The Macroeconomic and Budgetary Effects of Federal Investment

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Summary

The federal government buys many goods and services that are expected to increase private-sector productivity—that is, the ability of the private-sector workforce, using the stock of capital, to produce goods and services. Such purchases by the federal government are called investment. In an earlier report, the Congressional Budget Office examined various aspects of federal investment itself, such as its composition and the way it had changed over time.[1] Building on that analysis, this report explains how CBO, when analyzing proposals that would change the amount of federal investment, determines their effects on the economy and on the federal budget.

What Is Federal Investment?

The federal government invests in three broad areas for nondefense purposes:

- Physical capital, mostly for transportation, which contributes to the functioning of the economy;

- Education and training, which helps produce a skilled, capable workforce; and

- Research and development (R&D), which encompasses a wide variety of work in government laboratories, universities, and the private sector.

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1. See Congressional Budget Office, *Federal Investment* (December 2013), www.cbo.gov/publication/44974.

Notes: Unless this report indicates otherwise, all years mentioned when describing the federal budget are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end, and all years mentioned when describing economic variables, such as gross domestic product and interest rates, are calendar years.

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

The data underlying the figures in this report are posted along with the report on CBO's website.

In 2015, the federal government spent $293 billion on investment for nondefense purposes, which represented 1.6 percent of gross domestic product (GDP) and 8 percent of federal spending. (Federal investment for defense purposes primarily affects national security rather than productivity, so this report does not focus on it.)

In some cases, it is difficult to determine what increases productivity and thus qualifies as federal investment. For example, CBO's interpretation of empirical research suggests that spending on instruction and on the construction of school buildings affects future productivity; the agency therefore regards such spending as investment. But the empirical link between increases in federal spending on health care and greater private-sector productivity is relatively tenuous, so CBO does not currently regard federal spending on health care as investment.

How Does Federal Investment Affect the Economy?

The increase in productivity that results from federal investment boosts economic output—but only gradually. For instance, this report examines four illustrative policies that would change federal investment; in each of those policies, of every $1 billion increase in federal investment in 2016, CBO estimates, only $50 million would affect productivity in that year. In 2017, an additional $200 million of the $1 billion investment would begin to affect productivity, for a total of $250 million of productive investment. Each year, a greater share of the $1 billion would become productive, and the full amount would have made contributions to productivity after 20 years, CBO projects.

CBO further estimates that productive federal investment has an average annual rate of return of about 5 percent, or half of the agency's estimate of the average rate of return on private investment. Therefore, the boost in productivity from that $50 million of productive investment in 2016 would raise private-sector output by about $2.5 million in that year. In 2017, the addition of $250 million to productive investment would boost output by an estimated $12.5 million, and so on.

The macroeconomic effects of an increase in federal investment would depend on how that spending was financed. Although spending can be financed in a number of ways, this report examines just two—reducing other spending and increasing federal borrowing. If an increase in investment was financed by an offsetting reduction in other spending, the effect would be relatively straightforward: a boost in productivity that would increase GDP over the next decade.[2] For example, one of the illustrative policies presented in this report, called Policy 2, would increase funding for federal investment

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2. Specifically, that boost in productivity would be the sole economic effect as long as the offsetting reduction in other spending had no effect on people's incentives to work or save and fully canceled out the effect of the increase in investment on overall demand. If the increase in investment was instead financed by reductions in transfer payments or by increases in revenues, those changes *would* generally affect incentives to work and save, as well as overall demand; such a policy, therefore, would not cleanly isolate the effects of federal investment on productivity.

by $50 billion per year for 10 years, starting in fiscal year 2016, and decrease funding for other spending by offsetting amounts. That policy would make productivity slightly higher than it would have been otherwise, CBO estimates; as a result, over the 2016–2025 period, GDP would be $33 billion higher.

But if the increase in investment spending was financed by added federal borrowing, three factors would influence the economy. First, productivity would rise, increasing GDP over time, as in the previous case. Second, the increase in federal borrowing would reduce the amount of money available for *private* investment, damping GDP in later years. And third, because there would be no offsetting reductions in spending, total federal spending would increase, boosting overall demand and GDP during the first several years. Another illustrative policy in this report, Policy 4, would likewise increase funding for federal investment by $50 billion per year for 10 years, starting in fiscal year 2016, but it would finance the investment by an increase in borrowing. Over the 2016–2025 period, that policy would make GDP $15 billion higher, CBO estimates.

How Does Federal Investment Affect the Federal Budget?

An increase in federal investment would affect the budget in a number of ways. Because the resulting improvement in productivity would, on its own, increase GDP, the amount of taxable income would rise. Therefore, federal revenues would increase, and the deficit would shrink (provided that the increase in investment was not financed by added federal borrowing). But the higher productivity would also raise the return on capital, boosting interest rates and the cost to the federal government of servicing its debt. Reflecting those effects on tax revenues and interest costs, Policy 2 would shrink federal budget deficits by a total of $4 billion over the 2016–2025 period.

If the increase in investment was financed by an increase in federal borrowing, not by reductions in other spending, it would have additional effects on the deficit. The resulting increase in total federal spending would increase the deficit directly. Moreover, CBO estimates that interest rates would rise, increasing the federal government's interest payments, not only because of higher productivity but also for two more reasons. First, the increased government spending would raise overall demand, and the Federal Reserve, in CBO's view, would respond by raising short-term interest rates to prevent inflation from rising above the central bank's longer-term goal. Second, the increased borrowing would reduce the amount of money available for private investment, thereby heightening competition for investors' money. All told, Policy 4 would increase deficits by a total of $424 billion over 10 years.

What Are Some Limitations of CBO's Methods of Estimating Those Effects?

The findings in this report are CBO's best estimates of the macroeconomic and budgetary effects of the illustrative policies analyzed. However, those findings should not be used to directly infer the effects of particular investment proposals. That is the case for three main reasons:

■ Some investments start improving productivity soon after they are made, whereas others take much longer.

■ Similarly, some investments have stronger effects on productivity than others do.

■ The way that states, local governments, and private entities adjust their own investment spending in response to changes in federal investment can also vary, depending on the proposal.

In this report, CBO used an overall average for each of those factors. The agency continues to examine how they vary as groundwork for analyses of future proposals.

Federal Investment

The federal government purchases a wide range of goods and services that are expected to increase the economy's future productivity. Those purchases are called investment, and they fall into three categories:

■ Physical capital includes structures (such as buildings, transportation infrastructure, and water and power projects); major equipment (such as computers, machinery, and vehicles); and software.

■ Education and training includes early childhood, elementary, secondary, and postsecondary education; job training; and vocational training.

■ R&D itself has three components: basic research, whose purpose is the discovery of scientific principles; applied research, which translates such discoveries into more practical accomplishments; and the development of new products and technology.

In some cases, the federal government makes investments directly, such as when the Army Corps of Engineers constructs a dam or when a federal agency buys computer equipment. In other cases, the federal government invests through grants to state and local governments—as it does, for instance, with about half of all federal spending for education. The federal government also invests through grants to people and to private-sector organizations; examples include Pell grants for college students and the National Science Foundation's research grants for laboratories.[3]

This report focuses on federal nondefense investment, because nearly all of the federal investment that contributes to private-sector productivity over the longer term is for nondefense purposes. In CBO's assessment, the only kind of defense investment that contributes to private-sector productivity is basic and applied research, which represents only a small share of all defense investment.

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3. In addition, the federal government can affect private-sector investment through tax and regulatory policies, but this report does not explicitly examine them.

Federal spending not included in the three categories just mentioned may also affect private-sector productivity. For example, spending for health care may boost the economy's future productivity by improving people's health in the longer term.[4] But the link between productivity and health care spending is much less clear in the empirical literature than the link between productivity and spending on physical capital, education, and R&D. For that reason, CBO does not regard health care spending as investment. The agency continues to investigate the issue, however.

The Effects of Federal Investment on the Economy and the Federal Budget

In CBO's assessment, a change in federal investment affects the economy's productivity in the longer term. An increase in federal investment increases private-sector productivity and (all else being equal) boosts GDP; a decrease does the reverse.

However, the method of financing federal investment also affects the economy in the longer term. If the investment is financed by a change in federal borrowing, rather than by offsetting changes in federal spending or revenues, the amount of money available for private investment changes as well—in the opposite direction. An increase in federal investment boosts productivity but reduces the amount of money available for private investment; a decrease in federal investment reduces productivity but boosts the amount of money available for private investment. Those two changes—in productivity and in the amount of money available for private investment—have opposite effects on output, and the net effect depends on which is stronger.

