



Effects of Physical Infrastructure Spending on the Economy and the Budget Under Two Illustrative Scenarios

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Summary

Increases in physical infrastructure spending would boost private-sector productivity in the coming decades, contributing to economic growth that could lower the budgetary cost of that spending. To study such increases, the Congressional Budget Office examined two illustrative scenarios that would boost federal funding for a mix of types of physical infrastructure by \$500 billion over 10 years. (Those funds would not all be spent within 10 years.) The same broad mix of physical capital is funded in both scenarios, neither of which corresponds to a specific legislative proposal. CBO compared outcomes under each scenario with those from its projections for the economy and the budget if current laws governing taxes and spending generally remained unchanged.

Budgetary Effects of Macroeconomic Changes

In this dynamic analysis, CBO finds that the effects of macroeconomic changes on the federal budget would depend on how additional infrastructure spending was financed and the time period considered.

Under Scenario 1, which is deficit-neutral before accounting for macroeconomic changes, infrastructure is financed by reducing the government's noninvestment purchases.

- In present value, which expresses the flows of current and future income or payments in terms of their value at a single point in time, the budgetary effects over 30 years stemming from macroeconomic changes would *reduce* the net cost of funding \$500 billion of additional infrastructure by approximately one-third.
- From fiscal years 2022 to 2031, the deficit would *decrease* by \$11 billion because of the macroeconomic changes.

Under Scenario 2, infrastructure is financed by increasing federal borrowing.

- In present value, the budgetary effects over 30 years stemming from macroeconomic changes would *increase* the net cost of funding \$500 billion of additional infrastructure by approximately one-fourth.
- From fiscal years 2022 to 2031, the effects of macroeconomic changes would *decrease* the deficit by \$2 billion (not including the additional outlays for infrastructure).

There are many other financing possibilities, including combinations of those two. If physical infrastructure was financed with a combination of reductions in the government's noninvestment purchases and increases in federal borrowing, the result would roughly equal the weighted average of the estimates under Scenarios 1 and 2. For example, if the financing was one-half reductions in noninvestment purchases and one-half increases in federal borrowing, then the estimates under Scenarios 1 and 2 would be roughly equally weighted.

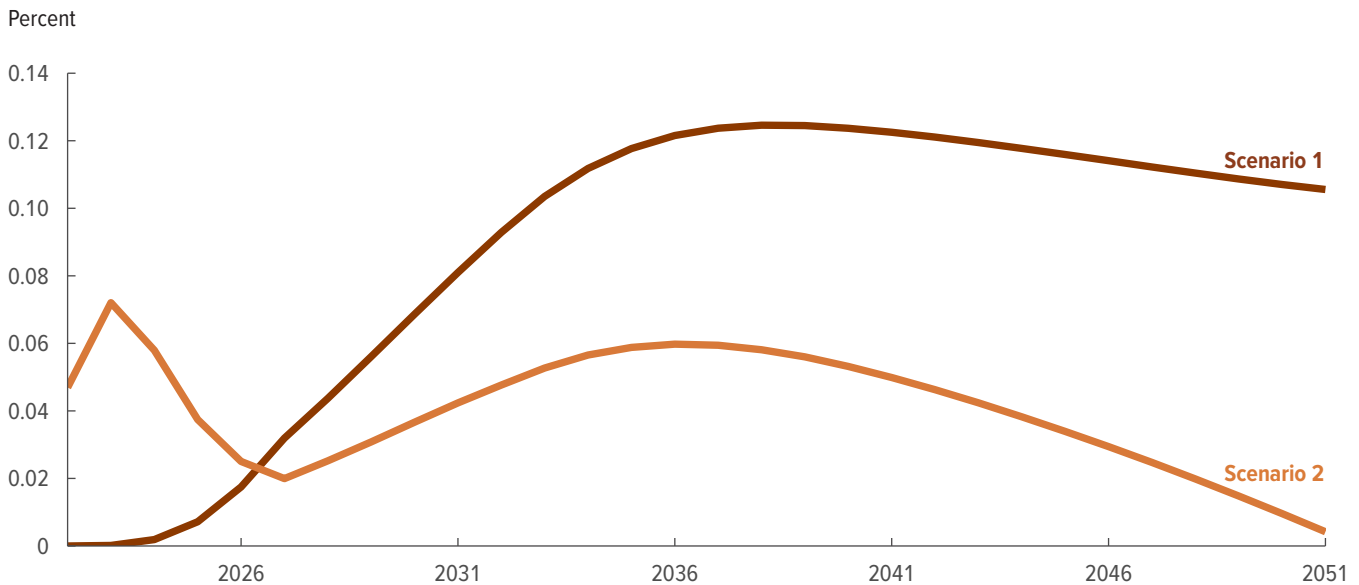
- In present value, the budgetary effects over 30 years stemming from the macroeconomic changes would *decrease* the net cost of funding \$500 billion of additional infrastructure by approximately one-twentieth.¹
- From fiscal years 2022 to 2031, the effects of macroeconomic changes would *decrease* the deficit by \$6 billion (not including the additional outlays for infrastructure).

