic effects on each category separately. A final step, excluded from the formulas below for simplicity, is to convert calendar year outlays into fiscal year outlays by applying a simple fiscal year conversion formula where applicable.

3.1 Mandatory Spending

Mandatory spending consists of federal noninterest spending that is not generally governed by the annual appropriation process. Outlays for mandatory programs usually depend on the number of program participants and the level of spending per participant, which is often tied directly to changes in the macroeconomy. The budgetary feedback estimates for mandatory spending reflect changes in eight components of the budget: Social Security, other indexed entitlements, Medicare, Medicaid, UI, the Supplemental Nutrition Assistance Program (SNAP), refundable tax credits, and child nutrition programs. Although changes in the macroeconomy could affect other programs, the BFM does not include those effects because CBO estimates they are approximately zero on average.

3.1.1 Social Security

Social Security comprises two social insurance programs: Old-Age and Survivors Insurance and Disability Insurance. Both programs provide benefits that are directly tied to wages and prices and thus are sensitive to changes in those variables.

An individual's initial benefit is a function of the beneficiary's earnings history, adjusted for growth in the national average wage index (AWI). In general, the more someone has earned, the higher the initial benefit. Consequently, increases (or decreases) in wages relative to CBO's baseline economic forecast will lead to Social Security outlays that are higher (or lower) than in CBO's baseline budget projections. The effect of a wage change today grows over the budget window because a change in average wages today will affect the stream of payments to all new beneficiaries; in general, wage changes do not affect payments to current beneficiaries. In addition, Social Security benefits are adjusted annually by the percentage change in the CPI for urban wage earners and clerical workers (CPI-W). Those adjustments are referred to as cost-of-living adjustments (COLAs). Increases in the CPI-W increase COLAs for all continuing beneficiaries.

The budgetary feedback on Social Security outlays calculated by the BFM depends on the percentage difference in the employment cost index (ECI) of per-worker wage and salary disbursements for private-industry workers (which serves as a proxy for AWI growth) relative to CBO's baseline ECI projection, the percentage difference in the price level (as measured by the CPI-W from the third quarter of the previous year) relative to CBO's baseline projection, and the estimated sensitivity of Social Security outlays to changes in the CPI-W and the ECI. Social Security benefits are updated by the AWI with a two-year lag, and COLA adjustments affect outlays with a one-year lag.

$$\Delta \text{Social Security outlays}_t = \beta_t^p \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} + \beta_t^w \times \frac{\widehat{y}_{t-2} - \overline{y}_{t-2}}{\overline{y}_{t-2}} \qquad (22)$$

p_t = Consumer price index for urban wage earners and clerical workers (Q3)

y_t = ECI

β_t^p = Estimated sensitivity of Social Security outlays to changes in price level

β_t^w = Estimated sensitivity of Social Security outlays to percentage changes in ECI

Table 22: Parameter Values for Equation 22

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^p	0	2,917.69	1,071.11	1,155.51	1,190.85	1,227.10	1,268.31	1,300.63	1,334.40	1,373.48	1,410.57
β_t^w	0	0	28.94	32.69	52.91	76.07	104.82	144.32	189.86	240.84	296.53

* All units are in billions of dollars.

3.1.2 Other Indexed Entitlements

Many federal programs operate similarly to Social Security, in which participants earn the right to benefits over time and then receive adjustments to their initial benefit amount on the basis of inflation. Those programs include compensation and pensions for veterans and retired military personnel, pensions for federal employees, Supplemental Security Income, and pensions for railroad workers. Although those programs have different eligibility requirements and formulas for determining initial benefits, each program adjusts the amounts paid to beneficiaries according to the annual change in the CPI-W.

Individually, those programs are relatively small. Taken together, however, they become sizable. Therefore, when estimating how marginal differences in the price level affect the federal budget, CBO groups those programs into a single line item in the BFM.

The budgetary feedback on outlays for other indexed entitlement programs depends on the percentage difference in the price level (as measured by the CPI-W from the third quarter of the previous year) relative to CBO's baseline projection and the estimated sensitivity of those programs to changes in the price level. The COLA adjustments affect outlays with a one-year lag, reflecting how indexation policies work in law.

$$\Delta\text{Other indexed entitlement outlays}_t = \beta_t \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} \tag{23}$$

p_t = Consumer price index for urban wage earners and clerical workers (Q3)

β_t = Estimated sensitivity of indexed entitlement outlays to price level

Table 23: Parameter Values for Equation 23

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0	818.54	297.56	350.36	325.84	305.50	318.65	324.86	330.62	352.83	314.76

* All units are in billions of dollars.