The other way to finance a change in federal investment is by changing other spending or tax policies. Those changes may themselves affect the economy by directly changing people's incentives to work and save, depending on which policies are changed and how.

Regardless of how it is financed, a change in federal investment also eventually affects interest rates. Increases in investment result in higher interest rates, and decreases result in lower ones.

Changes in federal investment also have some short-term macroeconomic effects. An increase in investment adds to overall demand, thereby making total output in the short term higher than it would have been otherwise. In the short term, an increase in investment also raises interest rates on securities with longer-term maturities. The short-term effects of a decrease in federal investment are the opposite.

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4. One recent study has found that expanding health insurance coverage for low-income children increases the rate at which they finish high school and college. See Sarah Cohodes and others, *The Effect of Child Health Insurance Access on Schooling: Evidence from Public Insurance Expansions*, Working Paper 20178 (National Bureau of Economic Research, May 2014), www.nber.org/papers/w20178.

Those long- and short-term macroeconomic effects of a change in federal investment feed back into the federal budget, adding to or subtracting from the change's direct budgetary effect. Two feedback effects are particularly strong: Changes in output alter the amount of taxable income and thus affect federal revenues; and changes in interest rates affect the federal government's interest payments.

CBO accounts for the effects of federal investment in its baseline economic projections (which show the path that the economy would follow if current law generally remained the same) and in its analyses of some fiscal policy proposals. Each year, for example, CBO's macroeconomic analysis of the President's budget identifies the proposals likely to change the amount of federal investment and examines their macroeconomic and budgetary effects (see Box 1).

Longer-Term Effects on Output From Changes in Productivity

A change in federal investment affects output in the longer term mainly by affecting the private sector's productivity. Spending on physical capital facilitates commerce; spending on education helps develop a skilled workforce; and spending on R&D promotes innovation. Increases in federal investment therefore tend to raise productivity and output, and decreases do the reverse. The size of those effects depends mainly on two factors: the rate of return on federal investment and the rate at which that return accrues over time.

The Rate of Return on Federal Investment. The degree to which federal investment affects long-term output by changing productivity is measured by the rate of return on federal investment—that is, by the increase in output resulting from an additional dollar of investment. Rates of return can be different for different types of investment, but because the current empirical literature does not offer a satisfactory way to estimate different rates of return for all of those types, the illustrative policies examined in this report use a single rate. That single rate reflects CBO's current best estimate of the average return on different federal investments.

The rate is also based on the assessment that, on average, federal investment ultimately yields a return that is one-half as large as the return on the average private-sector investment.[5] That assessment is derived from two estimates that, in turn, are based on a review of related research. First, CBO estimates that the average productivity of *public* investment is three-fourths as high as the average productivity of private investment, in general. Second, CBO estimates that overall, one-third of an increase in federal investment is generally offset by a decrease in investment by states

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5. For a discussion of various policy options that might increase the productivity of one type of federal investment, highway infrastructure spending, see Congressional Budget Office, *Approaches to Making Federal Highway Spending More Productive* (February 2016), www.cbo.gov/publication/ 50150.

and localities (and, to a lesser extent, by private entities).[6] On average, each dollar of federal investment increases total public investment by only two-thirds of a dollar; public investment is three-fourths as productive as private investment; and two-thirds times three-fourths equals one-half.

CBO estimates that the average rate of return on private-sector investment is currently about 10 percent—that is, that a $1 increase in private investment, all else being equal, increases output by 10 cents over a year. As a result, the average rate of return on federal investment in the illustrative policies examined in this report is about 5 percent. That estimate is broadly consistent with the findings of other researchers (see Box 2).

Several factors help explain CBO's current estimate that, on average, a dollar of federal investment increases output less than a dollar of private investment does. One factor is that federal investment is not driven by market forces; its goals include not only achieving positive economic returns but also improving quality of life, reducing inequities, supporting the work of the federal government itself, and addressing other objectives that policymakers may have. Another factor is that the federal government imposes various requirements that can increase the costs of the projects that it funds. For example, the Davis-Bacon Act of 1931 puts in place certain requirements on the wages that federally funded construction projects pay.

The estimate of the average rate of return on federal investment that CBO uses in this report is subject to considerable uncertainty, because rates of return are very difficult to determine. For instance, scientific and technological discoveries often build on prior work, making it hard to know which increases in productivity to attribute to which investments in R&D. Similarly, the education of many workers has been funded not only by the federal government but also by state and local governments, the private sector, and the workers and their families, so it is difficult to tell whose investments are responsible for the workers' increased productivity.

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6. CBO's estimate of how much states adjust their own investment spending in response to changes in federal investment is roughly in line with what the recent research literature has concluded, on average. One study has found that increases in federal highway grants are almost fully offset by lower state spending on highways, resulting in little or no increase in net spending. See Brian Knight, "Endogenous Federal Grants and Crowd-Out of State Government Spending: Theory and Evidence From the Federal Highway Aid Program," *American Economic Review*, vol. 92, no. 1 (March 2002), pp. 71–92, http://dx.doi.org/10.1257/000282802760015612. Another study, however, has found that only about half of increases in federal highway spending are offset by lower state and local highway funding. See Government Accountability Office, *Federal-Aid Highways: Trends, Effect on State Spending, and Options for Future Program Design*, GAO-04-802 (August 2004), www.gao.gov/products/GAO-04-802. A more recent study has found that highway grants resulting from the American Recovery and Reinvestment Act of 2009 (ARRA) have led to higher spending on highways by state governments. See Sylvain Leduc and Daniel Wilson, *Are State Governments Roadblocks to Federal Stimulus? Evidence on the Flypaper Effect of Highway Grants in the 2009 Recovery Act*, Working Paper 2013-16 (Federal Reserve Bank of San Francisco, September 2015), http://tinyurl.com/oro5upn (PDF, 522 MB).

Because the average rate of return on federal investment is so uncertain, CBO uses not only a central estimate of that rate in this report but also a range of possibilities around the central estimate.[7] At the high end of the range is the estimate that the average return on federal investment is equal to the average estimated return on private-sector investment—about 10 percent. At the low end is a rate of return of zero, which would mean that federal investment had no effect on future private-sector output. In CBO's view, that range covers roughly two-thirds of the distribution of the estimates found in the relevant research literature. The rate of return for a particular federal investment could lie outside that range; an investment might have a negative return (and thus dampen productivity), or it might yield a greater return than private-sector investment would. Indeed, some federal investment, such as successful R&D, can have very high returns.[8]

The uncertainty about the rate of return on federal investment does not translate into economically meaningful uncertainty about the effects of federal investment on GDP in the illustrative policies examined in this report. That is, shifting the rate of return from the low end to the high end of CBO's range does not change an investment's estimated effects on GDP much in relation to the size of the economy—because those effects are relatively small in relation to GDP for all points in the range. (It does, however, change those effects considerably in relation to the size of the investment itself.)

The Rate at Which the Return on Federal Investment Accrues Over Time. The benefits that result from an investment may occur over many years, and the timing of those benefits varies for the different types of investment. A new highway can improve transportation as soon as it is built, for example, but the economic benefits of early childhood education take longer to materialize. In general, in CBO's assessment, investments in education and in R&D take considerably longer to boost private-sector output than investments in physical capital do. In fact, some investments in education and R&D may take a decade or more to affect output.

In CBO's view, returns on federal investment accrue more slowly than returns on private investment do, on average. That is because most private-sector investment is for physical capital, whereas the majority of federal nondefense investment—56 percent from 1985 through 2012—is for education and R&D.

When analyzing the illustrative policies in this report, CBO used an approach that attempts to reflect how long the different types of federal investment take to affect private-sector output. Specifically, CBO estimated that only 5 percent of a federal investment becomes productive in the year of the investment, on average; that in the

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7. Here, a central estimate is one that uses values at the midpoints of estimated ranges for key inputs.

8. See Congressional Budget Office, *Federal Support for Research and Development* (June 2007), p. 15, www.cbo.gov/publication/18750.

following three years, an additional 20 percent, 15 percent, and 10 percent become productive; that an additional 5 percent becomes productive in each of the following six years, for a total of 80 percent after ten years; and that an additional 2 percent becomes productive in each of the following ten years, so that by the twentieth year, the entire investment has contributed to productivity (see Figure 1). CBO also estimated that federal investment depreciates over time at an annual rate of 2 percent, so that its returns gradually diminish and eventually fade out completely.