To assess how the net cost of funding infrastructure would be altered by macroeconomic changes occurring

1. CBO estimates that there would be no net budgetary effects over 30 years stemming from macroeconomic changes if the financing was roughly 45 percent reductions in noninvestment purchases and roughly 55 percent increases in federal borrowing.

Figure 1.

Increases in the Level of Real GDP



Data source: Congressional Budget Office. See www.cbo.gov/publication/57327#data.

Under both scenarios, funding for physical infrastructure would increase by \$50 billion annually for 10 years. Under Scenario 1, the resulting increase in outlays would be fully offset by a reduction in the government's noninvestment purchases; under Scenario 2, it would be financed by increased borrowing.

Effects are estimated relative to CBO's July 2021 economic projections.

Real GDP is gross domestic product adjusted to remove the effects of inflation.

Years are calendar years.

over 30 years, CBO used the ratio of the present value of effects on the deficit stemming from those macroeconomic changes to the present value of outlays for infrastructure. CBO estimated a present value in this report because most of the effects on the budget from macroeconomic changes would occur outside of the 10-year window generally used by the Congress in its budget process. The present-value estimates provide a more complete picture than the estimates over 10 years, which report the sum of effects in nominal dollars in each of the 10 years (as is typically done in CBO's cost estimates).

To evaluate the budgetary effects over a 30-year horizon, CBO used methods similar to those applied to credit programs such as student loans. The government's disbursements and collections related to infrastructure are like those for credit programs in that outlays are concentrated in the initial years and the government is paid back over time. With loans, the government is paid back by borrowers; with infrastructure, the government is paid back, in part, in the form of tax revenues stemming from macroeconomic changes. The rate of interest that is used

to translate future cash flows into current dollars is a key element of a present-value estimate. For federal credit programs, the rates (specified by law) to be used in cost estimates are the projected yields on Treasury securities of maturities matching the timing of the cash flows. CBO used those rates in this analysis and translated all cash flows into their current value in 2021.

Under Scenario 1, over all time horizons, the macroeconomic changes stemming from higher productivity would increase federal revenues (mainly from a boost in taxable income) and increase outlays by a smaller amount (mainly from higher interest rates).

Over 30 years under Scenario 2, the macroeconomic changes would increase deficits—mostly because increases in interest rates, applied to the large amount of debt in CBO's budget projections, would add to federal interest costs. Those changes would more than offset the boost in taxable income stemming from higher productivity. CBO estimates that interest rates would rise above what they would have been otherwise because of higher productivity, Federal Reserve actions, and reduced

amounts of money available for private investment; those higher interest rates would increase the federal government's interest payments. The effects on productivity would be the same as under Scenario 1.

During the 2022–2031 period under Scenario 2, the effects of macroeconomic changes would tend to decrease the deficit. That would occur because the increases in overall demand and productivity (which tend to shrink the deficit) would more than offset the effects of slightly higher interest rates (which tend to increase the deficit).

Macroeconomic Effects

Under Scenario 1, the increase in economic output stems purely from the boost in productivity (specifically, total factor productivity—real output per unit of combined labor and capital) resulting from additional infrastructure funding. One year of such funding, \$50 billion, is equivalent to 0.22 percent of nominal gross domestic product (GDP) in 2021. The scenario is constructed so that the increase in outlays for infrastructure each year is offset by a reduction in the government's noninvestment purchases that same year, before accounting for any effects of macroeconomic changes. That reduction would not directly affect incentives to work or save and would result in no net effect on overall demand for goods and services. CBO examined the effects on output over 30 years by comparing the results under the scenario in each year with its economic projections under current law (see Figure 1). The effect on the level of real GDP (that is, GDP adjusted to remove the effects of inflation) would rise through 2038 and largely persist thereafter, averaging 0.09 percent from 2022 to 2051. Were such a percentage increase applied to nominal GDP in 2021, it would have an effect equivalent to \$20 billion over one year.

Under Scenario 2, three factors would affect the economy. First, productivity would rise to the same extent as under Scenario 1, increasing output over time. Second, the increase in total spending would boost the overall demand and output in the short term, although most of the spending would occur after 2024 because of the equal annual amounts of funding over the decade and the lags between funding and outlays, dampening potential effects on interest rates and inflation. Third, the increase in federal borrowing would reduce the amount of funds available for private investment—a phenomenon called crowding out—which would dampen output in the longer term. The effect on the level of real GDP would peak in 2023 (from the boost in demand), lessen

before peaking again in 2036 (from the rise in productivity), and then dissipate by 2051 (from crowding out). The effect on the level of real GDP would average 0.04 percent from 2022 to 2051. Were such a percentage increase applied to nominal GDP in 2021, it would have an effect equivalent to \$9 billion over one year.

