CONGRESSIONAL BUDGET OFFICE

An Overview of CBO's Life-Cycle Growth Model

February 2019

CBO's Fiscal Policy Models

CBO uses several models to analyze the effects of fiscal policy. In CBO's view, changes in fiscal policy affect the economy in both the short and long term:

- Short-term effects are driven by changes in the demand for goods and services (such as consumption and investment) and changes in supply-side factors (such as growth in productivity and the supply of labor), as well as by the interactions between them.

- Long-term effects are primarily driven by changes in supply-side factors such as national saving, productivity, and people's incentives to work, save, and invest.

The life-cycle growth model (also called an overlapping-generations, or OLG, model) is one model that CBO uses to estimate the long-term effects of changes in fiscal policy.

Key Purposes of the Life-Cycle Growth Model

CBO uses the model to analyze the effects of fiscal policy on the following:

- People's incentives to work and save;
- The distribution of income, wealth, consumption, and taxes across households; and
- The well-being of different generations of households.

For example, the model can analyze the effects of changes to the Social Security system.

Features of the Model

The model has several useful features for analyzing changes in fiscal policy:

- The effects of government spending and taxation on households' behavior vary with their age, income, and wealth, allowing the effects of fiscal policy to be broken down by generation and different demographic groups.

- Households of different ages have different marginal propensities to consume, which is important in analyzing the effects of transfer payments.

- Households' work decisions vary with their age, income, and wealth, which is important in understanding the effects of changes in tax rates.

CBO Analyses Using the Life-Cycle Growth Model

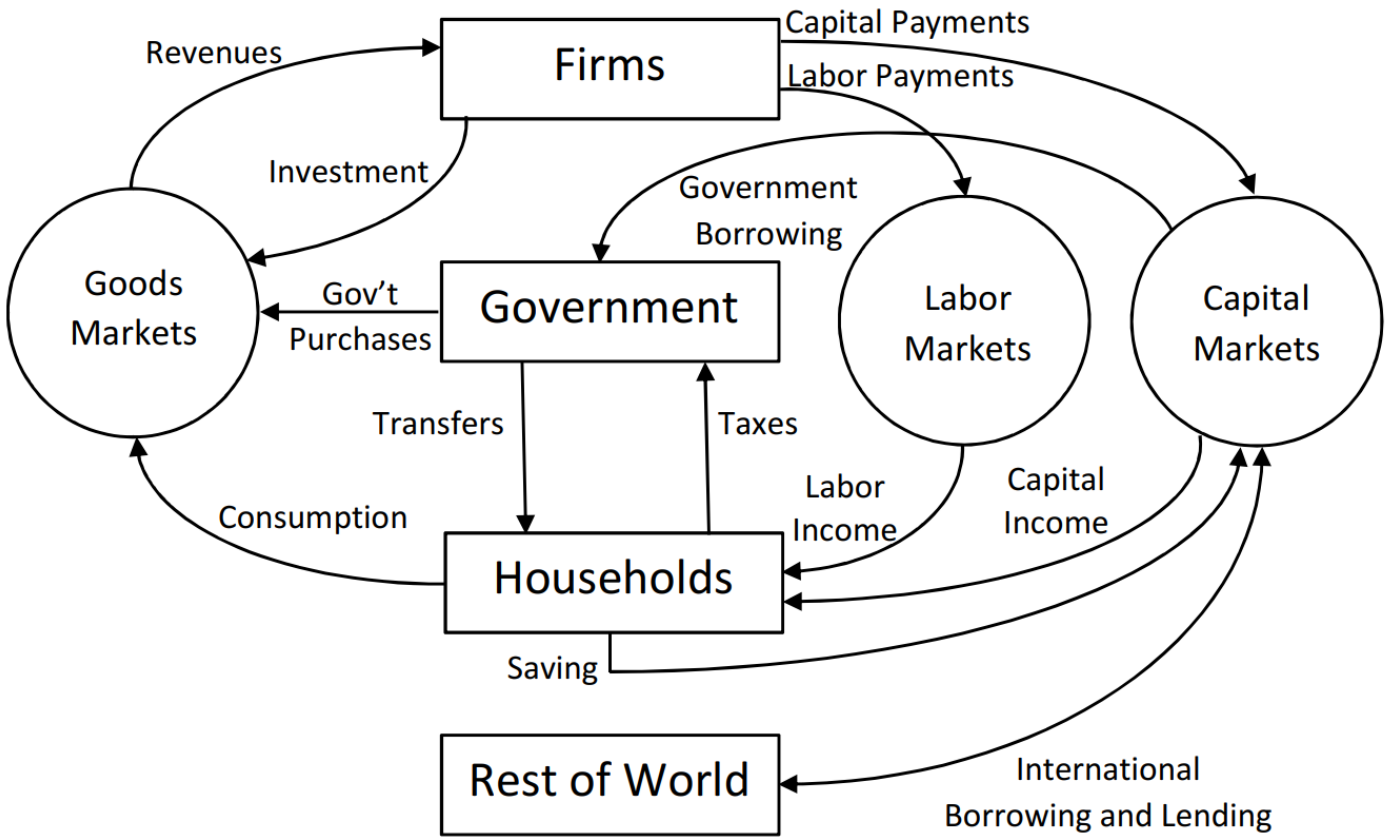
- *A Macroeconomic Analysis of the President's Budget* (2016)
- *A Macroeconomic Analysis of the President's Budget* (2015)
- *The Costs to Different Generations of Policies That Close the Fiscal Gap*, CBO Working Paper 2015-10
- *Fiscal Policy Effects in a Heterogeneous-Agent Overlapping-Generations Economy With an Aging Population*, CBO Working Paper 2013-07
- *Economic Impacts of Waiting to Resolve the Long-Term Budget Imbalance*, CBO Economic and Budget Issue Brief 2010-12