Longer-Term Effects on Output From Changes in Federal Borrowing

If a change in federal investment is not financed by offsetting changes in other spending or revenue policies, it must necessarily be financed by a change in federal borrowing. That change affects output in the longer term by affecting private investment.

Increased federal borrowing reduces the amount of money available for private investment—a phenomenon called crowding out.[9] CBO's central estimate is that for each dollar that the federal deficit increases, domestic private investment falls by 33 cents. That reduction in private investment results in a smaller capital stock, eventually shrinking output. Similarly, a reduction in federal borrowing leaves more money available for private investment, resulting in a larger capital stock and eventually greater output. Because the effect of federal borrowing on private investment is uncertain, CBO also uses a range of estimates for that effect, calculating that for each dollar that the federal deficit increases, domestic private investment falls by an amount ranging from 15 cents to 50 cents.[10]

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9. An increase in federal investment financed by federal borrowing also increases private saving and net inflows of foreign capital, tending to increase the amount of money available for private investment; however, those increases are smaller than the increase in federal borrowing, and therefore the net effect is less national saving and the crowding out of private investment. Increased deficits lead to greater private saving for two reasons. First, some people expect that policymakers will raise taxes or cut spending in the future to cover the cost of paying interest on the additional federal debt, so they start saving more to prepare for paying higher taxes or receiving less in benefits. Second, additional federal borrowing tends to raise interest rates, which boosts the return on saving. The increased net inflows of foreign capital—that is, foreign purchases of U.S. assets minus U.S. purchases of foreign assets—are partly a response to the higher interest rates that accompany larger federal deficits. Unlike U.S. investors, however, foreign investors are not motivated by the need to start saving more in anticipation of future tax increases or spending cuts.

10. The estimates are based on CBO's review of relevant studies published over the past two decades. For more detail, see Jonathan Huntley, *The Long-Run Effects of Federal Budget Deficits on National Saving and Private Domestic Investment*, Working Paper 2014-02 (Congressional Budget Office, February 2014), www.cbo.gov/publication/45140.

Longer-Term Effects on Output From Changes in Other Spending and Revenue Policies

If a change in federal investment is financed by changes in other spending or revenue policies, rather than by a change in federal borrowing, it does not affect the amount of money available for private investment. However, the changes in those spending or revenue policies may affect output by directly altering people's incentives to work and save. For example, if an increase in federal investment was financed by an increase in marginal tax rates (that is, the rates that apply to an additional dollar of income), people's after-tax wages would fall, reducing their incentive to work—and thus reducing the labor supply and output. CBO estimates that most changes in mandatory spending or revenues would directly affect people's incentives to work and save, but that changes in noninvestment discretionary spending would not.[11]

Longer-Term Effects on Interest Rates

Regardless of how it is financed, a change in federal investment affects interest rates in the longer term, CBO estimates. An increase in federal investment raises the productivity of labor and private capital and thus increases the return on that capital. That higher return increases the return on equity shares in the ownership of capital that investors purchase. Returns on other types of investment that compete for the investors' money then also rise; those other types of investment include U.S. Treasury securities.

The increase in interest rates boosts saving—pushing interest rates back down, but not enough to offset the original increase. And if the increase in federal investment is financed by a change in federal borrowing, interest rates rise further, because the increased borrowing heightens competition for investors' money.

Decreases in federal investment have the opposite effect: They result in lower interest rates in the longer term.

Short-Term Effects on Output and Interest Rates

In the short term, an increase in federal investment (unless it is offset by reductions in other federal spending) makes total output higher than it would have been otherwise. That happens because the increase in investment adds to overall demand, leading businesses to boost production. For example, the federal purchase of a new building might increase production by architectural firms, construction companies, and the companies that they contract with. Those companies would then hire more workers, who would demand more goods and services from other businesses.

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11. Discretionary spending refers to the outlays that result from budget authority provided by appropriation acts; mandatory spending refers to the outlays that result from budget authority provided by other laws—mostly spending for benefit programs such as Social Security, Medicare, and Medicaid.

The size of that effect depends on the state of the economy. The effect would be smaller if the increase in federal investment occurred when output was at or above its potential level.[12] In that case, the Federal Reserve would respond, in CBO's view, by increasing short-term interest rates and restraining the rise in overall demand in order to prevent inflation from rising above the central bank's longer-term goal. By contrast, if the increase in federal investment occurred when output was well below its potential level, the Federal Reserve would probably not respond by trying to restrain the boost in overall demand, and consequently the effect on overall demand would be larger.

If an increase in federal investment is financed by changes in other spending or revenue policies, those changes also affect output in the short term. For example, a reduction in noninvestment spending would subtract from overall demand, thereby offsetting the effect on output from the increase in investment spending. Output would remain unchanged in the short term if the kinds of noninvestment spending that were reduced had the same effect on demand as investment spending.

In the short term, an increase in federal investment also raises interest rates on securities with longer-term maturities. Increased federal investment boosts private-sector productivity in the longer term and hence the rate of return on future private investments; lenders, anticipating that higher rate of return, demand higher interest rates for long-term debt. In addition, if the increase in federal investment was financed by an increase in federal borrowing, the increases in current and projected deficits would immediately push up long-term interest rates and eventually boost short-term interest rates as well.

A decrease in federal investment has short-term effects that are the opposite. It lowers the overall demand for goods and services, thereby lowering output; and because it would eventually reduce private-sector productivity, it pushes down interest rates on securities with longer-term maturities. In addition, if it led to a reduction in federal borrowing, the anticipation of lower federal deficits would put further downward pressure on interest rates.

Other Effects

The macroeconomic effects of a change in federal investment can be amplified or muted by the actions of state and local governments and private businesses. The amplification occurs when federal investment serves as a complement to others' investment—when, for instance, an increase in federal spending for R&D leads to results that private firms build on. The muting occurs when federal investment serves as

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12. Potential output is not the nation's greatest possible output, which would occur if labor and capital were employed to their utmost extent, but rather the greatest output that can be sustained over a prolonged period without straining productive capacity and increasing the risk that inflation will rise above the Federal Reserve's goal. For further discussion of how CBO defines and estimates potential output, see Congressional Budget Office, *Why CBO Projects That Actual Output Will Be Below Potential Output on Average* (February 2015), www.cbo.gov/publication/49890.

a substitute for investments by state and local governments and private entities—that is, replacing investments that they would otherwise have made. In addition, increases in federal investment can reduce nonfederal investment by raising demand for investment goods and thus the price of those goods. On net, CBO's interpretation of the economics literature suggests that a $1 increase in federal investment reduces investment by states, localities, and private entities by one-third of a dollar. That reduction dampens the net effect of an increase in federal investment on output and interest rates, in both the short term and the long.

Some recent research suggests that policies that raise demand in the short term, especially during a deep recession or a slow recovery, can have positive economic effects in the long term as well. For example, an increase in demand for labor might prevent the erosion of some workers' skills during a period when labor is underused, eventually making the economy stronger than it would have been otherwise.[13] If that is the case, the short-term changes in demand caused by a change in federal investment could affect long-term output. Such effects are uncertain, so CBO does not incorporate them into its analyses, but it continues to investigate the issue.

Federal investment can also provide a range of noneconomic benefits. For example, improvements in transportation infrastructure can reduce congestion, thus increasing drivers' leisure time. That benefit is not measured in GDP, however.

Feedback Effects on the Federal Budget

Changes in federal investment may affect the budget directly by either increasing or reducing total federal spending, and the resulting economic changes feed back into the budget and affect it further. Of such feedback effects, two are particularly powerful: An increase in output raises taxable income and thus federal revenues, and an increase in interest rates increases the federal government's interest payments. Decreases in output and interest rates have the opposite effects.

There are many other kinds of feedback. For example, if an increase in federal investment boosted output, unemployment would fall in the short term (thereby affecting federal spending on unemployment benefits); interest rates would rise, increasing the proportion of capital income earned as interest (affecting federal revenues); and earnings would rise (affecting federal spending on Social Security benefits).

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13. See Dave Reifschneider, William Wascher, and David Wilcox, *Aggregate Supply in the United States: Recent Developments and Implications for the Conduct of Monetary Policy*, Finance and Economics Discussion Series Paper 2013-77 (Board of Governors of the Federal Reserve System, November 2013), http://go.usa.gov/5rZP; and J. Bradford DeLong and Lawrence H. Summers, "Fiscal Policy in a Depressed Economy," *Brookings Papers on Economic Activity* (Spring 2012), pp. 233–290, http://tinyurl.com/ccu2sgb.