3.1.3 Medicare

Medicare subsidizes medical insurance for people age 65 years or older as well as for certain disabled people younger than 65. A portion of Medicare payments for covered services are adjusted in accordance with price growth of specialized "market baskets."[11] The BFM proxies for the Medicare market baskets with a weighted average of the CPI-U and the ECI of per-worker wage and salary disbursements for private-industry workers. In addition, current law requires that the 10-year moving average of the growth in productivity in the nonfarm business sector (which measures the efficiency of capital and labor) be subtracted from the price increase of the market baskets.[12] Therefore, benefits paid by Medicare will decrease as the economy becomes more productive. Accordingly, budgetary feedback for Medicare outlays depends on the percentage change in the price of the Medicare market baskets' proxy and the change in the annualized growth rate of total factor productivity in the nonfarm business sector.

$$\Delta\text{Medicare outlays}_t = \beta_t \times \frac{\widehat{p}_t - \overline{p}_t}{\overline{p}_t} \tag{24}$$

p_t = Proxy for Medicare market basket (productivity adjusted)

$$= (1 + \pi_t) \times p_{t-1} \qquad \text{where} \quad p_{2018} = 1$$

$$\pi_t = \gamma \times \frac{y_t - y_{t-1}}{y_{t-1}} + (1-\gamma) \times \frac{p_t^{\text{CPI-U}} - p_{t-1}^{\text{CPI-U}}}{p_{t-1}^{\text{CPI-U}}} - \left[\left(\frac{z_t}{z_{t-10}} \right)^{1/10} - 1 \right]$$

y_t = ECI

$p_t^{\text{CPI-U}}$ = Consumer price index for all urban consumers

z_t = Nonfarm-business-multifactor productivity

γ = Weight placed on wages and salaries in the proxy for the Medicare market basket

β_t = Estimated sensitivity of Medicare outlays to price level

Table 24: Parameter Values for Equation 24

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0	13.83	16.19	16.82	16.29	16.04	17.01	17.28	17.66	19.04	18.26

* All units are in billions of dollars.

[11] An individual basket contains the different inputs for producing the specific medical goods or services, such as labor, medical supplies, and electricity.

[12] See section 3401 of the Affordable Care Act (amending 42 U.S.C. §1395ww(b)).

3.1.4 Medicaid

Medicaid funds medical care for certain low-income, elderly, and disabled people. The federal and state governments jointly finance the program, and the federal government reimburses states for a fraction of their Medicaid expenditures.

Medicaid outlays depend on the number of beneficiaries states enroll in their programs and the amount of federal spending per person. Because Medicaid eligibility is partially based on an individual's income, a relationship exists between the employment-to-population ratio and Medicaid enrollment. The BFM proxies for Medicaid enrollment by using Medicaid outlays' sensitivity to the employment-to-population ratio of people ages 16 to 64 in the economy. CBO's projections of the amount of federal spending per enrollee depend on changes in the CPI for medical care, the CPI-U, the ECI, and a proxy for Medicare's market baskets. The BFM uses Medicaid outlays' sensitivities to changes in those price indexes to calculate the budgetary feedback to Medicaid.

$$\begin{aligned}\Delta \text{Medicaid outlays}_t = &\beta_t^{epop} \times \left(\widehat{epop}_t - \overline{epop}_t\right) + \beta_t^{\text{basket}} \times \frac{\widehat{p}_t^{\text{basket}} - \overline{p}_t^{\text{basket}}}{\overline{p}_t^{\text{basket}}} \\ &+ \beta_t^{\text{CPI-U}} \times \frac{\widehat{p}_t^{\text{CPI-U}} - \overline{p}_t^{\text{CPI-U}}}{\overline{p}_t^{\text{CPI-U}}} + \beta_t^{\text{med}} \times \frac{\widehat{p}_t^{\text{med}} - \overline{p}_t^{\text{med}}}{\overline{p}_t^{\text{med}}} \\ &+ \beta_t^{\text{ECI}} \times \frac{\widehat{y}_t - \overline{y}_t}{\overline{y}_t} \end{aligned} \tag{25}$$

$epop_t$ = Employment-to-population ratio

p_t^{basket} = Proxy for Medicare market basket

$= (1 + \pi_t) \times p_{t-1}^{\text{basket}} \quad \text{where} \quad p_{2018}^{\text{basket}} = 1$

$$\pi_t = \gamma \times \frac{y_t - y_{t-1}}{y_{t-1}} + (1 - \gamma) \times \frac{p_t^{\text{CPI-U}} - p_{t-1}^{\text{CPI-U}}}{p_{t-1}^{\text{CPI-U}}}$$

y_t = ECI

$p_t^{\text{CPI-U}}$ = Consumer price index for all urban consumers

p_t^{med} = Consumer price index for medical care

γ = Weight placed on wages and salaries in the proxy for the Medicare market basket

β_t^{epop} = Estimated sensitivity of Medicaid outlays to changes in the e-pop ratio

β_t^{basket} = Estimated sensitivity of Medicaid outlays to changes in the Medicare market basket

$\beta_t^{\text{CPI-U}}$ = Estimated sensitivity of Medicaid outlays to changes in CPI-U

β_t^{med} = Estimated sensitivity of Medicaid outlays to changes in CPI for medical care

β_t^{ECI} = Estimated sensitivity of Medicaid outlays to changes in ECI

Table 25: Parameter Values for Equation 25

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^{epop}	−2.23	−2.40	−2.54	−2.68	−2.83	−2.99	−3.16	−3.33	−3.52	−3.71	−3.93
β_t^{basket}	77.56	83.60	88.97	94.63	100.51	106.61	113.05	119.84	127.03	134.60	142.52
$\beta_t^{\text{CPI-U}}$	54.35	61.90	67.50	71.82	75.87	79.72	83.57	87.54	91.16	95.15	98.62
β_t^{med}	87.13	90.27	95.06	101.15	107.53	114.22	121.37	129.61	138.69	148.30	159.14
β_t^{ECI}	107.04	111.15	115.61	120.45	125.49	130.84	136.61	142.59	148.81	155.37	162.32

* All units are in billions of dollars.

