Congressional Budget Office
Nonpartisan Analysis for the U.S. Congress

Assessing the Budgetary Implications of Economic Uncertainty With CBO's Incomes Model and Budgetary Feedback Model

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Implications of Economic Changes for the Deficit

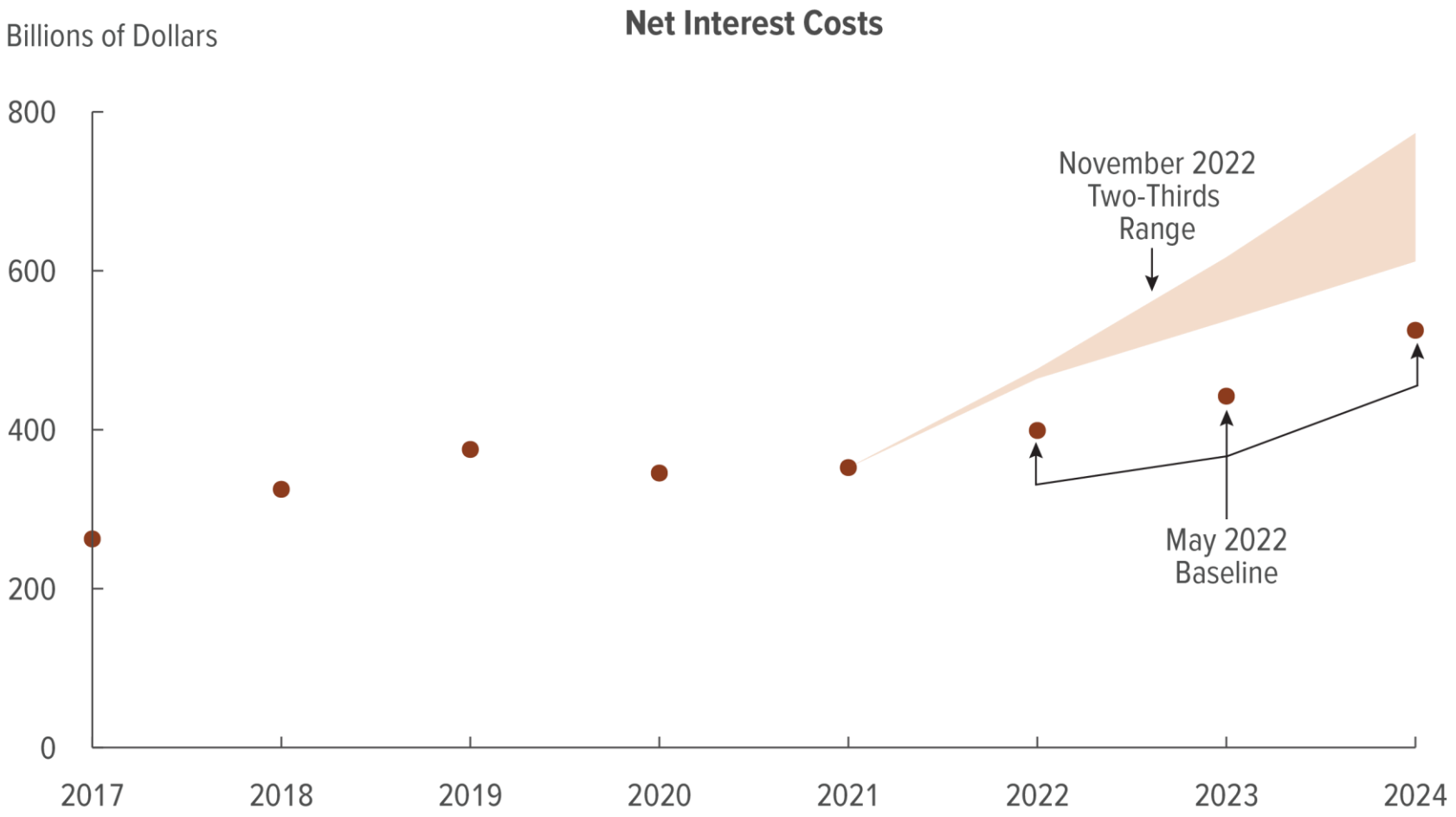
In November 2022, the Congressional Budget Office was asked to estimate how changes in its view of the economy might affect its budget estimates and to assess the uncertainty surrounding those outcomes. At that time, the economy was experiencing slower growth, higher inflation, and higher interest rates than had been projected in the agency's May 2022 baseline.