Structure of the Life-Cycle Growth Model

Four Components of the Model

- **Households** in the model optimally choose consumption, saving, and labor supply over their lifetime. Households are rational and forward-looking.
- **Firms** purchase households' labor and rent capital to maximize profits.
- The **government** collects income, payroll, and consumption tax revenues and runs public programs, including a Social Security system and other transfer programs. It finances budget deficits through borrowing.
- The **rest of the world** in the model interacts with the domestic economy through financial markets.

Interactions in Life-Cycle Growth Model



Payments flow between households, firms, the government, and the international economy.

Model Details

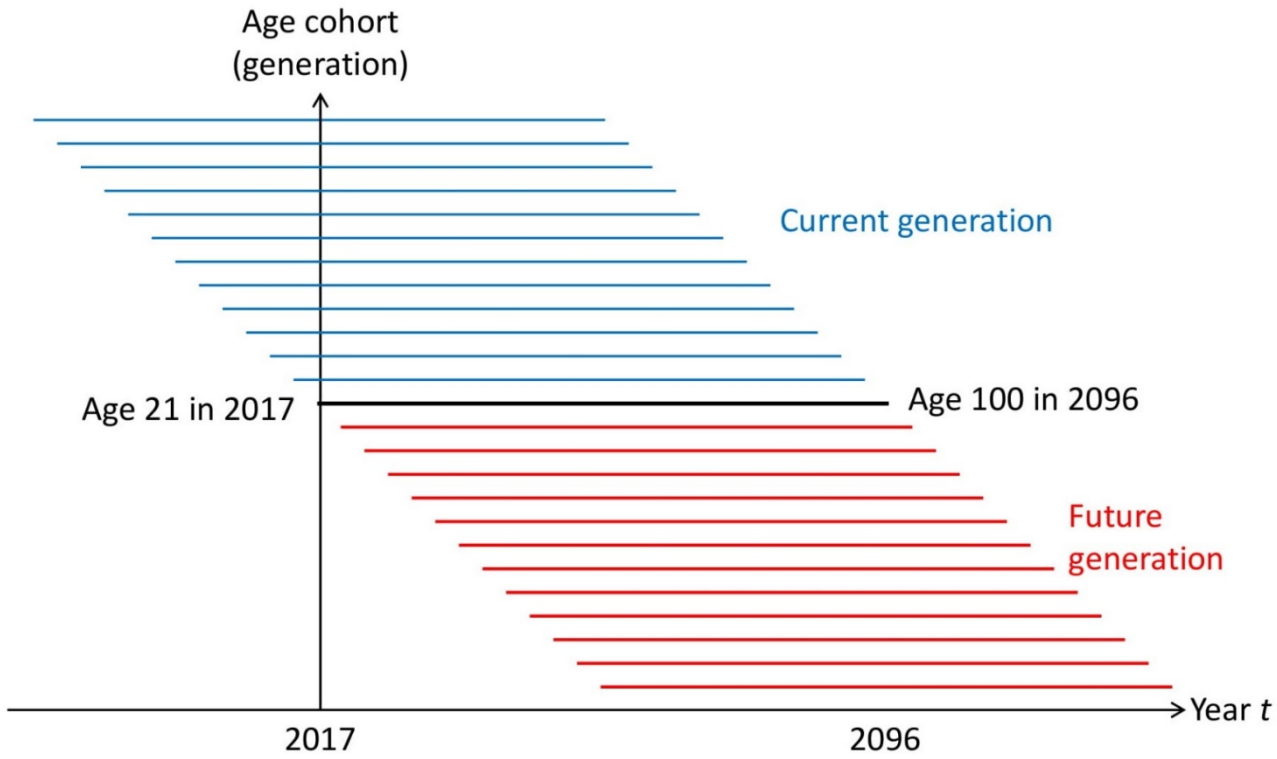