3.1.5 Unemployment Insurance

The UI program is a federal–state program that provides temporary benefits to people who have become involuntarily unemployed and who meet other eligibility criteria. The budgetary feedback on total UI benefits depends on the change in the number of unemployment spells that occur in a given year and the change in the average amount of benefits paid per week of unemployment. Because benefits are based on a person's earnings in previous years, a lag occurs between when the ECI increases (or decreases) and its effect on outlays.

$$\Delta\text{Unemployment insurance outlays}_t = \widehat{Q}_t \times \overline{D}_t \times \widehat{B}_t - \overline{Q}_t \times \overline{D}_t \times \overline{B}_t \tag{26}$$

Q_t = Number of unemployment spells = $\beta_t \times u_t \times LF_t$

u_t = Unemployment rate

LF_t = Civilian labor force age 16 or over (billions)

D_t = Average duration of an unemployment spell (weeks)

B_t = Average weekly unemployment insurance benefit = $B_{2019} \times \dfrac{p_{t-1}}{p_{2018}} \qquad \forall t > 0$

p_t = ECI

β_t = Estimated sensitivity of unemployment spells to the number of unemployed

Table 26: Parameter Values for Equation 26

	Fiscal Year										
Parameter	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0.342	0.343	0.402	0.405	0.375	0.375	0.375	0.375	0.378	0.380	0.380

3.1.6 Supplemental Nutrition Assistance Program

SNAP provides benefits to help low-income households purchase food. The SNAP benefit is indexed to the Department of Agriculture's Thrifty Food Plan, which CBO proxies for by using the measure of CPI for food at home. Thus, budgetary feedback on SNAP outlays depends on the percentage difference in that price level (as measured in the second quarter of the previous year) relative to CBO's baseline projection. The price level affects outlays with a one-year lag.

$$\Delta\text{SNAP outlays}_t = \beta_t \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} \tag{27}$$

p_t = Consumer price index for food at home (Q2)

β_t = Estimated sensitivity of SNAP outlays to changes in price level

Table 27: Parameter Values for Equation 27

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0	332.92	130.83	82.19	59.85	88.64	74.44	90.60	55.67	69.73	82.88

* All units are in billions of dollars.

3.1.7 Refundable Tax Credits

The Earned Income Tax Credit (EITC), the Child Tax Credit (CTC), and the American Opportunity Tax Credit (AOTC) provide refundable income tax credits of federal income taxes to eligible participants. If the amount of the credit that the participant is eligible for exceeds the income tax owed, the excess is paid as a refund and treated as an outlay for budgetary purposes.

The budgetary feedback for the outlays of all three credits depends on wages, inflation, and unemployment. Because, in general, the size of the credit shrinks as a person earns more, higher wages (as measured by wage and salary disbursements in NIPA Table 2.1), directly lower CBO's projections of outlays. In addition, the amount of that refund depends on how much a person owes in taxes. Because parts of the tax code are indexed to inflation and because that indexing generally decreases a beneficiary's tax liability, higher inflation (as measured by the C-CPI-U) increases the amounts refunded. Finally, for a given level of wages and salaries in the economy, higher employment would reduce the average wage per person, meaning that the amounts of the credit would increase on average and that tax liabilities would be lower on average, which translates to higher outlays.

$$\Delta\text{Earned Income Tax Credit outlays}_t = \beta_t^p \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} + \beta_t^w \times \frac{\widehat{y}_t - \overline{y}_t}{\overline{y}_t} + \beta_t^e \times \frac{\widehat{E}_t - \overline{E}_t}{\overline{E}_t} \tag{28}$$

p_t = Chained consumer price index for all urban consumers (fiscal year)

y_t = Wage and salary disbursements

E_t = Civilian employment: age 16 or over

β_t^p = Estimated sensitivity of EITC outlays to changes in price level

β_t^w =Estimated sensitivity of EITC outlays to percentage changes in wage and salary disbursements

β_t^e =Estimated sensitivity of EITC outlays to percentage changes in level of employment

Table 28: Parameter Values for Equation 28

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^p	126.18	129.26	131.92	133.44	137.52	140.32	143.48	144.70	145.90	148.86	151.14
β_t^w	−63.60	−65.30	−67.20	−69.20	−71.00	−72.50	−73.80	−75.90	−77.30	−79.70	−81.60
β_t^e	52.60	55.10	57.40	59.50	61.70	63.80	65.30	66.40	68.40	70.80	72.80

* All units are in billions of dollars.

$$\Delta\text{Child Tax Credit outlays}_t = \beta_t^p \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} + \beta_t^w \times \frac{\widehat{y}_t - \overline{y}_t}{\overline{y}_t} + \beta_t^e \times \frac{\widehat{E}_t - \overline{E}_t}{\overline{E}_t} \quad (29)$$

p_t = Chained consumer price index for all urban consumers (fiscal year)

y_t = Wage and salary disbursements

E_t = Civilian employment: age 16 or over

β_t^p = Estimated sensitivity of CTC outlays to changes in price level

β_t^w =Estimated sensitivity of CTC outlays to percentage changes in wage and salary disbursements