How the Results Compare With CBO's 2016 Analysis

The effects of macroeconomic changes on the deficit over 10 years are more favorable under both scenarios in this analysis than they were in CBO's broader analysis of the effects of federal investment in 2016. In this analysis, the mix of types of infrastructure results in smaller spending reductions by state and local governments, and it becomes productive more quickly than in the 2016 analysis. On the basis of more recent evidence, CBO also increased its estimate of the average effect on productivity stemming from infrastructure spending.

How the Effects Would Differ Under Alternative Policies

The economic and budgetary effects of increased infrastructure spending could be larger or smaller depending on the details of the infrastructure policy as well as its financing. The effects depend on many factors, including the following:

- How state and local governments respond to additional federal funding;
- How quickly funding leads to outlays;
- How quickly outlays increase productivity;
- How much outlays increase productivity; and
- How outlays are financed.

State and Local Responses. In its analysis of the illustrative scenarios examined in this report, CBO projects that an additional dollar of federal spending would increase physical infrastructure spending by 85 cents; the remaining 15 cents would be offset by a decrease in infrastructure spending by state and local governments. That offset would be smaller to the extent that a policy focused more on physical infrastructure spending undertaken directly by the federal government for capital that is not generally funded by states and local governments (such as air traffic control). It would also be lower to the extent that a policy included binding provisions to limit adjustments by state and local governments

Table 1.

Spending on Physical Infrastructure Under Both Illustrative Scenarios

Billions of Dollars

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total, 2022– 2031
Increase in Federal Funding	50	50	50	50	50	50	50	50	50	50	500
Increase in Federal Outlays	8	18	25	33	38	41	44	45	45	46	339

Data source: Congressional Budget Office. See www.cbo.gov/publication/57327#data.

Years are fiscal years.

or concentrated funding in a shorter period of time. It would be higher if the opposite was the case.

Speed of Outlays. Under both illustrative scenarios, funding for infrastructure would increase by \$50 billion per year for 10 years, starting in fiscal year 2022. Although the increase in funding would take place all at once at the beginning of each year, the increase in outlays from that funding would occur slowly because of the time that elapsed between the receipt of authority to incur obligations and disbursement. It would also occur at different rates for different types of physical capital. For example, funds for types of infrastructure that required complicated design, review, contracting, and construction, such as water supply facilities, would be spent more slowly than funds for other types, such as highway repairs. In both illustrative scenarios examined in this report, \$120 billion of the total \$500 billion in funding would be spent by fiscal year 2026, and \$339 billion would be spent by fiscal year 2031 (see Table 1). 96 percent of the funding would be spent by 2046. (CBO estimates that 4 percent would not be spent, on the basis of historical experience.) CBO used a historical average for the lag between funding and outlays for physical infrastructure in the illustrative scenarios. The speed of spending would depend on the particular mix of types of infrastructure that was funded and on the amount of funding.

Timing of Productivity Effects. The increase in productivity that results from outlays for infrastructure boosts economic output gradually because infrastructure projects take time to complete; some projects span several years from inception to completion and full realization of productivity. For every \$1 billion increase in infrastructure spending in both illustrative scenarios, \$400 million would fully affect the private sector's productivity in the

first year after the spending, \$800 million would fully affect productivity in the second year after the spending, and the entire amount of spending would have affected productivity seven years after the spending, CBO projects. The agency also estimates that infrastructure (specifically, the stock of public capital) depreciates over time at an annual rate of 3.2 percent, so its effects on productivity would slowly diminish over the coming decades. How quickly infrastructure spending led to increased productivity would depend on the specific mix of types of infrastructure that was funded.

Size of Productivity Effects. On the basis of published studies on the U.S. economy, CBO estimates that an additional dollar's worth of infrastructure capital increases real potential (maximum sustainable) GDP by 12.4 cents, on average. Using the 3.2 percent depreciation rate for public capital, the net effect is an increase of 9.2 cents. CBO used those estimates in its projections of the effects under the illustrative scenarios for 2022 to 2031. (For comparison, CBO used a similar method to estimate that an additional dollar's worth of private fixed capital increases real potential GDP by 15.6 cents and that the net effect is 9.8 cents, accounting for a 5.8 percent depreciation rate of private capital. The results vary depending on the methods and on the definitions of capital.) The gross effects on GDP and the net effects accounting for depreciation could be higher or lower, on average, depending on the particular mix of types of infrastructure and the particular projects chosen.

Financing. The economic and budgetary effects differ substantially between infrastructure that is financed by a reduction in noninvestment purchases and infrastructure that is financed by increased borrowing, as shown above. Other methods of financing—such as reducing benefits (including transfer payments), raising taxes, or increasing

Table 2.

Macroeconomic Effects

	Scenario 1	Scenario 2
Increases in the Level of Real GDP (Percent)		
2031	0.08	0.04
2041	0.12	0.05
2051	0.11	0
Change in the 10-Year Treasury Rate (Percentage points)		
2031	0.007	0.014
2041	0.005	0.018
2051	-0.002	0.017
Change in the GDP Price Index (Percent)		
2031	0	0.01
2041	0	0.01
2051	0	0.01

Data source: Congressional Budget Office. See www.cbo.gov/publication/57327#data.