- Shinichi Nishiyama and Felix Reichling, *The Costs to Different Generations of Policies That Close the Fiscal Gap*, Working Paper 2015-10 (Congressional Budget Office, December 2015), www.cbo.gov/publication/51097.

- Shinichi Nishiyama and Kent Smetters, "Analyzing Fiscal Policies in a Heterogeneous-Agent Overlapping-Generations Economy," in Karl Schmedders and Kenneth L. Judd, eds., *Handbook of Computational Economics*, vol. 3 (Elsevier, 2014), pp. 117–160.

- Shinichi Nishiyama, *Fiscal Policy Effects in a Heterogeneous-Agent Overlapping-Generations Economy With an Aging Population*, Working Paper 2013-07 (Congressional Budget Office, December 2013), www.cbo.gov/publication/44941.

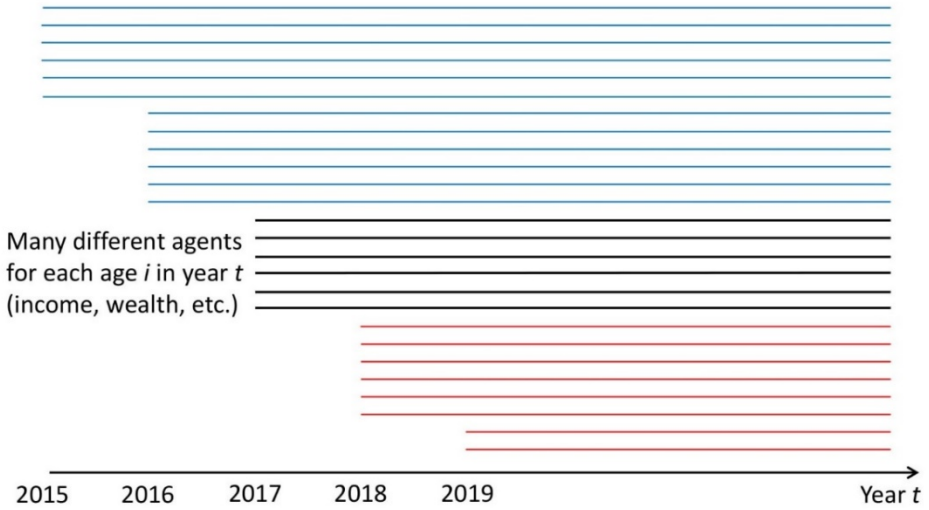
Structure of Households Over Time

In each period a new cohort of households is born. As households age, their mortality risk increases independently of their income, wealth, and other household characteristics. Households live to a maximum age of 100.