Changes in Federal Investment That Are Financed by Offsetting Changes in Spending: Two Illustrative Policies

Changes in federal investment affect output chiefly by affecting the private sector's productivity. To isolate that effect, CBO analyzed two illustrative policies that would change the amount of federal investment and finance that change by making offsetting changes in discretionary spending on other goods and services. Because the policies would not alter total federal spending, they would not affect demand in the short term. (Specifically, CBO assumed that the kinds of discretionary spending that were changed had the same effect on overall demand each year that federal investment did.) Because the policies would not change federal borrowing, they would not affect the amount of money available for private investment in the longer term. And CBO assumed that the offsetting changes in spending would not directly affect people's incentives to work or save. Therefore, the policies would affect the economy only by changing productivity.

The first policy would change funding for federal investment by $100 billion in fiscal year 2016 and funding for other discretionary spending by an offsetting amount. The second policy would start in 2016 and last a decade, changing funding for federal investment by $50 billion per year and changing funding for other discretionary spending by an offsetting amount each year. (In each policy, the change in investment *spending* would likewise equal the change in noninvestment spending every year.)[14] The total change in investment funding, $500 billion, would be similar to the 10-year increase in investment spending proposed in the President's 2017 budget (see Box 1).

CBO studied not only the policies' effects on the economy but also how those macroeconomic effects would feed back into the federal budget. In estimating that feedback, the agency did not use the detailed program-by-program analysis that it uses for its regular budget projections. Instead, it used a simplified analysis that incorporated average feedback effects on outlays and revenues.

For the sake of simplicity, the rest of this discussion focuses on what would happen if the changes were increases in investment. Decreases would have roughly opposite effects.

Policy 1: A $100 Billion Increase in Funding

The first illustrative policy would be a onetime $100 billion boost in funding for federal investment at the beginning of fiscal year 2016. The composition of the increase would roughly match the average composition of nondefense federal investment from 1988 to 2008: A little under half would pay for physical capital, about a third for education and training, and the remaining quarter for R&D.[15]

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14. Spending refers to cash disbursements from the Treasury; funding, by contrast, is the authority to enter into obligations that result in that spending.

15. CBO selected the period from 1998 to 2008 to exclude the effects of ARRA, which temporarily increased certain types of federal investment spending above their historical averages as a share of GDP.

Although the increase in funding would take place all at once, the increase in spending would occur slowly, and it would occur at different rates for the three varieties of investment, as historical experience suggests. In particular, the funds for physical capital would be spent more slowly than the other funds would, because of the time necessary for design, contracting, and construction. CBO estimates that 14 percent of the policy's total increase in spending would occur in fiscal year 2016; that roughly two-thirds would occur by the end of fiscal year 2018; and that nearly all of the funds— $98 billion—would be spent by 2025 (see Table 1).

The increase in federal investment would slowly boost productivity and output, and the resulting macroeconomic feedback would reduce deficits over the next decade.

Effects on the Economy. In calendar years 2016 and 2017, the increase in federal investment would have little effect on GDP or on gross national product (GNP).[16] The reason is that the offsetting changes in noninvestment discretionary spending would leave overall demand unchanged in the short term, and returns due to higher productivity occur slowly. After 2017, GDP would rise very gradually, ending up $4 billion (or about 0.02 percent) higher in 2025 than it would have been otherwise (see Figure 2 and Table 2). The increase in GDP would occur gradually not only because it takes time for federal investment to affect productivity but also because the spending increase would not take place all at once. Over the 2016–2025 period, the cumulative increases in GDP and GNP would be $19 billion and $14 billion, respectively.

Mostly because the policy's increase in investment would be small as a percentage of GDP, its effect would not change much—when measured as a percentage of GDP—if the return on federal investment was lower or higher than CBO's central estimate. If the return on federal investment was zero, GDP would be unchanged throughout the 2016–2025 period. If the return on federal investment was as high as the return on private investment, GDP would be $8 billion higher in 2025 (about 0.03 percent of projected GDP in that year) and a cumulative $39 billion higher over the period. GNP would be affected similarly, ranging between unchanged and $7 billion higher in 2025 and between unchanged and $30 billion higher over the whole of the period.[17]

The increase in federal investment would also result in interest rates that were slightly higher in 2025 than they are projected to be under current law. The reason is that the increased productivity of labor and private capital would raise the return on capital,

16. GNP differs from GDP, the more common measure of the output of the economy, by including the income that U.S. residents earn abroad and excluding the income that nonresidents earn in this country.

17. CBO has not quantified two different kinds of uncertainty: about the speed with which funds are spent, and about the speed with which investment increases productivity. In all of the illustrative policies examined here, higher speeds on both fronts would result in larger increases in output over the decade; lower speeds would result in smaller increases in output.

boost the return on equity shares in the ownership of capital, and therefore also boost the rates of return on financial assets of other types. (The higher interest rates explain why the increase in GDP would be larger than the increase in GNP: Interest income earned by foreigners would rise, and that income is included in GDP but excluded from GNP.)

Effects on Deficits. Because the increase in investment spending would be exactly offset by a decrease in other discretionary spending, the policy would not directly affect the deficit. However, its macroeconomic effects would feed back into the budget. Because the policy would slowly raise productivity and thereby increase GDP slightly, revenues from fiscal years 2016 to 2025 would be a cumulative total of $3 billion higher than they are projected to be under current law. And because the policy would result in slightly higher interest rates and thus increased interest payments on federal debt, spending would be a cumulative total of $1 billion higher. Therefore, deficits would be $2 billion smaller over the decade, CBO estimates. CBO's full range of estimates of the rate of return on federal investment suggests that the effect on deficits would be between zero and a $5 billion reduction over the decade.

Policy 2: A $500 Billion Increase in Funding

To examine the effects of a larger and longer-lasting change in federal investment on productivity, CBO evaluated a policy that would increase funding for federal investment by $50 billion per year for 10 years and finance that increase with offsetting changes in other discretionary spending. As in the previous illustrative policy, because total spending would not change, there would be no effect on demand in the short term, and because federal borrowing would not change, there would be no effect on the amount of money available for private investment in the longer term. Therefore, the policy would affect output only by increasing productivity. However, because investment funding would rise by a much larger amount and over a longer period than under the previous policy, the impact on productivity and output would be larger and would last longer.

Just as in the first policy, CBO allocated the increase in funding to the three major types of federal investment according to their average shares of total federal investment for nondefense purposes from 1988 to 2008. And again, the increase in total spending would occur more slowly than the increase in funding: Only $398 billion of the total $500 billion would be spent by 2025, the agency estimates (see Table 1). Indeed, only $485 billion would be spent by 2032.

As in the previous policy, macroeconomic feedback from the slow boost in productivity and output would reduce deficits over the next decade—albeit by greater amounts.

Effects on the Economy. The policy's increase in federal investment would have little effect on GDP and GNP in 2016 and 2017, CBO estimates. By slowly increasing productivity, the policy would then boost output gradually; in 2025, GDP would be

higher by $10 billion (or about 0.04 percent of projected GDP in that year) than under current law, and over the 2016–2025 period, it would be a cumulative $33 billion higher (see Table 3). GNP would increase by $7 billion in 2025 and by a cumulative $24 billion between 2016 and 2025.

Although the 10-year increase in investment spending under this policy ($398 billion) would be about four times as large as the one under the previous policy, the resulting cumulative increase in GDP ($33 billion) would be less than twice as large. The reason is that under this policy, most of the spending would occur in the second half of the next decade; during the first half, the policy's spending would be less than twice as large as the previous policy's. Because it takes time for federal investment to affect productivity, that later spending would not affect the economy's output between 2016 and 2025 as much as the spending in the first half of the decade would.

This policy's increase in investment funding would take place over a longer period than the previous policy's would, so the resulting boost in productivity and output would continue well beyond 2025. By CBO's estimates, the largest effect (relative to the size of the economy) would occur in 2035, when GDP would be about 0.06 percent higher than projected under current law.

Also, because the total change in federal investment would be larger than in the previous policy, varying the return on federal investment would have a larger impact on CBO's estimate of how much the policy would increase output. If the rate of return was zero, CBO estimates that GDP would be unchanged throughout the 2016–2025 period. If the rate of return was as high as the rate of return on private investment, GDP would be $20 billion higher in 2025 and $69 billion higher cumulatively over the decade.

Just as the previous policy would, this one would raise the return on capital, equities, and assets of other types. As a result, interest rates would be slightly higher in 2025 than they are projected to be under current law, CBO estimates.