β_t^e =Estimated sensitivity of CTC outlays to percentage changes in level of employment

Table 29: Parameter Values for Equation 29

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^p	41.84	42.30	43.00	39.88	41.88	42.90	40.34	23.60	22.74	22.70	22.76
β_t^w	−26.03	−28.00	−29.00	−31.80	−33.10	−34.40	−37.00	−28.80	−28.60	−28.50	−28.50
β_t^e	21.80	23.10	24.60	25.90	27.60	28.80	30.60	25.10	25.20	25.10	25.80

* All units are in billions of dollars.

$$\begin{aligned}\Delta\text{American Opportunity Tax Credit outlays}_t =& \beta_t^p \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} \\ &+ \beta_t^w \times \frac{\widehat{y}_t - \overline{y}_t}{\overline{y}_t} \\ &+ \beta_t^e \times \frac{\widehat{E}_t - \overline{E}_t}{\overline{E}_t}\end{aligned} \quad (30)$$

p_t = Chained consumer price index for all urban consumers (fiscal year)

y_t = Wage and salary disbursements

E_t = Civilian employment: age 16 or over

β_t^p = Estimated sensitivity of AOTC outlays to changes in price level

β_t^w =Estimated sensitivity of AOTC outlays to percentage changes in wage and salary disbursements

β_t^e =Estimated sensitivity of AOTC outlays to percentage changes in level of employment

Table 30: Parameter Values for Equation 30

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^p	1.64	1.64	1.60	1.58	1.72	1.80	1.80	2.34	2.20	2.26	2.30
β_t^w	−3.60	−3.40	−3.60	−3.50	−3.70	−3.70	−3.80	−4.00	−4.10	−3.90	−4.10
β_t^e	2.70	2.80	2.70	2.70	2.90	3.00	2.90	3.00	2.90	2.90	2.90

* All units are in billions of dollars.

3.1.8 Child Nutrition Programs

The accounts that CBO collectively identifies in its baseline as child nutrition programs comprise five programs: the National School Lunch Program, the School Breakfast Program, the Child and Adult Care Food Program, the Summer Food Service Program, and the Special Milk Program. Those programs reimburse schools and centers serving meals or snacks to participants. The amount reimbursed as well as the eligibility for participation varies by program. For the two largest programs, the National School Lunch Program and the School Breakfast Program, students qualify for free or reduced-priced meals on the basis of household income or participation in other income support programs (primarily SNAP). Reimbursement rates are determined by the price of food. Therefore, higher inflation in food prices would mean that those programs spend more and vice versa.

The budgetary feedback of outlays for child nutrition depends on the price level (as measured by the CPI for food at home in the second quarter of the previous year) and the estimated sensitivity of those outlays to changes in the price level. Changes in the price level affect outlays with a one-year lag.

$$\Delta\text{Child nutrition programs' outlays}_t = \beta_t \times \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}} \tag{31}$$

p_t = Consumer price index for food at home (Q2)

β_t = Estimated sensitivity of child nutrition outlays to changes in price level

Table 31: Parameter Values for Equation 31

	Fiscal Year										
Parameter*	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	0	37.66	24.40	28.03	28.29	29.71	30.98	32.20	33.44	34.86	36.39

* All units are in billions of dollars.

3.2 Discretionary Spending

CBO's baseline projections of discretionary spending grow with the measures of inflation specified in the Balanced Budget and Emergency Deficit Control Act of 1985. That act requires discretionary budget authority for the current year to be inflated to incorporate the effects of rising wages and inflation.[13] Projected discretionary outlays, however, depend on an estimate of the fraction of the budget authority spent in the years after that authority has been provided. Therefore, the BFM model uses a weighted average of the ECI and the GDP deflator to estimate budgetary feedback and adjusts those changes with an overall average of the fraction of discretionary budget authority spent each year.[14]

Such estimates of changes in discretionary spending over the budget window do not necessarily reflect how discretionary spending would change. The Congress appropriates money on the basis of its view of the federal government's needs, which is not explicitly tied to the economy. Although economic factors can inform decisions to add, eliminate, shrink, or expand departments and programs, the result of the appropriation process does not necessarily reflect the effects of wage or price inflation (or, indeed, any other specific economic factor). Thus, although higher inflation in CBO's baseline economic forecast translates to higher baseline projections of discretionary spending, the true amount of spending depends solely on Congressional decisions.

In addition, the estimated effects of inflation on projections of discretionary spending are an artifact of how CBO is required to make such projections. Lawmakers could amend the Deficit Control Act of 1985 to require CBO to make no inflationary adjustments to discretionary spending. CBO's projections of discretionary spending would then be nonresponsive to changes in its economic forecast.

[13]Budget authority is the authority provided by law to incur financial obligations that will result in immediate or future outlays of federal funds. Discretionary budget authority is provided and controlled by annual appropriation acts.