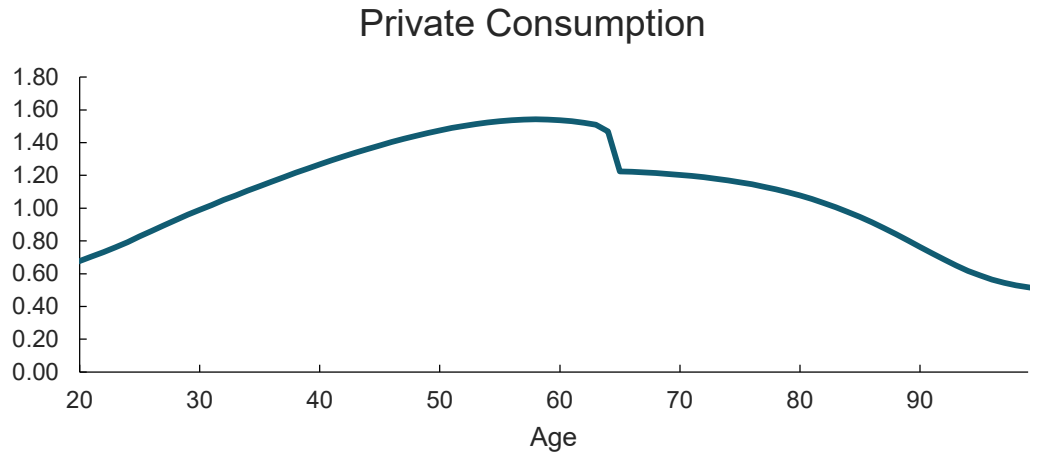
Structure of Households Over Time

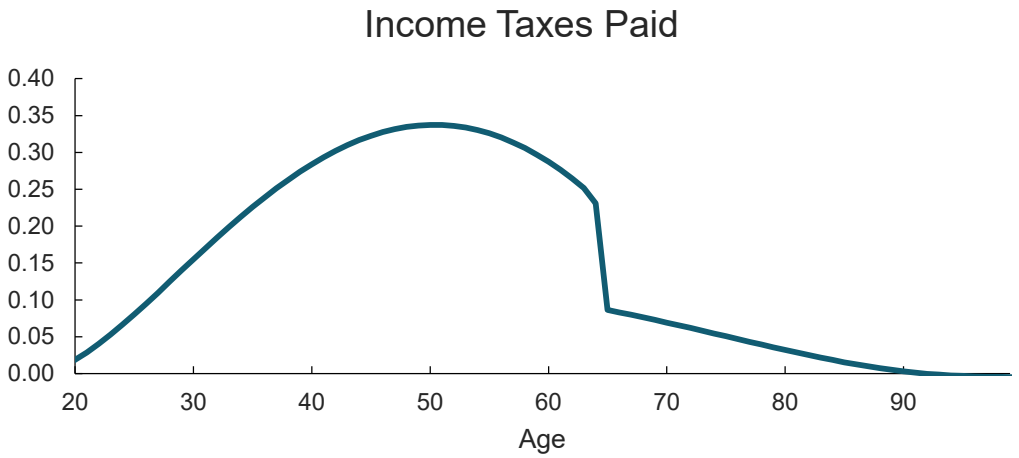
- Households are differentiated not just by their age but also their wage rate, wealth, and average lifetime earnings.
- Those differences mean that different households of the same age can respond differently to the same policy change.
- That has important effects on the overall macroeconomic response to fiscal policy changes.