Effects on Deficits. Once more, the policy's increase in investment spending would be exactly offset by a decrease in noninvestment discretionary spending each year, so the policy would not directly affect the deficit. However, the resulting increase in the economy's output would feed back into the budget, making revenues $6 billion higher between 2016 and 2025 than they will be under current law. Spending would increase by $1 billion, mainly because the higher interest rates would increase interest payments on federal debt. On net, deficits would be $4 billion smaller over the next decade, CBO estimates.[18] According to CBO's full range of estimates, deficits would be between unchanged and $8 billion smaller over the decade.

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18. Because of rounding, the stated effect on the deficit does not exactly equal the stated effect on revenues minus the stated effect on spending.

Changes in Federal Investment That Are Financed by Changes in Federal Borrowing: Two Illustrative Policies

To examine how the effect of federal investment on output depends on its financing, CBO analyzed two illustrative policies that would be financed by a change in borrowing. The policies would influence the economy in three ways. First, they would change productivity, just as the previous two policies would. Second, because there would be no offsetting changes in spending or revenues, total federal spending would change, affecting overall demand in the short term. Third, the change in borrowing would affect the amount of money available for private investment.

Because those three effects would occur at different rates, whether their net impact on output was positive or negative would change over time. During the first two years, CBO estimates, changes in overall demand would constitute the largest effect on output—boosting output or reducing it, depending on whether the change in investment was an increase or a decrease. After that, the net impact on output would be determined by the other two effects.

CBO assumed that the policies' changes in investment would be distributed among the three varieties of investment in the same proportions as in the previous two illustrative policies. The agency also assumed that the rates of spending for the three varieties would be the same as in those policies. And once again, the rest of this discussion focuses on what would happen if the changes in investment were increases; decreases would have roughly opposite effects.

Policy 3: A $100 Billion Increase in Funding

This policy, like the first policy described above, would be a onetime $100 billion increase in funding for federal investment in 2016—but in this case, the increase would be paid for with federal borrowing. Over the next decade, the policy would increase output and deficits.

Effects on the Economy. In the short term, the policy's effect on overall demand would be the strongest factor increasing output. GDP would be an estimated $22 billion higher in calendar year 2016, and also in 2017, than it is projected to be under current law. Those figures represent CBO's central estimates; using likely ranges for key parameters (in particular, the extent to which higher overall demand raises output), the agency estimates that GDP would be between $9 billion and $35 billion higher in 2016, and between $6 billion and $38 billion higher in 2017, than under current law.

By 2025, the policy's positive effects on GDP resulting from heightened productivity would be slightly stronger than the negative effects on GDP resulting from the crowding out of private investment. As a result, GDP in that year would be about $1 billion higher than the amount projected under current law, according to CBO's central estimate; using ranges of estimates for key parameters, the agency estimates that GDP

would be as much as $10 billion higher or $8 billion lower than under current law (see Table 4).

Over the whole of the next decade, the policy's positive effects on GDP (resulting from the short-term boost in overall demand and from the longer-term rise in productivity) would be greater than its negative effects (from the crowding out of private investment). As a result, GDP would be higher by a cumulative $45 billion over the decade than projected under current law, CBO estimates—or between $32 billion lower and $129 billion higher, if likely ranges for key parameters are used.

The policy's effects on GNP would be noticeably different from its effects on GDP because it would increase interest payments and profits earned by foreigners, whose income earned in this country is included in GDP but not in GNP. Under the policy, GNP in 2025 would be $5 billion lower than projected under current law, according to CBO's central estimate; according to the ranges of estimates for key parameters, GNP would be between $14 billion lower and $5 billion higher. Over the decade, GNP would be a cumulative $5 billion higher than under current law—or between $92 billion higher and $73 billion lower, according to the ranges for key parameters.

In the short term, according to CBO's central estimates, the interest rate on 10-year Treasury securities would be 0.02 percentage points higher in 2016, and 0.03 percentage points higher in 2017, than projected under current law. That would happen because the Federal Reserve would modestly raise short-term interest rates in response to the policy's increase in overall demand, CBO expects. That increase in short-term rates would also push up long-term interest rates. Over the remainder of the decade, changes in interest rates would be largely driven by the policy's increase in productivity, which would raise the return on capital, and by the policy's increased borrowing, which would crowd out private investment. But because those two effects would be small, interest rates would be little changed by 2025.

Effects on Deficits. From fiscal years 2016 to 2025, the policy would directly make the deficit larger by financing the increase in federal investment through increased federal borrowing. The direct increase in the deficit, a cumulative $98 billion, would be slightly less than the policy's $100 billion increase in funding because not all of that funding would be spent by the end of the decade.

Macroeconomic feedback from the policy would increase the deficit further. Mostly because of higher overall demand in the short term, federal revenues would rise by $4 billion cumulatively from 2016 to 2025. And mostly because higher interest rates would boost interest payments on federal debt, spending would rise by $17 billion cumulatively from 2016 to 2025. The total budgetary cost of the policy would thus

increase by $13 billion, to roughly $110 billion. According to the full range of estimates, the net increase in deficits would be between $102 billion and $119 billion over the decade.[19]

The macroeconomic feedback resulting from the policy would differ in a number of ways from the feedback resulting from the first policy described above. Under that policy, the feedback effects on revenues would occur more slowly, because they would result solely from the policy's gradual increase in productivity. And the feedback effects on spending would be smaller in the first policy because that policy would increase interest rates less.

Policy 4: A $500 Billion Increase in Funding

This policy, like the second policy described above, would increase funding for federal investment by $50 billion per year for 10 years, starting in fiscal year 2016. But like the third policy, it would be financed by a change in federal borrowing. Over the next decade, it would increase cumulative output slightly and boost cumulative deficits.

Effects on the Economy. Because this policy would initially increase federal investment less than the third policy would, its effect on overall demand in the short term would be smaller. CBO estimates that greater overall demand would make GDP $12 billion higher in calendar year 2016, and $18 billion higher in 2017, than projected under current law. Using likely ranges for key parameters, the agency estimates that the increase in GDP would be between $5 billion and $19 billion in 2016 and between $5 billion and $31 billion in 2017.

However, because the cumulative increase in federal investment and borrowing would be much larger under this policy than under the third policy, the longer-term increase in productivity would be greater, and so would the crowding out of private investment. In 2025, the negative effect on output from crowding out would be stronger than the positive effect from increased productivity, CBO estimates. (That would happen under this policy but not under the third because in this case, the increase in investment spending would occur more slowly, and the full impact of the policy on productivity would therefore take longer to materialize.) As a result, this policy would make GDP in 2025 $9 billion (or 0.03 percent) lower than projected under current law (see Table 5). GNP would be lower by a much greater amount, $29 billion. This policy's large increase in federal investment also means that using a range of estimates of the return on federal investment (and of the other key parameters) has a larger impact on output: Using that range, CBO estimates that GDP would be between $15 billion higher and $28 billion lower in 2025.

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19. Also, under this policy, the additional federal borrowing itself would further swell the government's interest payments on the national debt by $31 billion from 2016 to 2025. By long-standing Congressional convention, CBO's cost estimates do not include changes in debt service resulting from changes in the amount of debt. So if CBO were producing a cost estimate for a policy like this one that accounted for macroeconomic feedback, it would include the $13 billion in feedback effects but not the $31 billion change in debt service.

Over the next decade, as with the third policy examined above, the cumulative boost in GDP that would result from the short-term increase in overall demand and from the gradual rise in productivity would be stronger than the negative effects from crowding out. From 2016 through 2025, CBO estimates, GDP would be higher than projected under current law by a cumulative $15 billion (or between $95 billion lower and $140 billion higher, when likely ranges for key parameters are used). Chiefly because of more interest payments flowing overseas, GNP would be lower by a cumulative $69 billion (or between $186 billion lower and $67 billion higher). Also as with the previous policy, interest rates would increase slightly, because increased government spending would boost overall demand, increased productivity would raise the return on capital, and increased borrowing would crowd out private investment.

The policy's effects on output would continue well beyond 2025. According to CBO's estimates, the greatest effect on output resulting from the policy's increase in productivity would occur in 2035; thereafter, that effect would diminish, as the investments purchased under the policy continued to depreciate. Even in 2035, however, that positive effect on output from increased productivity would be weaker than the negative effect from crowding out. On net, CBO estimates, GDP in 2035 would be about 0.04 percent lower than projected under current law.

Effects on Deficits. The policy's changes in federal borrowing would directly increase deficits by a cumulative $398 billion from fiscal years 2016 to 2025. Again, that increase would be less than the policy's total $500 billion increase in funding because not all of that funding would be spent by the end of the decade.

