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18-9 Effects of Low Productivity Growth on Fiscal Sustainability in the United States

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Abstract

Productivity growth has slowed in the United States in the past decade, and some analysts expect growth to remain low in coming years. Besides being an important determinant of living standards and GDP, productivity growth also affects the fiscal outlook, because expenditures and revenues tend to move with GDP and because productivity growth might have a direct effect on government borrowing costs. In this paper, I calculate the likely effects of slower productivity growth on the long-term budget outlooks of federal and state and local governments. In particular, I examine how projections of deficits and debt change if annual labor productivity growth is 0.6 percentage points slower than in Congressional Budget Office's current baseline. For the federal government, I find that the effect of slower productivity growth is to worsen primary deficits, because some outlays are invariant to changes in productivity growth while revenues move more than one for one with it. These increased deficits imply that the federal debt will reach 146 to 173 percent of GDP by 2042, compared with the baseline estimate of 130 percent of GDP, with the range depending on the assumption about how interest rates move with productivity growth.

Changes in productivity growth appear less important for the state and local sector. Revenues are more likely to move one-for-one with productivity growth, because state and local income taxes are less progressive than federal taxes, and because sales taxes and property taxes make up a much larger fraction of tax collections. A slowdown in productivity growth is likely to exert some upward pressure on state and local spending relative to GDP, stemming from the somewhat heavier burden of pension spending and increased eligibility for Medicaid and other poverty-related programs, but these increases are likely to be small.

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Productivity growth in the United States slowed in the past decade. After rising 2.2 percent a year between 1996 and 2004, growth in labor productivity slowed to an average rate of just 1.0 percent between 2004 and 2015.

Analysts disagree about the prospects for productivity growth. Some, like Robert Gordon, see growth continuing to be relatively muted. Others, like Erik Brynjolffson, expect productivity growth to pick up rapidly as the economy learns to make better use of recent advances in computing and robotics.[1]

Productivity growth is the key determinant of changes in future living standards, because with slower productivity growth, consumption grows more slowly. Productivity growth is also an important conditioning assumption for projections of government revenues and expenditures, which tend to move with GDP. Although the Congressional Budget Office (CBO) sometimes presents the sensitivity of its projections to its assumptions about productivity growth, it does not release the details of its analysis or examine the channels through which productivity might affect the fiscal outlook. In addition, because of the complexities of modeling policies across 50 states, there are few analyses of the effects of productivity growth on the budgets of state and local government.

This paper explores the implications of productivity growth for the long-term outlook for government budgets. It is organized as follows. The first section examines the low-productivity scenario and the relationship between productivity growth and interest rates. The second section assesses the direct effect of changes in productivity growth on federal, state, and local government revenues and noninterest spending. The third section explores the impact of a productivity slowdown on interest costs and debt dynamics. Because of the lack of CBO-like projections for state and local governments, the analysis of them is less comprehensive, although it does shed some light on the channels through which productivity might affect the state and local sector. The last section summarizes the paper's main findings.

Low Productivity and the Relationship between Productivity Growth and Interest Rates

Debt and Deficit Projections

Under current law, the CBO regularly publishes 10- and 30-year projections of federal budget deficits and federal debt. The most recent 10-year projection—which incorporates the effects of the legislation enacted in late 2017 and early 2018—shows that the deficit rises from 3.5 percent of GDP in 2017 to 5.0 percent in 2028, and the federal debt climbs from 78 percent to 96 percent of GDP (CBO 2018b).[2] The most recent 30-year projection preceded the recent legislation. Incorporating the legislation would mean that the projected federal debt would climb from 77 percent of GDP in 2017 to about 134 percent of GDP by 2043.[3,4] The projected increases in

[1] "The Future of Work and Innovation: Robert Gordon and Erik Brynjolfsson Debate at TED2013," https://blog.ted.com/the-future-of-work-and-innovation-robert-gordon-and-erik-brynjolfsson-debate-at-ted2013/.

[2] The legislation consists of the Tax Cuts and Jobs Act of 2017, the Bipartisan Budget Act of 2018, and the Consolidated Appropriations Act 2018.

[3] The basic methodology behind these calculations is to take each part of the budget—Social Security, Medicare, individual income tax revenues, and so forth—and extend it past 2028 (the last year of the most recent CBO 10-year projection) using the growth rates for those components in the March 2017 Long-Term Budget Outlook. I made two exceptions to this procedure for parts of recent legislation that are likely to change growth rates after 2028. First, I estimated the effects of switching from the Consumer Price Index for All Urban Consumers (CPI-U) to the chained CPI for individual income taxes. Second, I made a rough estimate of the effects of the repeal of the individual

deficits and debt can be attributed to population aging, as the other forces on the budget—rising revenues, falling nonentitlement spending, and steep increases in medical costs—are essentially offsetting, as Sheiner (2018) shows.