Under both scenarios, funding for physical infrastructure would increase by \$50 billion annually for 10 years. Under Scenario 1, the resulting increase in outlays would be fully offset by a reduction in the government's noninvestment purchases; under Scenario 2, it would be financed by increased borrowing.

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user fees—would lead to different results that would depend on the specific policies.

Scenario 1—Infrastructure Spending Financed by Reducing Noninvestment Purchases

To isolate the way that increases in infrastructure spending would affect output in the long term through effects on the private sector's productivity, CBO analyzed a scenario under which increased spending for infrastructure would be fully offset by reducing the government's noninvestment purchases. For the purposes of illustration, that reduction in purchases would not directly affect incentives to work or save. (Many other financing policies, including reducing benefits or raising taxes, would affect such incentives.) Under Scenario 1, total deficits and debt would remain unchanged before accounting for the effects of macroeconomic changes. Therefore, the total amount of funds available for private investment would be unaltered. In addition, there would be no effect

on the overall demand for goods and services because the offsetting changes in infrastructure spending and noninvestment purchases would leave overall demand unchanged. Thus, the scenario illustrates the long-term effects of infrastructure spending on productivity and output and not any short-term effects on output stemming from changes in overall demand.

Effects on Output

The combination of increased infrastructure spending and reduced noninvestment purchases would have little effect on real GDP in 2022 and 2023, CBO estimates. As productivity slowly increased, output would rise gradually; in 2031, the level of real GDP would be higher by 0.08 percent. In 2051, the level of real GDP would be 0.11 percent higher (see Table 2).

Effects on Interest Rates and Inflation

The increase in infrastructure spending would cause interest rates to be higher than they would have been otherwise because the increased productivity in the private sector would boost the return on private investment in physical capital. That higher return would in turn raise the return on investments in financial assets of other types that compete for investors' money. As a result, the interest rate on 10-year Treasury securities would be about 0.007 percentage points higher in 2031 than it is projected to be under current law, CBO estimates. By 2051, that effect would be more than offset by a rise in private investment resulting from the macroeconomic changes that would reduce deficits, as discussed in the following section.

Inflation would be unchanged, on balance, under Scenario 1. In the next several years, the combination of increased infrastructure spending and reduced noninvestment purchases would leave overall demand unchanged, exerting no pressure on inflation. Increased productivity of labor and private capital would put downward pressure on the prices of goods and services by lowering businesses' cost of producing an additional unit of output, but inflation would be largely unaffected over the next decade, in CBO's assessment. Over the next few years, the effects on private sector productivity would be too small relative to the size of the entire economy to generate a noticeable effect on prices, both because spending would occur slowly and because new investment takes time to affect productivity. Also, upward pressure on the prices of infrastructure materials in the short term would push in the opposite direction of the downward pressure from increased productivity. In the remainder of the

Table 3.

Budgetary Effects

Billions of Dollars

	Scenario 1		Scenario 2	
	2031	Total, 2022– 2031	2031	Total, 2022– 2031
Direct Budgetary Effects				
Effect on Outlays	0	0	46	339
Effect on Revenues	0	0	0	0
Increase (-) in the Deficit	0	0	-46	-339
Effects of Macroeconomic Changes				
Effect on Outlays	2	7	4	19
Effect on Revenues	5	17	4	21
Decrease in the Deficit	3	11	1	2
Total Budgetary Effects				
Effect on Outlays	2	7	49	358
Effect on Revenues	5	17	4	21
Increase (-) or Decrease in the Deficit	3	11	-45	-337

Data source: Congressional Budget Office. See www.cbo.gov/publication/57327#data.

Under both scenarios, funding for physical infrastructure would increase by \$50 billion annually for 10 years. Under Scenario 1, the resulting increase in outlays would be fully offset by a reduction in the government's noninvestment purchases; under Scenario 2, it would be financed by increased borrowing.

Effects are estimated relative to CBO's February 2021 budget projections.

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decade, the Federal Reserve would adjust the short-term interest rates to prevent inflation from deviating from the central bank's long-term objective, in CBO's assessment.