[14]The Budget Control Act of 2011 caps most discretionary spending in 2021. In cases where those caps would apply, CBO adjusts the estimates produced by the BFM to ensure that projections of discretionary spending comply with the Budget Control Act. For more on how CBO projects discretionary spending, see Box 3-1 of Congressional Budget Office, *The Budget and Economic Outlook: 2019–2029* (January 2019), www.cbo.gov/publication/54918.

$$\Delta\text{Discretionary outlays}_t = \sum_{i=2019}^{t} \left(S_t^i \times \beta_i \times \frac{\widehat{p}_i - \overline{p}_i}{\overline{p}_i} \right) \tag{32}$$

$$p_t = (1+\pi_t) \times p_{t-1} \qquad \text{where} \quad p_{2018} = 1$$

$$\pi_t = \omega \times \frac{p_t^y}{p_{t-1}^y} + (1-\omega) \times \frac{p_t^w}{p_{t-1}^w} \qquad \text{where} \quad \omega = \text{parameter}$$

p_t^y = GDP deflator

p_t^w = Employment cost index

β_t = Estimated sensitivity of budget authority to changes in price level in period t

S_t^i = Estimated effect of a change in budget authority in period i on outlays in period t

Table 32: Parameter Values for Equation 32

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^*	n.a.	0	112.99	108.36	512.48	709.96	823.00	913.59	987.73	1,054.08	1,096.36	1,148.79
S_t^i	2019	0.540	0.270	0.096	0.039	0.028	0	0	0	0	0	0
S_t^i	2020	0	0.540	0.270	0.096	0.039	0.028	0	0	0	0	0
S_t^i	2021	0	0	0.540	0.270	0.096	0.039	0.028	0	0	0	0
S_t^i	2022	0	0	0	0.540	0.270	0.096	0.039	0.028	0	0	0
S_t^i	2023	0	0	0	0	0.540	0.270	0.096	0.039	0.028	0	0
S_t^i	2024	0	0	0	0	0	0.540	0.270	0.096	0.039	0.028	0
S_t^i	2025	0	0	0	0	0	0	0.540	0.270	0.096	0.039	0.028
S_t^i	2026	0	0	0	0	0	0	0	0.540	0.270	0.096	0.039
S_t^i	2027	0	0	0	0	0	0	0	0	0.540	0.270	0.096
S_t^i	2028	0	0	0	0	0	0	0	0	0	0.540	0.270
S_t^i	2029	0	0	0	0	0	0	0	0	0	0	0.540

* Units are in billions of dollars.

n.a. = not applicable.

3.3 Net Interest

Because the federal government typically spends more than it receives, it borrows money by selling various Treasury securities to cover the shortfall. The government pays interest on the stock of debt, which generally reflects the cumulative deficits of all previous years. The interest rate that the government pays on newly issued debt depends on related, prevailing interest rates.

The BFM accounts for changes to net interest payments resulting from macroeconomic feedback in two ways. First, the BFM estimates how changes in interest rates affect interest payments made on new federal debt and existing debt that is refinanced at prevailing market interest rates. The second is known as debt service and refers to the change in net interest outlays that results from changes in annual deficits and associated borrowing.

Changing interest rates affect net interest payments directly, but only for newly issued debt because changes in the rates that CBO expects the government will have to pay do not affect the rates of the debt it owes now. However, as existing securities mature, and if ongoing deficits are financed by additional borrowing, the government must issue debt at prevailing interest rates. Thus, over time, an increasing share of projected federal debt will be subject to the changes in interest rates. Relatedly, the budgetary feedback of interest payments on existing debt as a result of changing interest rates depends on the maturity structure of the deficit and level of debt within each of the following categories:

1. Treasury bills (securities with less than 1 year to maturity)
2. Treasury notes (2 to 10 years to maturity)
3. Treasury bonds (greater than 10 years to maturity)
4. Floating-rate notes
5. State and local government series
6. Savings bonds
7. Indexed Treasury securities

The relevant interest rates for debt categories 1–3 are defined by the change in the weighted average of each category's component parts. Debt category 4 uses the change in the 2-year Treasury note rate, and debt categories 5–7 use the change in the 5-year Treasury note rate. The total budgetary feedback of interest payments on existing debt sums the effects across debt categories. Each of the first six debt categories depends on CBO's projected stock of debt in the baseline, the percentage-point change in the relevant interest rate, and the estimated sensitivity of payments in period t resulting from a change in interest rates in period i.

$$\Delta\text{Interest payments on existing debt}_t = \sum_{j=1}^{6}\left[\sum_{i=2019}^{t}\left(\tilde{\beta}_t^{i,j}[\widehat{r}_i^j - \overline{r}_i^j] \times \overline{D}_i^j\right)\right] \tag{33}$$

r_i^j = Interest rate for debt category j in period i (1 percent = 0.01)

D_i^j = Level of debt of type j in period i (billions of dollars)

$\beta_t^{i,j}$ = Estimated change in net interest outlays in period t per 1 percentage-point change in interest rate for each billion dollars of outstanding debt in period i for debt category j

$$\tilde{\beta}_t^{i,j} = \frac{\beta_t^{i,j}}{D_t^j}$$

Table 33: Parameter Values for Equation 33 (Treasury Bills)