Macroeconomic feedback from the policy would decrease revenues by a cumulative $4 billion from 2016 to 2025. That would occur because lower output in the second half of the decade would reduce profits while the higher interest rates boosted interest income—and profits are taxed at a higher effective rate than interest income is. Feedback would also increase spending by $23 billion, primarily because the slight increase in interest rates would boost interest payments on federal debt. As a result of those feedback effects, the budgetary cost of the policy over the decade would increase by $26 billion, to $424 billion. Under the full range of estimates, the cost would be between $407 billion and $439 billion.[20]

How the Size of a Change in Federal Investment Influences Its Effects

Over the next 10 years, the cumulative effects on GDP of the second policy described above, which would increase investment funding by a total of $500 billion, are less than twice as large as those of the first policy, which would increase investment funding by $100 billion—because the $500 billion would be spread out over a much longer period. The cumulative effects of the fourth policy on GDP, meanwhile, would be smaller than those of the third, even though the investment funding would be greater—

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20. The additional federal borrowing itself would further swell the government's interest payments on the national debt by $73 billion from 2016 to 2025.

because the deficit increases would also be greater. Nevertheless, if the timing of the spending and the nature of the financing were the same among the policies, a $500 billion policy would have effects that were about five times as large as the effects of the corresponding $100 billion policy.

The effects of still larger changes in investment, however, might not be proportional to the effects of the policies analyzed in this report. As a result, the estimates in this report might not be useful for assessing the effects of such changes. For example, very large reductions in spending could have disproportionately large effects if they led highly productive investments, such as the Interstate System of highways, to deteriorate. In addition, the effects of very large increases in federal investment might not be as large as the effects of equally large decreases. If investment projects were chosen on the basis of a ranking from most to least productive, the negative economic impact of canceling projects that were already scheduled or under way would be larger than the positive economic impact of undertaking new projects.

Some Limitations of CBO's Methods

For three main reasons, the methods that CBO used to analyze the illustrative policies in this report apply only partly to the analysis of particular proposals. First, the extent to which federal investment spending affects private-sector output by changing productivity increases over time—but at different speeds for the three major types of investment (in physical capital, R&D, and education and training). An analysis of a particular proposal would account for differences in those speeds. CBO's analysis of the illustrative policies, by contrast, uses an average percentage—one that is based on the three types' historical shares of total federal investment (see Figure 1).

CBO also used an average rate of return for all three types of investment, even though they no doubt have different rates of return, as do different investments within each type. In CBO's view, evidence is relatively weak about the rates of return on federal investment in R&D and in education and training (see Box 2). The agency therefore estimated those rates of return as a fraction of the average return on all private-sector investment; the resulting rates were roughly equal to CBO's estimate of the average rate of return on federal investment in physical capital. So for the sake of simplicity, CBO used a single rate of return—equal to the value for physical capital—for all three types in its evaluation of the illustrative policies.

A third feature of this analysis that may not apply to specific proposals is the way that it accounts for states', local governments', and private entities' adjustments of their own investment spending in response to changes in federal investment. Those adjustments may magnify or mute the effects of the original federal investment on output, depending on the details of the proposal and the condition of the state and local governments' finances. CBO's estimate of nonfederal responses is consistent with the findings in the recent research literature. However, the studies in that literature are limited in scope—they largely examine state highway spending—and their estimates vary considerably.

About This Document

This report provides background information about how the Congressional Budget Office estimates the effects of federal investment on the economy and on the budget. In keeping with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Keith Hall Director

June 2016

The Effects of Federal Investment Proposed in the President's Budget for 2017

Each year, after the President releases the Administration's budget request, the Congressional Budget Office analyzes the proposals in that request. Using its own economic projections and estimating procedures, CBO projects what the federal budget would look like over the next 10 years if the President's proposals were adopted. CBO usually provides that information in two reports. In general, the first report examines the proposals' direct effects on the budget; the second, which takes more time to prepare, shows the effects that the proposals would have on the economy and how those macroeconomic effects would, in turn, feed back into the budget.[21]

In the President's 2017 budget, he proposed to increase federal investment by boosting spending on surface transportation, education and job-training programs, and research and development (R&D). To that end, the President has proposed increasing the existing limits on discretionary spending for 2017 through 2021 and setting limits for the 2022–2026 period that would be higher than the amounts projected in CBO's baseline. CBO estimates that during the 2017–2026 period, federal investment would be $514 billion greater under the President's proposals than it is in the baseline.

Such an increase would eventually boost the economy's potential output (which is the economy's maximum sustainable level of production) by raising productivity—by amounts that would differ by the type of investment. However, the increase in investment would probably reduce potential output slightly over the 10-year period, in CBO's assessment: The small increases in productivity occurring during that period would be more than offset by the fact that the increase in investment would temporarily encourage people to leave the labor force and enter school (an effect that would be particularly strong for a proposed increase in investment in higher education). After completing school, however, the people who had left the labor force would rejoin it and be more productive than they would have been otherwise.

The proposed increases in investment would have a limited effect on productivity over the next decade partly because certain types of investment take a while to begin boosting output. For instance, CBO expects that the proposed increases in spending for early childhood education would boost the eventual earnings of people who are currently children in preschool, but not until after 2026. Similarly, there would be lags between spending money on transportation and R&D and seeing potential output rise—a shorter lag in the former case, a longer one in the latter. All told, CBO estimates that only $234 billion, less than half of the total increase in federal investment, would begin to have an effect on potential output between 2017 and 2026. (That share is smaller than the corresponding share in the illustrative policies examined in this report.) Most of the boost to the economy's potential output resulting from that $234 billion increase in investment—as well as all of the other $280 billion—would occur well after 2026.

The investment proposals in the President's 2017 budget would have many other effects on the economy. In particular, by increasing productivity, they would raise the return on investment (that is, interest rates) and the return on working (that is, wages and salaries). Those increases would

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21. See Congressional Budget Office, *An Analysis of the President's 2017 Budget* (March 2016), www.cbo.gov/publication/51383; and Congressional Budget Office, *A Macroeconomic Analysis of the President's 2017 Budget* (June 2016), www.cbo.gov/publication/51625.

strengthen people's incentives to save, invest, and work, and they would also increase the government's interest payments. As this report explains, the size of those effects would depend on how the President's investment proposals were financed. But there is no way to clearly identify that financing, because the President's budget request included many changes to spending and did not specify how any particular change would be financed. (CBO's analysis of the macroeconomic effects of the President's proposals incorporated the effects of the financing of that budget as a whole.)

Finally, the President's budget proposals would have many effects on the economy beyond those resulting from changes in federal investment.

Box 2.

Researchers' Estimates of the Effects of Public Investment on Output

Researchers' estimates of the long-term effects of public investment on output vary according to the type of investment under consideration. Studies of investment in physical capital typically provide a direct estimate of the investment's effect on output. By contrast, studies of education and of research and development (R&D) typically provide only indirect evidence. For example, many researchers have estimated the effect of additional years of education on people's wages, and some have estimated the effects of additional years of education on output, but there are few estimates of the direct effect on output of federal investment in education. Similarly, though some researchers have estimated the effect of federal investment in R&D on various outcomes (such as the number of patents granted), there is little evidence of how those outcomes affect output.

Because there are few estimates of the direct effect on output of federal investment in education and in R&D, the Congressional Budget Office bases its estimate of the productivity of federal investment primarily on researchers' estimates of the productivity of investment in public physical capital. On the basis of published studies on the U.S. economy, CBO estimates that an increase in public investment that increases public capital by 1 percent boosts private-sector output by about 0.06 percent in the long term, on average.[22] That is, the long-term *elasticity* of output with respect to public capital is roughly 0.06. Research that estimates the effect on output of a particular kind of investment in physical capital, highway spending, similarly suggests that the elasticity ranges from 0.04 to 0.09.[23]

The elasticity of 0.06 is roughly consistent with the findings of a recent survey.[24] That survey looked at 68 studies, conducted between 1983 and 2008, that examined government investment in physical capital as far back as the 1940s. The studies found long-term elasticities that ranged from negative

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22. Here, public capital is the total fixed assets of federal, state, and local governments.