Effects on Deficits

The macroeconomic changes under Scenario 1 would reduce deficits over the 30-year period that CBO examined and, in present value, offset approximately one-third of the net cost of the \$500 billion of additional infrastructure funding. In estimating those effects, the agency used a simplified analysis (based on its Budgetary Feedback Model) that incorporated average effects on spending and revenues rather than the detailed program-by-program analysis that it uses for its regular budget projections.²

2. For a detailed description of CBO's Budgetary Feedback Model, see Nathaniel Frenzt and others, *A Simplified Model of How Macroeconomic Changes Affect the Federal Budget*, Working Paper 2020-01 (Congressional Budget Office, January 2020), www.cbo.gov/publication/55884. The current version of the

CBO's rough present-value estimate used Treasury rates to translate future cash flows into current dollars, and it represents the average projected effect on federal debt. Present-value estimates would be smaller if they translated future cash flows using an approach incorporating market risk—that is, the cost associated with the tendency of assets to perform well when the economy is strong and poorly when the economy is underperforming. Negative deviations from the average amount of future cash flows outweigh positive deviations when people place greater weight on scenarios in which the economy is underperforming.³

From 2022 to 2031, higher productivity and output would help boost revenue from income and payroll taxes by a total of \$17 billion compared with the amounts projected under current law. In addition, mainly because higher interest rates would increase the interest payments on federal debt, spending would increase by a total of \$7 billion over 10 years. On net, deficits would be \$11 billion smaller over the next decade, CBO estimates (see Table 3).

Scenario 2—Infrastructure Spending Financed by Borrowing

To provide a point of comparison illustrating how the financing of infrastructure can have important effects, CBO analyzed an increase in infrastructure spending financed by federal borrowing.

Effects on Output

Under Scenario 2, an increase in overall demand would be the strongest factor increasing output over the next several years. The level of real GDP would be 0.05 percent higher in 2022 and 0.07 percent higher in 2023, CBO estimates. The effect on real GDP from increased demand would start to dissipate after 2023, but positive effects on real GDP resulting from the longer-term

model uses CBO's February 2021 budget projections. The model was used to inform the approximations made in the analysis of the 30-year budgetary effects in this report, in which CBO used its March 2021 long-term budget projections.

3. See Congressional Budget Office, *Measuring the Cost of Government Activities That Involve Financial Risk* (April 2021), www.cbo.gov/publication/56778; and *Estimates of the Cost of Federal Credit Programs in 2021* (April 2020), www.cbo.gov/publication/56285. See also Michael Falkenheim, *Fair-Value Cost Estimation and Government Cash Flows*, Working Paper 2021-05 (Congressional Budget Office, April 2021), www.cbo.gov/publication/57062, and *Governmental Risk Taking Under Market Imperfections*, Working Paper 2021-07 (Congressional Budget Office, June 2021), www.cbo.gov/publication/57255.

increase in productivity would be larger than the negative effects from the crowding out of private investment in the remainder of the decade. The effect on the level of real GDP compared with the projection under current law would peak at 0.06 percent in 2036, CBO estimates. In later years, the effect would lessen.

Over time, the crowding out of private investment stemming from increased deficits would become increasingly important as government borrowing reduced the funding available to the private sector. CBO estimates that for each dollar that the federal deficit increased, domestic private investment would fall by 33 cents.⁴ That would result in a smaller capital stock, higher interest rates, and lower output over time than would otherwise be the case. Under Scenario 2, the \$339 billion increase in deficits from 2022 to 2031 would reduce private investment by \$112 billion, CBO estimates. The resulting decrease in the stock of private capital would cause real GDP to be about 0.04 percent lower in 2031 than it would be if that stock remained unchanged. (Such crowding out of private investment would not occur under Scenario 1 because deficits would be unaffected before accounting for macroeconomic changes.)

Effects on Interest Rates and Inflation

In the longer term, interest rates projected under Scenario 2 would be higher than those under current law for two reasons. First, increased productivity of the private sector would boost the return on private investment in physical capital and financial assets of other types just as it would under Scenario 1. Second, because the amount of funds available for private investment would be reduced, the stock of private capital would be lower. As a result, the number of workers per unit of physical capital would increase, thereby boosting the productivity of capital and thus the return on private investment and other financial assets. CBO estimates that all told, the interest rate on 10-year Treasury securities would be about 0.014 percentage points higher in 2031 than it is projected to be under current law, and that effect would persist in later years. Under Scenario 2, interest rates would be affected by a smaller amount in 2022 and 2023 than afterwards, mainly because CBO expects the Federal Reserve to continue its policy of keeping short-term interest rates near zero through mid-2023.

The increase in overall demand would put upward pressure on the prices of goods and services. Because of lags in spending, most of that pressure would occur after 2022, causing inflation to be slightly higher than it would have been otherwise for a few years. In CBO's estimation, the effect on inflation would dissipate in the second half of the next decade because the agency expects that during that period, the Federal Reserve would raise the short-term interest rates to offset the effects of increased spending on overall demand and prevent inflation from rising above the central bank's long-term objective. Because inflation would increase in the next few years, however, the level of the GDP price index would be 0.01 percent higher by 2027 than projected under current law, CBO estimates, and that effect would persist in later years.