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
$\tilde{\beta}_t^{i,1}$	2019	0.617	0.542	0.004	0	0	0	0	0	0	0	0
$\tilde{\beta}_t^{i,1}$	2020	0	0.617	0.542	0.004	0	0	0	0	0	0	0
$\tilde{\beta}_t^{i,1}$	2021	0	0	0.617	0.542	0.004	0	0	0	0	0	0
$\tilde{\beta}_t^{i,1}$	2022	0	0	0	0.617	0.542	0.004	0	0	0	0	0
$\tilde{\beta}_t^{i,1}$	2023	0	0	0	0	0.617	0.542	0.004	0	0	0	0
$\tilde{\beta}_t^{i,1}$	2024	0	0	0	0	0	0.617	0.542	0.004	0	0	0
$\tilde{\beta}_t^{i,1}$	2025	0	0	0	0	0	0	0.617	0.542	0.004	0	0
$\tilde{\beta}_t^{i,1}$	2026	0	0	0	0	0	0	0	0.617	0.542	0.004	0
$\tilde{\beta}_t^{i,1}$	2027	0	0	0	0	0	0	0	0	0.617	0.542	0.004
$\tilde{\beta}_t^{i,1}$	2028	0	0	0	0	0	0	0	0	0	0.617	0.542
$\tilde{\beta}_t^{i,1}$	2029	0	0	0	0	0	0	0	0	0	0	0.617

Table 34: Parameter Values for Equation 33 (Treasury Notes)

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
$\tilde{\beta}_t^{i,2}$	2019	0.052	0.197	0.196	0.156	0.125	0.111	0.073	0.059	0.028	0.026	0.020
$\tilde{\beta}_t^{i,2}$	2020	0	0.052	0.197	0.196	0.156	0.125	0.111	0.073	0.059	0.028	0.026
$\tilde{\beta}_t^{i,2}$	2021	0	0	0.052	0.197	0.196	0.156	0.125	0.111	0.073	0.059	0.028
$\tilde{\beta}_t^{i,2}$	2022	0	0	0	0.052	0.197	0.196	0.156	0.125	0.111	0.073	0.059
$\tilde{\beta}_t^{i,2}$	2023	0	0	0	0	0.052	0.197	0.196	0.156	0.125	0.111	0.073
$\tilde{\beta}_t^{i,2}$	2024	0	0	0	0	0	0.052	0.197	0.196	0.156	0.125	0.111
$\tilde{\beta}_t^{i,2}$	2025	0	0	0	0	0	0	0.052	0.197	0.196	0.156	0.125
$\tilde{\beta}_t^{i,2}$	2026	0	0	0	0	0	0	0	0.052	0.197	0.196	0.156
$\tilde{\beta}_t^{i,2}$	2027	0	0	0	0	0	0	0	0	0.052	0.197	0.196
$\tilde{\beta}_t^{i,2}$	2028	0	0	0	0	0	0	0	0	0	0.052	0.197
$\tilde{\beta}_t^{i,2}$	2029	0	0	0	0	0	0	0	0	0	0	0.052

Table 35: Parameter Values for Equation 33 (Treasury Bonds)

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
$\tilde{\beta}_t^{i,3}$	2019	0.026	0.088	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2020	0	0.026	0.088	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2021	0	0	0.026	0.088	0.091	0.091	0.091	0.091	0.091	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2022	0	0	0	0.026	0.088	0.091	0.091	0.091	0.091	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2023	0	0	0	0	0.026	0.088	0.091	0.091	0.091	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2024	0	0	0	0	0	0.026	0.088	0.091	0.091	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2025	0	0	0	0	0	0	0.026	0.088	0.091	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2026	0	0	0	0	0	0	0	0.026	0.088	0.091	0.091
$\tilde{\beta}_t^{i,3}$	2027	0	0	0	0	0	0	0	0	0.026	0.088	0.091
$\tilde{\beta}_t^{i,3}$	2028	0	0	0	0	0	0	0	0	0	0.026	0.088
$\tilde{\beta}_t^{i,3}$	2029	0	0	0	0	0	0	0	0	0	0	0.026

Table 36: Parameter Values for Equation 33 (Floating-Rate Notes)

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
$\tilde{\beta}_t^{i,4}$	2019	0.689	0.248	0	0	0	0	0	0	0	0	0
$\tilde{\beta}_t^{i,4}$	2020	0	0.689	0.248	0	0	0	0	0	0	0	0
$\tilde{\beta}_t^{i,4}$	2021	0	0	0.689	0.248	0	0	0	0	0	0	0
$\tilde{\beta}_t^{i,4}$	2022	0	0	0	0.689	0.248	0	0	0	0	0	0
$\tilde{\beta}_t^{i,4}$	2023	0	0	0	0	0.689	0.248	0	0	0	0	0
$\tilde{\beta}_t^{i,4}$	2024	0	0	0	0	0	0.689	0.248	0	0	0	0
$\tilde{\beta}_t^{i,4}$	2025	0	0	0	0	0	0	0.689	0.248	0	0	0
$\tilde{\beta}_t^{i,4}$	2026	0	0	0	0	0	0	0	0.689	0.248	0	0
$\tilde{\beta}_t^{i,4}$	2027	0	0	0	0	0	0	0	0	0.689	0.248	0
$\tilde{\beta}_t^{i,4}$	2028	0	0	0	0	0	0	0	0	0	0.689	0.248
$\tilde{\beta}_t^{i,4}$	2029	0	0	0	0	0	0	0	0	0	0	0.689

Table 37: Parameter Values for Equation 33 (State and Local Government Series)