23. See M. Ishaq Nadiri and Theofanis P. Mamuneas, *Contribution of Highway Capital to Industry and National Productivity Growth* (prepared by Apogee Research, Inc., for the Federal Highway Administration, Office of Policy Development, September 1996), www.ntl.bts.gov/lib/5000/5800/5807/growth.pdf (1.0 MB); and John Fernald, "Roads to Prosperity? Assessing the Link Between Public Capital and Productivity," *American Economic Review*, vol. 89, no. 3 (June 1999), pp. 619–638, http://tinyurl.com/pzg9qtt. For further discussion, see Congressional Budget Office, *Approaches to Making Federal Highway Spending More Productive* (February 2016), www.cbo.gov/publication/50150.

24. Pedro R. D. Bom and Jenny E. Ligthart, "What Have We Learned From Three Decades of Research on the Productivity of Public Capital?" *Journal of Economic Surveys*, vol. 28, no. 5 (December 2014), pp. 889–916, http://dx.doi.org/10.1111/joes.12037.

to significantly positive. After accounting for the studies' differences in scope and design, the survey reported a long-term elasticity of output with respect to all national public capital that was roughly 0.12. However, the survey also reported that studies examining relatively recent periods had found significantly lower elasticities, suggesting that the elasticity has declined over time and that the current elasticity is significantly lower than 0.12.

CBO's estimate of the elasticity of output with respect to public capital, 0.06, implies that the average return on an additional dollar of federal investment is about 5 percent, which is roughly one-half as large as CBO's current estimate of the average return on an additional dollar of private investment.[25] That 5 percent is therefore CBO's central estimate. In CBO's judgment, that central estimate, and the range of estimates that the agency uses to assess the uncertainty surrounding it, are consistent with the range of estimates found in the research literature.

The research literature also provides evidence that increased public investment strongly boosts output in the short term. For example, a recent study by the International Monetary Fund found that in advanced and developing economies alike, increases in public infrastructure investment significantly increased output in the short term (as well as in the long term).[26] Another recent study found that in the United States, increases in state highway spending boosted state output in the year of the spending increase and one year afterward.[27] Those findings are consistent with CBO's estimates, in this report, of the short-term effects of increases in investment that are not financed by means of offsetting spending cuts.

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25. The return on an additional dollar's worth of public capital is calculated as the elasticity of output with respect to public capital, roughly 0.06, multiplied by the ratio of output to public capital, which is estimated to have been about 1.3 in 2015. (For a similar approach to calculating that return, see Bom and Ligthart, p. 907.) That calculation yields a rate of return on public capital of about 8 percent. In CBO's view, however, an additional dollar of federal investment increases public capital by only about two-thirds of a dollar, on average, because the remaining one-third is offset by a decrease in investment by state and local governments. So the average rate of return on an additional dollar of federal investment is about two-thirds times 8 percent—that is, about 5 percent.

26. Abdul Abiad and others, "Is It Time for an Infrastructure Push? The Macroeconomic Effects of Public Investment," in *World Economic Outlook: Legacies, Clouds, Uncertainties* (International Monetary Fund, October 2014), pp. 75–114, www.imf.org/external/pubs/ft/weo/2014/02.

27. The estimated effect on state output then became negative for a few years, then became significantly positive, and finally disappeared about 10 years after the increase in spending. See Sylvain Leduc and Daniel Wilson, *Roads to Prosperity or Bridges to Nowhere? Theory and Evidence on the Impact of Public Infrastructure Investment*, Working Paper 18042 (National Bureau of Economic Research, May 2012), www.nber.org/papers/w18042.

Figure 1.

The Share of Federal Investment That Becomes Productive Under the Illustrative Policies

Percent

Year After Purchase
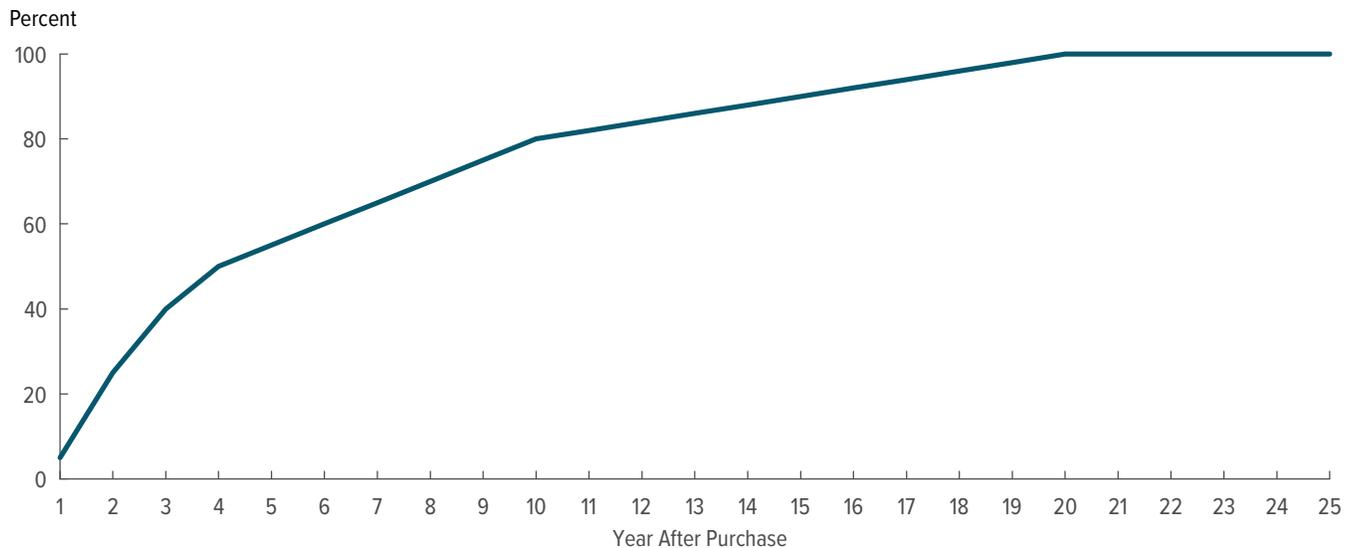
Source: Congressional Budget Office.

Table 1.

Funding and Spending in the Illustrative Policies

Billions of Dollars

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total, 2016–2025
Policies 1 and 3											
Additional Funding for Investment	100	0	0	0	0	0	0	0	0	0	100
Estimated Outlays	14	35	21	14	9	3	2	1	*	*	98
Policies 2 and 4											
Additional Funding for Investment	50	50	50	50	50	50	50	50	50	50	500
Estimated Outlays	7	25	36	43	46	47	49	49	48	48	398

Source: Congressional Budget Office.

Outlays are cash disbursements from the Treasury; funding, by contrast, is the authority to enter into obligations that result in that spending.

In Policies 1 and 2, the increases in investment funding would be financed by offsetting changes in noninvestment discretionary spending.

The total amount spent and the timing of the spending could vary, depending on the particular components of the increase in federal investment.

* = between zero and $0.5 billion.

Figure 2.