Effects on Deficits

Over the next 30 years, the macroeconomic changes under Scenario 2 would increase deficits, mainly because higher interest rates applied to the large amount of debt in CBO's budget projections would more than offset the effects of higher productivity. In present value, those changes would increase the net cost of funding \$500 billion of additional infrastructure by approximately one-fourth.⁵

From fiscal years 2022 to 2031, mostly because of a boost in households' and businesses' taxable income, the increase in revenues from macroeconomic changes would be \$21 billion. Spending on interest payments and benefit programs would also increase, mainly because of higher interest rates and inflation. CBO estimates that spending to be a cumulative \$19 billion higher under Scenario 2 than projected under current law. The effects of the macroeconomic changes under Scenario 2 would decrease the deficit by \$2 billion over the next decade, CBO estimates.

Without accounting for the macroeconomic changes, increased outlays for infrastructure in this scenario would increase deficits by a cumulative \$339 billion between fiscal years 2022 and 2031. That increase is less than the \$500 billion increase in total funding for physical

4. For more details, 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.

5. Under this scenario, the deficit financing itself would boost the government's interest payments on the national debt and thus further increase the net cost of funding \$500 billion of additional infrastructure above the amount reported here. By long-standing Congressional convention, CBO's cost estimates do not include changes in debt service resulting from changes in the amount of debt, and those amounts are excluded in this analysis as well.

infrastructure because not all of that funding would be spent by the end of the decade—a result that also holds true under Scenario 1.

How This Analysis Compares With CBO's 2016 Analysis

The two illustrative scenarios presented in this analysis are similar to two that CBO analyzed in 2016, but they differ in the types of investment spending analyzed.⁶ CBO has also updated its analytical methods to incorporate new research conducted in the past five years. Overall, macroeconomic changes have a more favorable effect on the budget in this analysis than in 2016.

This analysis focuses solely on physical infrastructure. By contrast, in 2016, CBO analyzed a combination of investment spending on physical infrastructure, education, and research and development.⁷ Physical infrastructure funding would be spent more slowly after being authorized (with 75 percent being spent after five years, CBO estimates) than the investment combination analyzed in 2016 would have been (with 94 percent being spent over five years). Physical infrastructure would become productive more quickly (with 80 percent of spending being productive within two years) compared with the investment combination analyzed in 2016 (with 25 percent of spending having become productive within two years). More of the spending in this analysis would be for activities largely funded by the federal government than in CBO's 2016 analysis (which included spending on other investments, such as education, for which the share of federal funding is low): States and local governments were projected to reduce their spending by 15 cents for each dollar of federal spending, compared with 33 cents in 2016.

In this analysis, CBO estimates that an increase in public capital by 1.0 percent boosts real potential GDP by about 0.08 percent, on average.⁸ That effect, when

applied to the ratio of GDP to all nondefense fixed assets of federal, state, and local governments in 2019 (1.55), implies that an additional dollar's worth of infrastructure capital would increase real potential GDP by 12.4 cents. CBO estimated the depreciation rate of those assets to be 3.2 percent, resulting in a net increase of 9.2 cents.⁹ In 2016, CBO estimated that an increase in public capital by 1.0 percent boosted real potential GDP by about 0.06 percent, on average.¹⁰ That effect, when applied to the ratio of GDP to all fixed assets of federal, state, and local governments in 2015 (1.36), implied that an additional dollar's worth of infrastructure capital increased real potential GDP by roughly 8 cents.¹¹ CBO estimated the depreciation rate to be 2 percent, resulting in a net increase of about 6 cents in 2016.

How the Effects Depend on the Policies Involved

The illustrative scenarios analyzed in this report reflect the effects of increases in a broad mix of types of physical infrastructure. The effects of a specific set of policies would differ for many reasons, including responses by state and local governments, the speed of spending, timing of productivity effects, size of productivity effects, and financing. Changes to infrastructure spending affect output; they can also have effects that are not measured

6. See the results for Policy 2 and Policy 4 in Congressional Budget Office, *The Macroeconomic and Budgetary Effects of Federal Investment* (June 2016), www.cbo.gov/publication/51628.

7. For discussion of types of investment, see Congressional Budget Office, *Federal Investment: 1962 to 2018* (June 2019), www.cbo.gov/publication/55375.

8. CBO's estimate is roughly in the middle of the range from 0.12 to 0.05 used by a recent study. See Valerie A. Ramey, *The Macroeconomic Consequences of Infrastructure Investment*, Working Paper 27625 (National Bureau of Economic Research, July 2020), www.nber.org/papers/w27625.

9. Following Ramey's approach, the depreciation rate is estimated by dividing current-cost depreciation of nondefense fixed assets of federal, state, and local governments in 2019 by current-cost stock of nondefense fixed assets in the previous year as measured by the Bureau of Economic Analysis. For discussions of alternative approaches to calculating depreciation rates, see Michael D. Giandrea and others, *Alternative Capital Asset Depreciation Rates for U.S. Capital and Multifactor Productivity Measures*, Working Paper 539 (Bureau of Labor Statistics, April 9, 2021), www.bls.gov/osmr/research-papers/2021/ec210050.htm; and Jennifer Bennett and others, *Measuring Infrastructure in BEA's National Economic Accounts*, Working Paper 27466 (National Bureau of Economic Research, June 2020), www.nber.org/papers/w27466.