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
$\tilde{\beta}_t^{i,5}$	2019	0.221	0.424	0.168	0.062	0.024	0.014	0.004	0.002	0.002	0	0
$\tilde{\beta}_t^{i,5}$	2020	0	0.221	0.424	0.168	0.062	0.024	0.014	0.004	0.002	0.002	0
$\tilde{\beta}_t^{i,5}$	2021	0	0	0.221	0.424	0.168	0.062	0.024	0.014	0.004	0.002	0.002
$\tilde{\beta}_t^{i,5}$	2022	0	0	0	0.221	0.424	0.168	0.062	0.024	0.014	0.004	0.002
$\tilde{\beta}_t^{i,5}$	2023	0	0	0	0	0.221	0.424	0.168	0.062	0.024	0.014	0.004
$\tilde{\beta}_t^{i,5}$	2024	0	0	0	0	0	0.221	0.424	0.168	0.062	0.024	0.014
$\tilde{\beta}_t^{i,5}$	2025	0	0	0	0	0	0	0.221	0.424	0.168	0.062	0.024
$\tilde{\beta}_t^{i,5}$	2026	0	0	0	0	0	0	0	0.221	0.424	0.168	0.062
$\tilde{\beta}_t^{i,5}$	2027	0	0	0	0	0	0	0	0	0.221	0.424	0.168
$\tilde{\beta}_t^{i,5}$	2028	0	0	0	0	0	0	0	0	0	0.221	0.424
$\tilde{\beta}_t^{i,5}$	2029	0	0	0	0	0	0	0	0	0	0	0.221

Table 38: Parameter Values for Equation 33 (Savings Bonds)

Parameter	(i)	Fiscal Year (t)										
		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
$\tilde{\beta}_t^{i,6}$	2019	0.025	0.133	0.026	0.008	0.004	0.006	−0.003	−0.010	−0.009	−0.009	−0.004
$\tilde{\beta}_t^{i,6}$	2020	0	0.025	0.133	0.026	0.008	0.004	0.006	−0.003	−0.010	−0.009	−0.009
$\tilde{\beta}_t^{i,6}$	2021	0	0	0.025	0.133	0.026	0.008	0.004	0.006	−0.003	−0.010	−0.009
$\tilde{\beta}_t^{i,6}$	2022	0	0	0	0.025	0.133	0.026	0.008	0.004	0.006	−0.003	−0.010
$\tilde{\beta}_t^{i,6}$	2023	0	0	0	0	0.025	0.133	0.026	0.008	0.004	0.006	−0.003
$\tilde{\beta}_t^{i,6}$	2024	0	0	0	0	0	0.025	0.133	0.026	0.008	0.004	0.006
$\tilde{\beta}_t^{i,6}$	2025	0	0	0	0	0	0	0.025	0.133	0.026	0.008	0.004
$\tilde{\beta}_t^{i,6}$	2026	0	0	0	0	0	0	0	0.025	0.133	0.026	0.008
$\tilde{\beta}_t^{i,6}$	2027	0	0	0	0	0	0	0	0	0.025	0.133	0.026
$\tilde{\beta}_t^{i,6}$	2028	0	0	0	0	0	0	0	0	0	0.025	0.133
$\tilde{\beta}_t^{i,6}$	2029	0	0	0	0	0	0	0	0	0	0	0.025

Distinct from the first six debt categories, the budgetary feedback of interest payments on indexed securities depends on the percentage-point change in the rate of inflation as measured by the CPI-U.

$$\Delta\text{Interest payments on indexed debt}_t = \beta_t \times \left[\frac{\widehat{p}_t - \overline{p}_t}{\overline{p}_t} - \frac{\widehat{p}_{t-1} - \overline{p}_{t-1}}{\overline{p}_{t-1}}\right] \tag{34}$$

$p_t =$ Consumer price index for all urban consumers

$\beta_t =$ Estimated sensitivity of outlays on indexed debt to changes in rate of inflation

Table 39: Parameter Values for Equation 34

Parameter*	Fiscal Year										
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t	954.00	1,495.40	1,494.50	1,464.90	1,438.90	1,414.80	1,366.70	1,360.10	1,383.30	1,399.10	1,420.30

* All units are in billions of dollars.

The total change in interest payment outlays is the sum of the change in interest payments on existing debt (equation 33) and changes in payments made on indexed debt (equation 34).

$$\Delta\text{Interest payment outlays}_t = \Delta\text{Interest payments on existing debt}_t + \Delta\text{Interest payments on indexed debt}_t \tag{35}$$

In addition to changes resulting from differences in interest rates (see equation 35), the budgetary feedback on net interest payments depends on the changes in debt service. If changes in the macroeconomy resulted in deficits that were higher (or lower) than in CBO's baseline budget projections, the federal government would have to borrow more (or less) to finance those deficits, resulting in higher (or lower) interest payments.