CBO began by generating 100 simulations of economic conditions over the next two years. On average, those simulated economic conditions contributed to larger deficits than estimated in the agency's May 2022 baseline. In the middle two-thirds of the cases,

- The deficit for fiscal year 2023 was larger by $200 billion to $300 billion, or 20 percent to 30 percent, and
- The deficit for fiscal year 2024 was larger by $210 billion to $480 billion, or 20 percent to 46 percent.

For more details about this analysis, see Congressional Budget Office, *CBO's Current View of the Economy in 2023 and 2024 and the Budgetary Implications* (November 2022), www.cbo.gov/publication/58757. For CBO's May 2022 baseline projections, see Congressional Budget Office, *The Budget and Economic Outlook: 2022 to 2032* (May 2022), www.cbo.gov/publication/57950.

Implications of Economic Changes for Net Interest Costs



Analysis of the 100 simulations showed that in almost every case, increases in net interest costs were the primary contributor to greater deficits.

CBO's simulations of interest rates and inflation rates consistent with its view of economic conditions in November 2022 were generally higher than the rates the agency projected in May 2022.

As a result, the middle two-thirds of the projections of net interest costs using the rates in the simulations were above the amounts projected in May 2022.

The effects on revenues and noninterest spending also contributed to greater deficits in most cases.

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CBO's Analytic Method for Estimating Economic Uncertainty

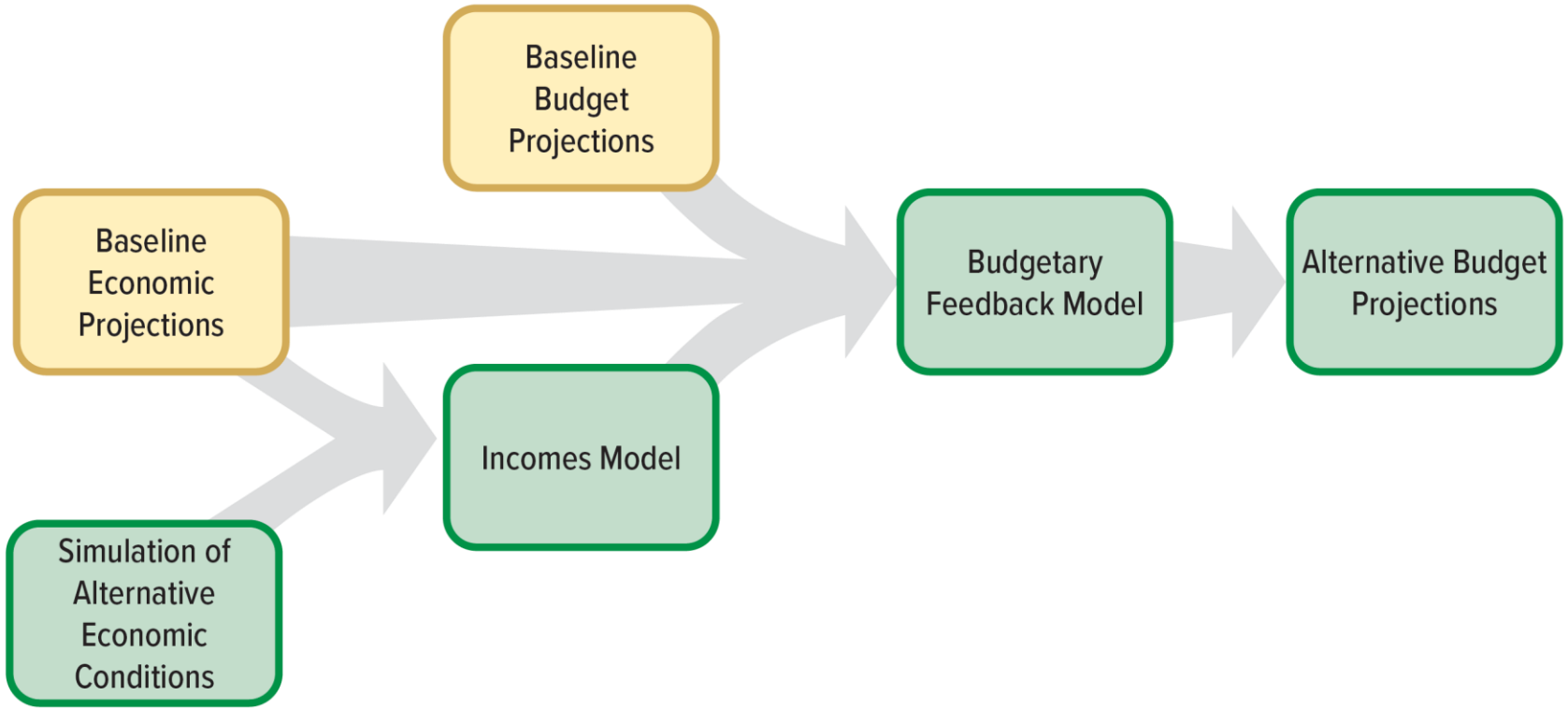
The analysis of economic uncertainty was conducted in three main steps:

- Preliminary economic projections provided central estimates for each variable;
- 100 simulations of the rates of unemployment, inflation, and interest were jointly estimated around the central estimates, reflecting asymmetric dynamics and relating the variables through an expectations-augmented Phillips curve and an inertial Taylor rule; and
- Forecasts conditional on those rates were estimated using symmetric distributions in which economic output and other variables were synchronized with the simulations of unemployment, inflation, and interest rates.

This document focuses on how CBO took 100 simulations of the variables generated in those three steps and assessed their implications for the federal budget.

For discussion of the first step, see Robert W. Arnold, *How CBO Produces Its 10-Year Economic Forecast*, Working Paper 2018-02 (Congressional Budget Office, February 2018), www.cbo.gov/publication/53537. For discussion of the second step, see Congressional Budget Office, "Estimating the Uncertainty of the Economic Forecast Using CBO's Expanded Markov-Switching Model" (January 2023), www.cbo.gov/publication/58884. For discussion of the third step, see Congressional Budget Office, "Estimating the Uncertainty of the Economic Forecast Using CBO's Bayesian Vector Autoregression Model" (January 2023), www.cbo.gov/publication/58883.

Modeling the Budgetary Implications of Economic Uncertainty



CBO used its Incomes Model (IM) to forecast a larger set of income and interest rate variables that were synchronized with each of the 100 simulations, producing many subcomponents of the national income and product accounts that aggregate into larger income categories.

CBO used its Budgetary Feedback Model (BFM) to estimate how revenues, noninterest spending, and net interest costs would have differed from its baseline budget projections under the economic conditions in each simulation.

The Incomes Model

Inputs to the Incomes Model

The IM takes a small number of variables as inputs, including:

- Production variables, such as gross domestic product (GDP) and private investment;
- Employment variables, such as wages and salaries and the unemployment rate;
- Price indexes, such as the GDP price index and the consumer price index; and
- Interest rates, such as the federal funds rate, the 3-month Treasury bill rate, and the 10-year Treasury note rate.

Outputs of the Incomes Model

The IM generates a larger number of variables as outputs that are largely organized around Tables 1 through 4 in the national income and product accounts. The IM combines the simulation inputs with a baseline projection to produce simulation outputs, including:

- Proprietors' income and labor compensation;
- Total nonwage personal income and net interest payments;
- Current transfer payments and corporate profits;
- Consumption of fixed capital and capital income; and
- Interest rates on Treasury securities with durations of 1, 3, 5, and 30 years.

Each variable has its own equation in the model. This document includes six examples of those different types of equations. (Their inclusion does not necessarily imply importance relative to other equations.)

Example Equation: Compensation

The value of total employee compensation in a given simulation depends on compensation in CBO's baseline projection and on the ratio of wages and salaries in the simulation relative to the baseline.

In the equation, $\bar{x}$ denotes a value of the variable x in CBO's baseline projection, and $\hat{x}$ denotes either a simulated value of x from the model's inputs or a value of x projected using the IM to be consistent with a simulation.

Define C as total employee compensation.

Define W as wages and salaries.

Define subscript t as indicating the year.

$$\hat{C}_t = \bar{C}_t \left(\hat{W}_t \Big/ \bar{W}_t \right)$$

Example Equations: Taxes, Business Payments, and Capital Income

Define T as taxes on production and imports.

Define Y as GDP.

Define $m(x, j)$ as a moving-average function that returns the average values of the variable x over the previous j calendar quarters, and ρ as a coefficient.

$$\hat{T}_t = \bar{T}_t \left[1 + \rho m \left({\hat{Y}_t}/{\bar{Y}_t} - 1 \, , 2 \right) \right]$$

Define P as current transfer payments by businesses.

$$\hat{P}_t = \bar{P}_t \left({\hat{Y}_t}/{\bar{Y}_t} \right)$$

Define K as domestic capital income.

Define D as the statistical discrepancy between national income and national output.

$$\hat{K}_t = \hat{Y}_t - \hat{C}_t - \hat{T}_t - \bar{D}_t \left({\hat{Y}_t}/{\bar{Y}_t} \right)$$

Example Equations: Interest

Define R^{5y} as the interest rate on 5-year Treasury notes and β as a set of coefficients.