10. For discussion of the basis of that estimate, see Congressional Budget Office, *The Macroeconomic and Budgetary Effects of Federal Investment* (June 2016), Box 2, www.cbo.gov/publication/51628. In 2016, CBO relied on a survey of estimates from 1983 to 2008 and a finding that studies examining recent periods had reported significantly lower estimates than those for the full period.

11. In 2016, CBO found that productive federal investment had an average annual rate of return of about 5 percent. That value of 0.05 was found by multiplying the boost in real potential GDP for a 1 percent increase in public capital (0.06) by the ratio of GDP to all fixed government assets (1.36) and by the fraction of spending maintained by states and local governments for each dollar of federal spending (1 – 0.33).

in GDP but that increase quality of life or address other social goals. Average effects for the nation as a whole may include negative effects in some areas and positive effects in others.

How State and Local Governments Respond to Additional Federal Funding

The particular mix of types of infrastructure that the federal government funded would affect decisions made at other levels of government. The majority of federal spending for infrastructure takes the form of grants to state and local governments.¹² When state and local governments receive grants, they may redirect some spending that they would have otherwise undertaken using their own resources to other kinds of spending (or back to taxpayers). That fiscal substitution can take place even though federal grant programs often require state and local governments to meet a minimum funding share (for example, a 20 percent state share for many highway programs) or impose a maintenance-of-effort requirement (requiring state funding to reach some benchmark level that approximates what would have been spent without federal funds). Spending for infrastructure owned by the federal government is not expected to result in state or local fiscal substitution.

In this analysis, CBO assumed for simplicity that the substituted funds would increase noninvestment purchases and would not have longer-term effects on productivity. Under Scenario 2, those purchases contribute to the short-term effects of the spending on overall demand.

How Quickly Funding Leads to Outlays

The particular mix of types of infrastructure the federal government funded would affect the speed at which such funding led to outlays. The authority to incur financial obligations that will result in outlays of federal government funds (which is called budget authority) is typically provided up front in a law. Appropriation acts provide that authority for most federal infrastructure spending. Obligations of budget authority are recorded when the funds are legally committed, and estimates of how legislative proposals would affect the federal deficit reflect

cash-based measures of costs over a 10-year period.¹³ The federal budget generally reports outlays for federal activities—including spending for infrastructure—on a cash basis when the funds are disbursed (say, to a state or local government).

CBO used historical experience as the primary basis for projecting the length of that lag between appropriation and outlay.¹⁴ The lags can vary substantially by type of infrastructure. For example, for highway grants, about 60 percent of the outlays have occurred within the first two years of appropriation. By contrast, for spending on ports and waterways, only 6 percent of outlays have taken place within the same time frame; only in the fifth year has sixty percent of spending occurred.

In some cases, particularly when funding increases for infrastructure are large, are unexpected, or involve creating new programs, CBO expects that the initial rate of outlays will be slower than historical averages. For instance, state and local governments may need to perform additional planning and design activities to utilize the additional funds, or it may take time to establish the administration of a new program. Not all appropriations are ultimately spent.

How Quickly Outlays Affect Productivity

The particular mix of types of infrastructure the federal government funded would affect the speed at which spending increased productivity. Many infrastructure projects take longer to complete than a single year. Even once infrastructure projects are complete, it may take additional time for the private sector to take full advantage of them. For instance, firms and workers may relocate or businesses may reorganize their operations to better use the available public capital after new water utilities or highways are built.

How Much Outlays Increase Productivity

The particular mix of types of infrastructure the federal government funded would affect the magnitude of productivity effects. Spending on physical capital facilitates

12. For more information about federal, state, and local spending for infrastructure, see Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2017* (October 2018), www.cbo.gov/publication/54539.

13. For a discussion of alternative approaches to the standard “cash-basis” budgetary treatment for federal investment, see Congressional Budget Office, *Budgeting for Federal Investment* (April 2021), www.cbo.gov/publication/56900.

14. For additional information about such lags, see Congressional Budget Office, “CBO’s Waterfall Model For Projecting Discretionary Spending, March 2021” (March 2021), www.cbo.gov/publication/57051.

commerce in different ways depending on the kind of infrastructure. Better transportation infrastructure reduces costs of distributing goods and services. More water and sewer systems reduce the cost of housing by making land able to support more concentrated development. More spending for the electric grid can reduce the price of electricity and increase its reliability.

Large increases in spending on mature infrastructure systems that have been well-maintained are unlikely to produce large economic effects. After a system has been established, subsequent incremental improvements do not raise productivity to the same extent. An additional consideration is that some kinds of infrastructure are subject to congestion, and when new capacity is added to those systems, the benefits diminish over time as the infrastructure again approaches capacity. By contrast, increases in funding for infrastructure systems that have significantly depreciated may have larger effects.