The Effects of the Illustrative Policies on Output and the Deficit

Billions of Dollars
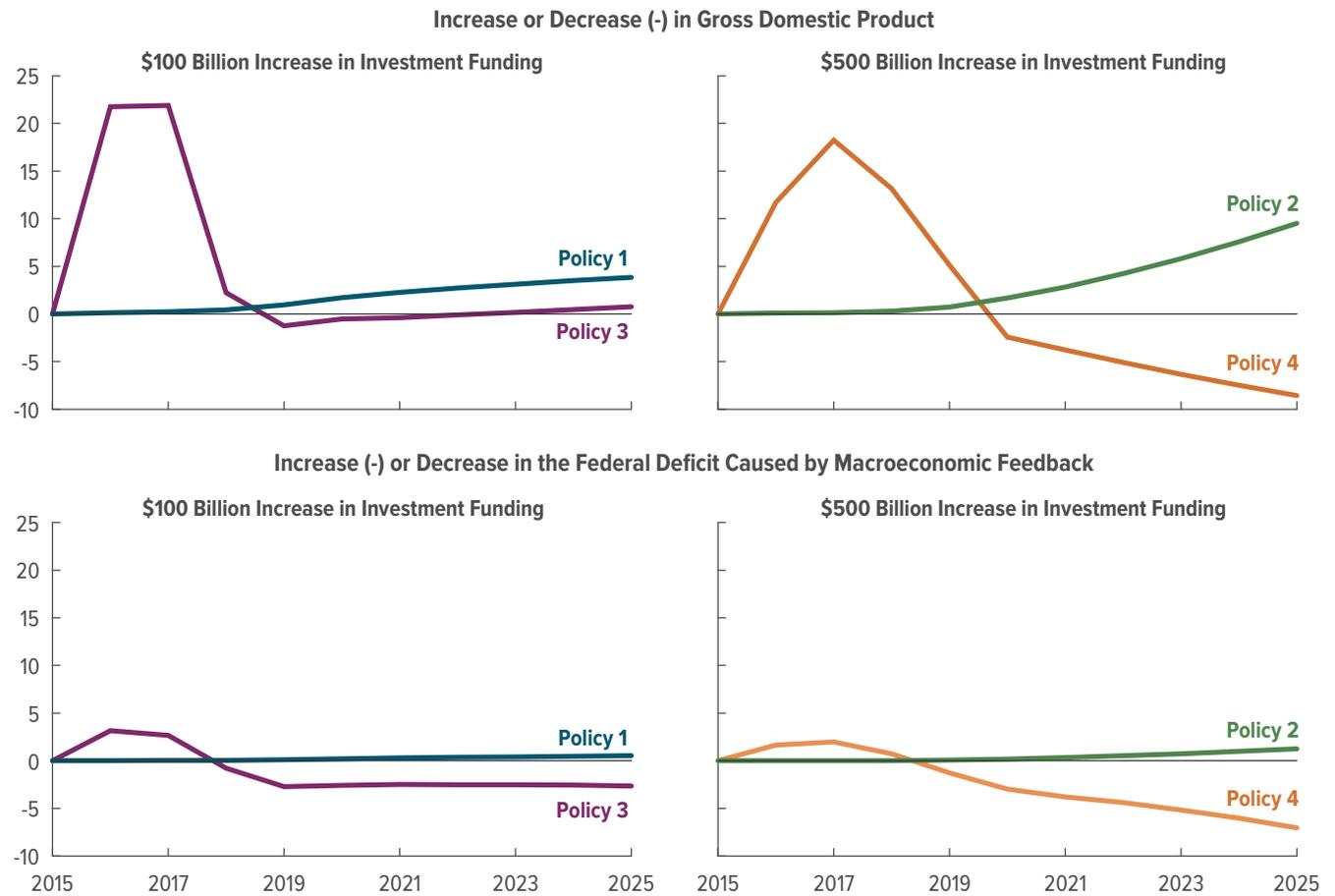
Increase or Decrease (-) in Gross Domestic Product

Source: Congressional Budget Office.

In Policy 1, a onetime $100 billion increase in investment funding would be financed by offsetting changes in noninvestment discretionary spending.

In Policy 2, an annual $50 billion increase in investment funding for 10 years would be financed by offsetting changes in noninvestment discretionary spending.

In Policy 3, a onetime $100 billion increase in investment funding would be financed by federal borrowing.

In Policy 4, an annual $50 billion increase in investment funding for 10 years would be financed by federal borrowing.

Table 2.

The Effects of Policy 1

	2025	Total, 2016–2025
Macroeconomic Effects		
Increase in Gross Domestic Product		
(Billions of dollars)		
Central Estimate	4	19
Likely Range	0 to 8	0 to 39
Increase in Gross National Product		
(Billions of dollars)		
Central Estimate	3	14
Likely Range	0 to 7	0 to 30
Increase in 10-Year Treasury Rate		
(Percentage points) [a]		
Central Estimate	*	n.a.
Likely Range	*	n.a.
Budgetary Effects (Billions of dollars)		
Direct Budgetary Effects		
Effect on Outlays	0	0
Effect on Revenues	0	0
Increase (-) or		
Decrease in the Deficit	**0**	**0**
Effects of Macroeconomic Feedback		
Effect on Outlays	**	1
Effect on Revenues	1	3
Decrease in the Deficit	**1**	**2**
Total Budgetary Effects		
Effect on Outlays	**	1
Effect on Revenues	1	3
Decrease in the Deficit	**1**	**2**

Source: Congressional Budget Office.

In Policy 1, a onetime $100 billion increase in investment funding would be financed by offsetting changes in noninvestment discretionary spending.

CBO's central estimates are the outcomes expected when key inputs to an analysis are at the midpoints of their ranges.

n.a. = not applicable; * = between zero and 0.005 percentage points; ** = between zero and $0.5 billion.

a.   Rounded to the nearest 0.01 percentage point.

Table 3.

The Effects of Policy 2

	2025	Total, 2016–2025
Macroeconomic Effects		
Increase in Gross Domestic Product		
(Billions of dollars)		
Central Estimate	10	33
Likely Range	0 to 20	0 to 69
Increase in Gross National Product		
(Billions of dollars)		
Central Estimate	7	24
Likely Range	0 to 16	0 to 52
Increase in 10-Year Treasury Rate		
(Percentage points) [a]		
Central Estimate	*	n.a.
Likely Range	0 to 0.01	n.a.
Budgetary Effects (Billions of dollars)		
Direct Budgetary Effects		
Effect on Outlays	0	0
Effect on Revenues	0	0
Increase (-) or Decrease in the Deficit	**0**	**0**
Effects of Macroeconomic Feedback		
Effect on Outlays	**	1
Effect on Revenues	2	6
Decrease in the Deficit	**1**	**4**
Total Budgetary Effects		
Effect on Outlays	**	1
Effect on Revenues	2	6
Decrease in the Deficit	**1**	**4**

Source: Congressional Budget Office.

In Policy 2, an annual $50 billion increase in investment funding for 10 years would be financed by offsetting changes in noninvestment discretionary spending.

CBO's central estimates are the outcomes expected when key inputs to an analysis are at the midpoints of their ranges.

n.a. = not applicable; * = between zero and 0.005 percentage points; ** = between zero and $0.5 billion.

a.   Rounded to the nearest 0.01 percentage point.

Table 4.

The Effects of Policy 3

	2025	Total, 2016–2025
Macroeconomic Effects		
Increase in Gross Domestic Product		
(Billions of dollars)		
Central Estimate	1	45
Likely Range	-8 to 10	-32 to 129
Increase in Gross National Product		
(Billions of dollars)		
Central Estimate	-5	5
Likely Range	-14 to 5	-73 to 92
Increase in 10-Year Treasury Rate		
(Percentage points) [a]		
Central Estimate	0.01	n.a.
Likely Range	* to 0.01	n.a.
Budgetary Effects (Billions of dollars)		
Direct Budgetary Effects		
Effect on Outlays	**	98
Effect on Revenues	0	0
Increase (-) or Decrease in the Deficit	**	**-98**
Effects of Macroeconomic Feedback		
Effect on Outlays	2	17
Effect on Revenues	**	4
Increase (-) in the Deficit	**-3**	**-13**
Total Budgetary Effects		
Effect on Outlays	3	114
Effect on Revenues	**	4
Increase (-) in the Deficit	**-3**	**-110**
Memorandum:		
Effect on Debt Service	5	31

Source: Congressional Budget Office.

In Policy 3, a onetime $100 billion increase in investment funding would be financed by federal borrowing.

CBO's central estimates are the outcomes expected when key inputs to an analysis are at the midpoints of their ranges.

n.a. = not applicable; * = between zero and 0.005 percentage points; ** = between -$0.5 billion and $0.5 billion.

a.   Rounded to the nearest 0.01 percentage point.

Table 5.

The Effects of Policy 4

	2025	Total, 2016–2025
Macroeconomic Effects		
Increase in Gross Domestic Product		
(Billions of dollars)		
Central Estimate	-9	15
Likely Range	-28 to 15	-95 to 140
Increase in Gross National Product		
(Billions of dollars)		
Central Estimate	-29	-69
Likely Range	-50 to -2	-186 to 67
Increase in 10-Year Treasury Rate		
(Percentage points) [a]		
Central Estimate	0.02	n.a.
Likely Range	0.02 to 0.03	n.a.
Budgetary Effects (Billions of dollars)		
Direct Budgetary Effects		
Effect on Outlays	48	398
Effect on Revenues	0	0
Increase (-) in the Deficit	**-48**	**-398**
Effects of Macroeconomic Feedback		
Effect on Outlays	4	23
Effect on Revenues	-3	-4
Increase (-) in the Deficit	**-7**	**-26**
Total Budgetary Effects		
Effect on Outlays	53	421
Effect on Revenues	-3	-4
Increase (-) in the Deficit	**-56**	**-424**
Memorandum:		
Effect on Debt Service	17	73

Source: Congressional Budget Office.

In Policy 4, an annual $50 billion increase in investment funding for 10 years would be financed by federal borrowing.

CBO's central estimates are the outcomes expected when key inputs to an analysis are at the midpoints of their ranges.

n.a. = not applicable.

a. Rounded to the nearest 0.01 percentage point.