Define R^{10y} as the interest rate on 10-year Treasury notes.

Define R^{3m} as the interest rate on 3-month Treasury bills.

$$\hat{R}_t^{5y} = \beta_0 + \beta_1 \bar{R}_t^{5y} + \beta_2 \hat{R}_t^{10y} + \beta_3 \hat{R}_t^{3m}$$

Define I as net interest and γ as a set of coefficients.

Define R^f as the federal funds rate.

$$\hat{I}_t = \bar{I}_t \left\{ 1 + \gamma_1 \left({}^{\hat{Y}_t}\!/_{\bar{Y}_t} - 1 \right) + \gamma_2 \left[m\left(\hat{R}_t^f, 2\right) - m\left(\bar{R}_t^f, 2\right) \right] + \gamma_3 \left[m\left(\hat{R}_t^{10y}, 12\right) - m\left(\bar{R}_t^{10y}, 12\right) \right] \right\}$$

The Budgetary Feedback Model

Inputs to and Outputs of the Budgetary Feedback Model

The BFM takes the variables from the IM as inputs.

CBO uses the BFM to project values for categories of revenues and spending that are used to compute aggregate budgetary outcomes, including the following:

- The federal budget deficit,
- Federal debt held by the public, and
- The ratio of debt to GDP.

Each budget variable has its own set of equations in the model. This document includes two examples.

For a complete description of the BFM's equations, see Nathaniel Frentz and others, *A Simplified Model of How Macroeconomic Changes Affect the Federal Budget*, Working Paper 2020-01 (January 2020), www.cbo.gov/publication/55884.

Additional Variables Projected Using the Budgetary Feedback Model

CBO uses the BFM to project the following major sources of revenues:

- Individual income tax liabilities,
- Payroll tax liabilities,
- Corporate income tax liabilities,
- Federal Reserve remittances,
- Customs liabilities,
- Estate and gift tax liabilities, and
- Excise tax liabilities.

CBO also uses the BFM to project outlays for mandatory, discretionary, and net interest spending. Mandatory spending consists of the following major categories:

- Social Security,
- Medicare,
- Medicaid,
- Unemployment insurance,
- The Supplemental Nutrition Assistance Program,
- Refundable tax credits,
- Child nutrition programs, and
- Other indexed entitlements.

Example Equation: Payroll Taxes

Define l as payroll tax liabilities under the Federal Insurance Contributions Act.

Define y as wage and salary disbursements.

Define b as private group health insurance benefits.

Define n as civilian employment of people age 16 or over.

Define τ^y as the effective marginal tax rate on wage and salary disbursements and τ^b as the rate on employment-based health insurance benefits.

Define β^w as the estimated sensitivity to changes in the level of average wages lagged two years and β^e as the estimated sensitivity of Federal Insurance Contributions Act tax liabilities to percentage changes in employment.

$$\hat{l}_t = \bar{l}_t + \tau_t^y(\hat{y}_t - \bar{y}_t) + \tau_t^b(\hat{b}_t - \bar{b}_t) + \beta_t^w\left(\hat{y}_{t-2}/\hat{n}_{t-2} - \bar{y}_{t-2}/\bar{n}_{t-2}\right) + \beta_t^e\left(\hat{n}_t/\bar{n}_t - 1\right)$$

Example Equation: Social Security Spending

Define s as Social Security spending.

Define p the consumer price index for urban wage earners and clerical workers in the third calendar quarter.

Define y as the employment cost index.

Define β^p as the estimated sensitivity of Social Security outlays to changes in the level of prices and β^w as their sensitivity to changes in employment costs.

$$\hat{s}_t = \bar{s}_t + \beta_t^p \left(\hat{p}_{t-1} / \bar{p}_{t-1} - 1 \right) + \beta_t^w \left(\hat{y}_{t-2} / \bar{y}_{t-2} - 1 \right)$$

About This Document

This document was prepared to enhance the transparency of CBO's work and to encourage external review of that work. In keeping with CBO's mandate to provide objective, impartial analysis, the document makes no recommendations.

Jaeger Nelson and Matthew Wilson prepared the document with guidance from Robert Arnold, Richard DeKaser, and Devrim Demirel. Byoung Hark Yoo, Michael McGrane, and John Seliski (formerly of CBO) provided comments.

Mark Hadley and Jeffrey Kling reviewed the document. Christine Browne edited it and R. L. Rebach created the graphics. The document is available at www.cbo.gov/publication/58885.

CBO seeks feedback to make its work as useful as possible. Please send comments to communications@cbo.gov.