It may be difficult for a program to allocate a large spending increase in as economically productive a way as it had previously. For instance, the Transportation Infrastructure Finance and Innovation Act program provides federal credit assistance to eligible surface transportation projects that receive an investment-grade credit rating. The program received a large boost in funding over the 2013–2015 period before the additional authorization was curtailed, but even by the end of 2018, much of that funding increase remained unobligated.¹⁵

Infrastructure spending serves a number of goals besides economic productivity, and those social goals may lower the effect of that spending on economic output. For instance, spending for water utilities may emphasize providing cleaner water; spending for transportation infrastructure may focus on expanding access, improving safety, or reducing the environmental impact of travel; and subsidies for broadband communication may boost living standards. Those benefits to society do not necessarily translate into increases in GDP.

Social goals may also be addressed by the way in which infrastructure is built. The Davis-Bacon Act requires workers on federally funded construction projects to be paid the prevailing local wage. CBO estimates that repeal

of the act could reduce federal outlays by \$1 billion a year over the next 10 years as a result of paying workers lower wages.¹⁶ Two Buy America provisions require that state and local governments use iron and steel made in the United States and that other manufactured goods used in federally funded transportation projects be produced and assembled domestically.¹⁷ Those provisions increase the costs of infrastructure in order to support American production but do not generally boost the productivity gains stemming from completed projects. CBO has not analyzed the quantitative effects of those provisions on the economy.

Rates of return for individual infrastructure projects vary considerably, and policies that analyze the benefits and costs when allocating spending for infrastructure can make that spending more productive than programs that do not. For example, according to the Federal Highway Administration's analysis, capital spending would produce greater benefits relative to costs than it has recently if it was reoriented toward expanding urban interstates, making major repairs of urban highways, and repairing bridges.¹⁸

Depreciation—which encompasses factors like wear and tear, aging, and obsolescence of existing public capital stock—is also a factor in the size of productivity effects. Different kinds of infrastructure depreciate at different rates, and equipment typically depreciates faster than structures. Because of depreciation, the effects of infrastructure spending on productivity gradually diminish and eventually disappear. However, those effects extend well beyond the 10-year period the Congress uses for budget analysis because depreciation occurs very slowly for infrastructure.

How Spending Is Financed

Any increase in spending for physical infrastructure would increase deficits or require offsetting changes in spending or revenue (potentially including user fees).

15. See William J. Mallett, *The Transportation Infrastructure Finance and Innovation Act (TIFIA) Program*, Report R45516, version 2 (Congressional Research Service, February 15, 2019), <https://go.usa.gov/x6eaQ>.

16. See Congressional Budget Office, *Options for Reducing the Deficit: 2021 to 2030* (December 2020), www.cbo.gov/publication/56783.

17. For further discussion, see Michaela D. Platzer and William J. Mallett, *Effects of Buy America on Transportation Infrastructure and U.S. Manufacturing*, Report R44266, version 9 (Congressional Research Service, July 2, 2019), <https://go.usa.gov/x6eaV>.

18. See Congressional Budget Office, *Approaches to Making Federal Highway Spending More Productive* (February 2016), www.cbo.gov/publication/50150.

Each of those approaches would have different effects on the economy.¹⁹

Increased federal borrowing reduces the amount of money available for private investment. That reduction in private investment results in a smaller capital stock, eventually shrinking output.

If a change in federal investment was financed by changes in other spending or revenue policies rather than by a change in federal borrowing, it would not affect the amount of money available for private investment. However, CBO estimates that most changes in mandatory spending or revenues would directly affect people's incentives to work and save—with effects that could go in either direction depending on the specifics of the policy. For example, reducing benefits that provide income support or health insurance would cause people to save more. Raising taxes on labor income would reduce after-tax wages and the return on each additional hour worked. Higher taxes on capital income, such as dividends and capital gains, would lower the average after-tax rate of return on private wealth holdings (or the return on investment), which would reduce the incentive to save and invest and would lead to reductions in saving, investment, and the capital stock. By contrast, changes in noninvestment purchases would not affect incentives to work and save.

If an increase in spending for physical infrastructure was paid for by revenue from fees on people or businesses who used them, incentives to work and save would not be affected in the same way that they would be if the increase was funded through increased taxes. Raising user fees would reduce economic output but would also increase economic efficiency by having users account for costs in their decisions about use. For example, highway users impose costs in the form of pavement damage as well as on other users, nearby nonusers, the environment, and the economy in the form of congestion, risk of accidents, noise, pollution, and dependence on foreign oil.²⁰

19. For more detailed discussion, see Jaeger Nelson and Kerk Phillips, *The Economic Effects of Financing a Large and Permanent Increase in Government Spending*, Working Paper 2021-03 (Congressional Budget Office, March 2021), www.cbo.gov/publication/57021.

20. See Congressional Budget Office, *Alternative Approaches to Funding Highways* (March 2011), www.cbo.gov/publication/22059.

This report was prepared at the request of Senator Portman. In keeping with the Congressional Budget Office's mandate to provide objective, impartial analysis, the report makes no recommendations.

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



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