In the BFM, the sensitivity of debt service to a surplus (or deficit, if negative) is proxied using the projected interest rate of a three-year Treasury note. The duration used by the BFM is less than that of the Treasury's overall portfolio because debt service reflects only the marginal borrowing cost of debt issued to finance new programs or other changes relative to CBO's baseline. When borrowing needs are higher (or lower) than anticipated, the Treasury typically first adjusts the auction sizes of short- and medium-term securities. Changes in debt service in a given period are affected by changes in the surplus (or deficit) from the start of the forecast window through the end of the period. For example, a change in the surplus (or deficit) in 2019 affects debt service outlays in every year from 2019 to the end of the projection window.

$$\Delta\text{Debt service}_t = \sum_{i=2019}^{t} \left(\beta_t^i \times \frac{\widehat{r}_i}{\overline{r}_i} \times (-\Delta\tilde{s}_i) \right) \tag{36}$$

r_i = Yield on a three-year constant maturity Treasury note issued in period i

$\Delta\tilde{s}_i = \Delta s_i - \Delta\text{Interest payment outlays}_i$ (billions of dollars)

Δs_i = Change in surplus, excluding interest rate effect

β_t^i = Estimated sensitivity of debt service outlays in year t to deficit in period i

Table 40: Parameter Values for Equation 35

		Fiscal Year (t)										
Parameter	(i)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
β_t^i	2019	0.012	0.032	0.034	0.036	0.036	0.036	0.037	0.038	0.040	0.041	0.043
β_t^i	2020	0	0.018	0.035	0.036	0.037	0.038	0.038	0.039	0.041	0.042	0.043
β_t^i	2021	0	0	0.019	0.036	0.037	0.037	0.037	0.038	0.04	0.041	0.042
β_t^i	2022	0	0	0	0.018	0.035	0.036	0.036	0.037	0.038	0.040	0.041
β_t^i	2023	0	0	0	0	0.018	0.035	0.035	0.036	0.037	0.038	0.040
β_t^i	2024	0	0	0	0	0	0.017	0.033	0.034	0.036	0.037	0.038
β_t^i	2025	0	0	0	0	0	0	0.017	0.033	0.034	0.036	0.037
β_t^i	2026	0	0	0	0	0	0	0	0.017	0.033	0.034	0.036
β_t^i	2027	0	0	0	0	0	0	0	0	0.017	0.034	0.035
β_t^i	2028	0	0	0	0	0	0	0	0	0	0.017	0.034
β_t^i	2029	0	0	0	0	0	0	0	0	0	0	0.017

4 Limitations of the Budgetary Feedback Model

Although the BFM is useful for estimating the budgetary feedback of changes in the macroeconomy, it has several limitations. The first pertains to the BFM's assumption that the relationship between the budgetary feedback and changes in the macroeconomy are unaffected by changes in policy. Some policy changes affect these relationships and alter the sensitivity of revenues and outlays to changes in the macroeconomy. The BFM implicitly holds those relationships fixed. For example, a tax policy that changed statutory tax rates would probably alter the relationship between changes in the economy and revenues. The BFM would not capture those effects unless the underlying revenue-related parameters were adjusted to reflect the change in tax policy.

The second limitation is that the BFM is an approximation of the models used to produce the sensitivities in its equations. However, the BFM's estimates are often a good approximation of the estimate of budgetary feedback that CBO would find when using a wider suite of models to conduct dynamic analyses of legislative proposals. For example, a proposal might call for a change in government spending that might affect inflation. CBO's dynamic analysis of such a proposal would include estimates of changes in inflation that could be reasonably approximated by using the BFM's sensitivities for inflation.

In cases subject to either of those limitations on the BFM's accuracy, the BFM's estimates of budgetary feedback may differ substantially from those that CBO might produce when using the models underpinning the BFM. For example, suppose that legislation changed the statutory tax rates on personal income. Using the BFM without first using CBO's revenue models to update the effective marginal tax rates (which the BFM treats as parameters) on wages and salaries would not then be a useful exercise: The revenue from each additional dollar of wages or salaries would generate a tax liability different from that before the policy change. In addition, the BFM cannot capture some complex dynamics associated with some elements of the budget as well as CBO's full set of baseline projection models can. For example, corporate income tax revenues in the BFM rely on effective marginal tax rates that reflect only changes to tax liabilities arising in the same period as the changes in the relevant economic variable. However, because of the complexities in the timing of how net operating loss carryforwards affect future tax liabilities, CBO's models of corporate tax revenues will estimate changes in corporate income tax liabilities more accurately than the BFM. Similarly, because the BFM uses NIPA measures as inputs, considering the budgetary feedback from policy changes that operate through channels not measured in the NIPAs, such as asset valuations, would be inappropriate. CBO would then evaluate budgetary effects by using alternative or supplemental methods.

The third limitation pertains to the BFM's ability to address only relatively small changes in the macroeconomy. That limitation arises because the BFM is calibrated to relatively small changes in the macroeconomy. For significant deviations in the macroeconomy, the BFM should not be used to compute budgetary feedback. For example, a large change in the unemployment rate may have larger effects on UI enrollment, and thereby UI outlays, than is captured by the sensitivity used in the BFM. All those limitations are kept in mind when analyzing budgetary feedback, with adjustments made when necessary.

Finally, the BFM gives no meaningful guidance on how policy proposals might affect the economy. A team of macroeconomists working with CBO's cost analysts determine the changes to the economy that would result from policy differences. Although the BFM can be used to determine how those economic changes might affect the budget, working backward to determine what kind of economic changes might be required to achieve a certain budgetary outcome will not be helpful in formulating policy.