Life-Cycle Behavior of Individuals

These figures depict the life-cycle behavior of an average household in the model. Vertical axes show internal model values and are useful only for comparisons of relative size over the life cycle. Retirement is set at age 65.





Fiscal Policy in the Model

Key Features of Fiscal Policy in the Model

- There are four types of taxes in the model:
  - Progressive income tax
  - Flat payroll tax
  - Flat consumption tax
  - Lump-sum tax

- The model has four types of government outlays:
  - Spending on goods and services
  - Old-Age, Survivors, and Disability Insurance (OASDI) and Medicare transfer payments
  - Other lump-sum transfer payments to households
  - Interest payments made on outstanding debt

Key Features of Fiscal Policy in the Model

- The government operates a budget based on the tax revenues it collects from households and its outlays.
- In the short run, the government does not have to balance its budget in each period and can finance deficits through debt issuance or run a surplus.
- In the long run, the government adjusts fiscal policy to stabilize the debt-to-GDP ratio.

Government Debt Over Time

- Debt evolves over time as revenues differ from outlays.

- In each period, the next period's debt is current debt plus
  - Spending on goods and services,
  - OASDI and Medicare transfer payments,
  - Other lump-sum transfer payments to households, and
  - Interest payments made on outstanding debt

  and minus

  - Income taxes collected,
  - Payroll taxes collected,
  - Consumption taxes collected, and
  - Lump-sum taxes collected.

Simulating the Effects of Fiscal Policy Changes

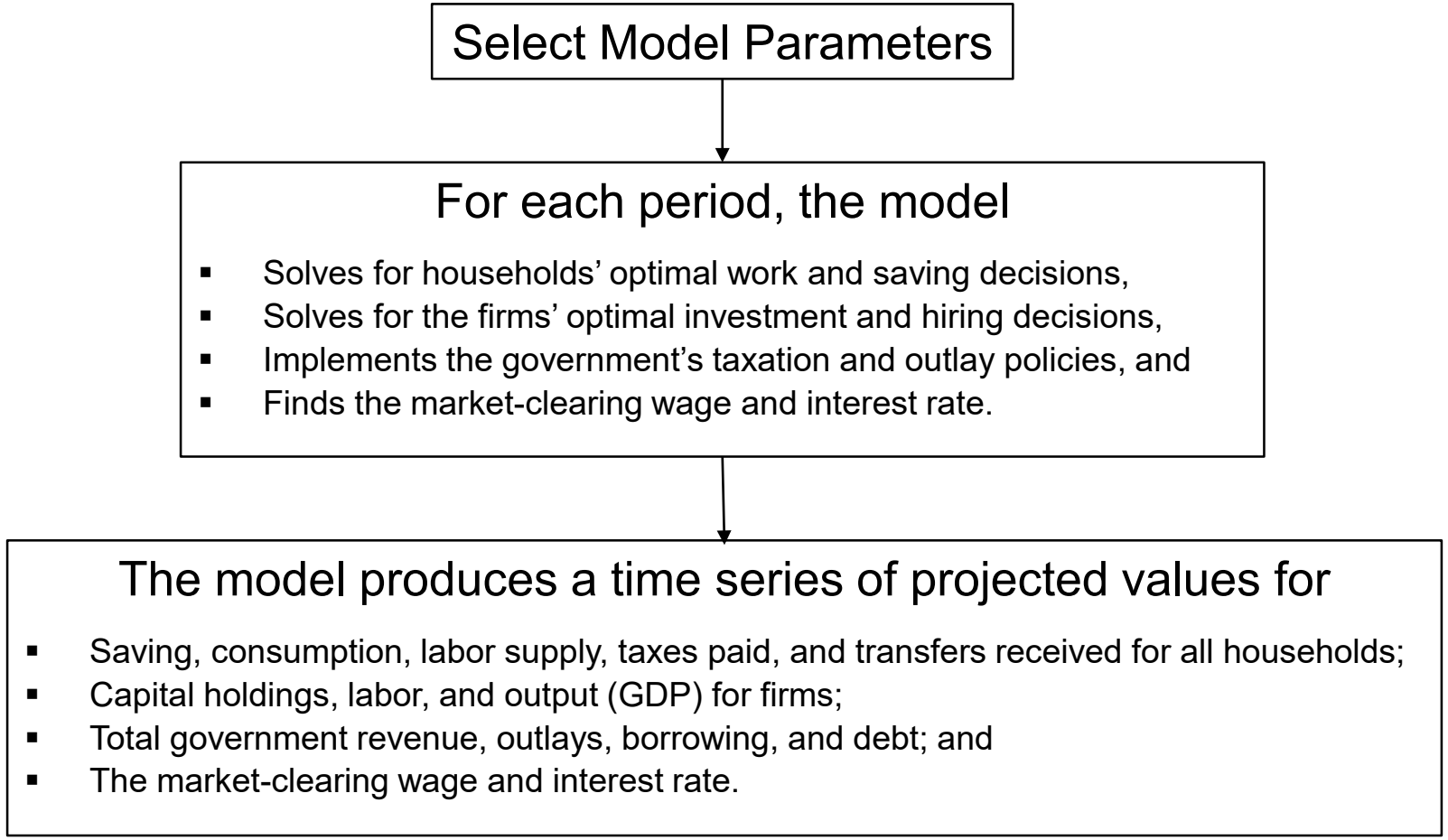
Baseline and Alternative Simulations

Effects of fiscal policy changes are assessed by examining the differences between a baseline simulation and an alternative simulation:

- A baseline simulation is a set of projections for macroeconomic variables produced under the assumption that current law will remain unchanged over the period of interest, followed by a policy change that stabilizes the debt-to-GDP ratio in the long run.

- The alternative simulation incorporates the policy changes in question during the period of interest, followed by a policy change that stabilizes the debt-to-GDP ratio in the long run.

Simulation Procedure



The Closure Rule

- In the model, budget deficits adjust in the long run to ensure that fiscal policy changes do not result in an unsustainable path for government debt.
- Those adjustments are implemented through a closure rule and usually consist of changes in various types of outlay and/or tax policies.
- CBO sets the closure rule to ensure a stable solution to the model for each simulation and to minimize interference with the effects of the fiscal policies that underlie those simulations.

An Example

Effects of Waiting to Stabilize the Debt-to-GDP Ratio

This example quantifies the economic effects of stabilizing the debt-to-GDP ratio earlier rather than later. Those effects are assessed by comparing the economic outcomes under two illustrative policies:

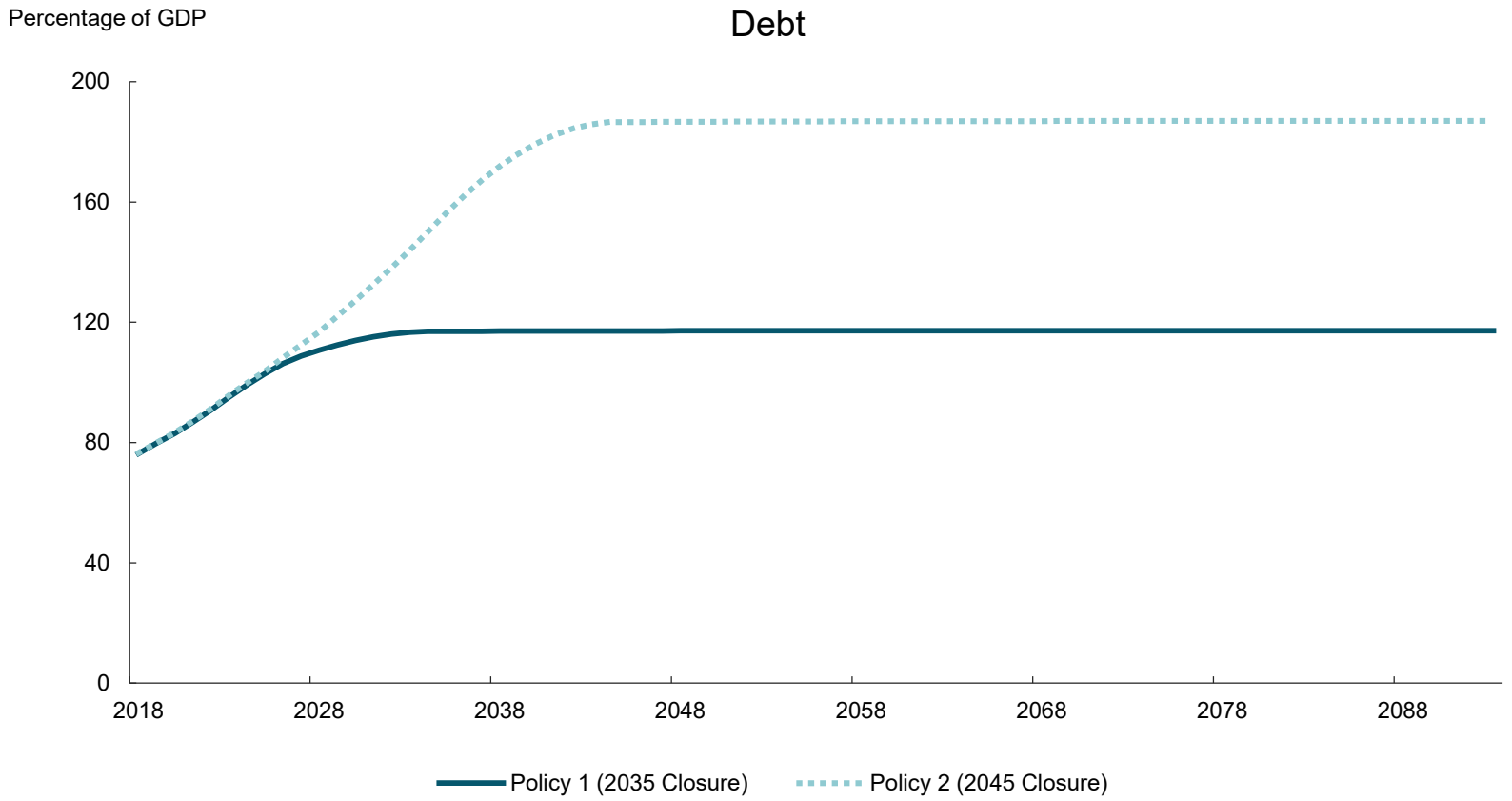
- Policy 1 starts reducing federal deficits in 2025 to stabilize the debt-to-GDP ratio by 2035.
- Policy 2 starts reducing federal deficits in 2035 to stabilize the debt-to-GDP ratio by 2045. Because the policy starts later, the deficit reductions are larger.

Under each policy, the debt-to-GDP ratio is stabilized in the long run by an equal cut to government spending on goods and services and increase in lump-sum taxes.

Households and firms have perfect foresight and alter their behavior in anticipation of future policy changes.

Effects of Waiting to Stabilize the Debt-to-GDP Ratio

Because Policy 2 starts reducing deficits 10 years later than Policy 1, the debt-to-GDP ratio is higher in the long run under Policy 2.



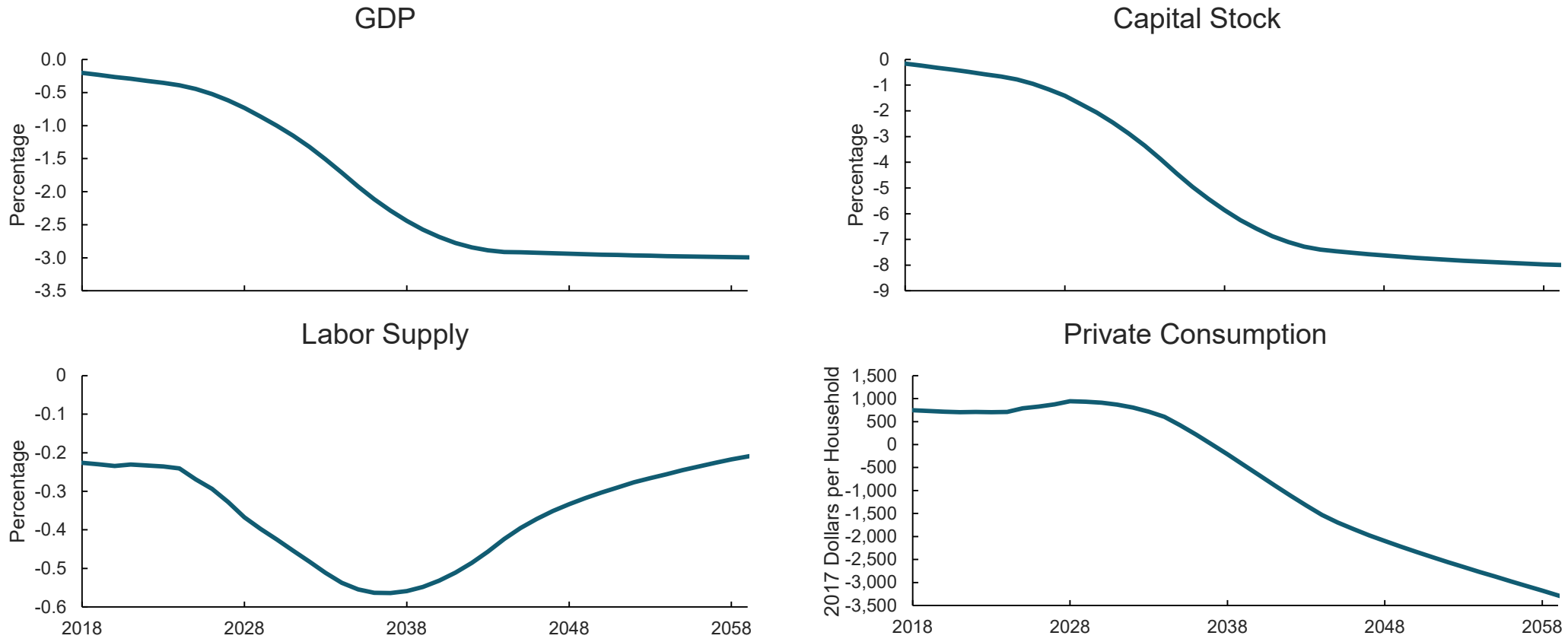
Effects of Waiting to Stabilize the Debt-to-GDP Ratio

Stabilizing the debt-to-GDP ratio in 2045 instead of 2035 results in the following:

- Lower levels of capital and GDP due to more crowding out of private investment driven by a higher level of debt relative to GDP;
- A lower level of labor supply driven by lower wages and the later increase in lump-sum taxes; and
- An increase in private consumption in the short term but a substantial decrease in private consumption in the long run. That is driven by the later increase in lump-sum taxes and a relatively lower wage rate in the long run.

Effects of Waiting to Stabilize the Debt-to-GDP Ratio

These figures show the estimated effects of stabilizing the debt-to-GDP ratio in 2045 instead of 2035. The effects are expressed as changes from what each variable would equal in a given year if stabilization occurred in 2035.



About This Document

These slides were prepared to enhance the transparency of the work of the Congressional Budget Office and to encourage external review of that work. In keeping with CBO's mandate to provide objective, impartial analysis, this document makes no recommendations.

Jaeger Nelson and Kerk Phillips prepared this document with guidance from Jeffrey Werling and Devrim Demirel. Wendy Edelberg and Jeffrey Kling reviewed the document, and Rebecca Lanning edited it. An electronic version is available on CBO's website (www.cbo.gov/publication/54985).