Projected Changes in Productivity

Productivity growth—the efficiency with which inputs are turned into outputs—is a key assumption underlying these projections. To some extent, the slowdown in productivity may reflect temporary factors associated with the aftermath of the Great Recession. The CBO expects labor productivity to average 1.6 percent a year over the next 25 years, about the same as the average over the past 30 years but well below the rates observed during the high-productivity years of the late 1990s and early 2000s.[5]

Productivity growth is extremely difficult to predict, but many commentators believe that it is likely to remain subdued. To measure a reasonable downside risk, I analyze the effects of a 0.6 percentage point decline in economywide labor productivity growth, so that it rises about 1.0 percent a year instead of the 1.6 percent assumed by CBO in its baseline projections (figure 1).

I assume that the decline in productivity growth relative to CBO's baseline affects income growth uniformly across the board rather than having differential effects by skill or income level. This assumption is important, because the distribution of income has important implications for government revenues and expenditures. Whether this assumption is reasonable is hard to know. Many observers believe that the widening disparity in income observed in the United States over recent decades is attributable to the fact that technological advancements have improved the productivity of the highly skilled but not people at the bottom of the skill distribution. If productivity growth is slowing, it could be slowing across the board or at the top of the earnings distribution.[6]

Productivity Growth and Interest Rates

Assumptions about interest rates are important in projecting the fiscal outlook. They likely depend on productivity growth. There is a strong theoretical link between interest rates and

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mandate under the Affordable Care Act on tax revenues. Both modifications were modest and had the effect of lowering future deficits.

[4] Although the recent legislation increases deficits in the near term, it reduces them further out. Thus the debt-to-GDP ratio in 2028 is higher than it was in the CBO's March 2017 Long-Term Budget Outlook but about the same by 2043. The budgetary effects of the recently enacted legislation were muted by the fact that many of the provisions that raised deficits are temporary. For example, the individual income tax cuts expire in 2025, and the discretionary spending caps are lifted for only two years. Auerbach, Galen, and Krupkin (2018) estimate that given a baseline in which today's policies are assumed to continue (a current policy baseline instead of a current law baseline), the deficit would reach 7 percent of GDP by 2028.

[5] I use the CBO's March 2017 Long-Term Budget Outlook measure for labor productivity (the ratio of real output to hours worked). Productivity growth is often measured for the nonfarm business sector, omitting the household, nonprofit, and government sectors. Here I use the figures for the whole economy, because they are more relevant for projecting government revenues and expenditures. The CBO's 10-year reports use a different measure—potential labor productivity—which is the ratio of potential output to the potential labor force size.

[6] It is also possible to imagine scenarios in which a slowdown in productivity growth goes hand in hand with widening income inequality. Such a scenario might occur, for example, if the productivity slowdown were coupled with an increasing productivity divergence between highly productive and less productive firms (as documented by Andrews, Criscuolo, and Gal 2016 for firms in the OECD since the early 2000s), or if the slowdown in productivity were caused by a reduction in competition and economic dynamism (as suggested by Furman and Orszag 2018).

productivity growth. In both the Ramsey model and the baseline New Keynesian model, two common models of economic growth, interest rates move with productivity growth, as Hamilton et al. (2015) note.[7] The exact relationship depends on the intertemporal elasticity of consumption, which measures how willing people are to forgo consumption today in order to consume more tomorrow. A decline in productivity growth means that people will be poorer in the future. When consumption is not very substitutable across time, people respond to perceptions of a less rosy future by increasing saving now, in order to mitigate the impact on future consumption, pushing down interest rates. However, when consumption is very substitutable over time, people do not increase saving much in response to lower future income, and interest rates do not decline as much.

Empirically, there is some evidence that interest rates do move with productivity growth. Laubach and Williams (2015) estimate that a 1 percentage point reduction in the growth rate of the economy lowers interest rates by 1.3 percentage points. Pointing to empirical estimates of the intertemporal elasticity of consumption, Lukasz and Smith (2015) and Mehrotra (2018) suggest that a 1 percentage point reduction in productivity growth could lower interest rates by as much as 2 percentage points.

However, Hamilton et al. (2015) note that the relationship between interest rates and productivity growth is "much more tenuous than widely believed." They show that the correlation of average US GDP growth with average interest rates from peak to peak varies across time and across samples and is often negative or zero. They argue that "if, indeed, we are headed for stagnation for supply-side reasons, any such slowdown should not be counted on to translate to a lower equilibrium rate over periods as short as a cycle or two or a decade."

Because of this uncertainty, I analyze the effects of a productivity slowdown under three different assumptions about interest rates: interest rates move one for one with productivity growth, interest rates move two for one with productivity growth, and interest rates are invariant to productivity growth.

Effect of Changes in Productivity on Government Revenues, Noninterest Spending, and Poverty

The effect of productivity growth on government deficits and fiscal sustainability depends on the extent to which government spending and revenues are implicitly "indexed" to GDP growth. If spending and revenues moved one for one with GDP and the government had no debt, changes in productivity growth would not affect fiscal sustainability; deficits relative to GDP and ratios of debt to GDP would be unaffected. Of course, even in this case, lower productivity growth would have real effects on taxpayers. Government spending and tax payments would both be lower, but no new legislation would be required to restore fiscal sustainability.

If, however, government outlays and revenues do not move one for one with productivity growth, changes in productivity growth can affect the fiscal outlook and require policy changes to restore fiscal sustainability. If, for example, tax collections move with GDP but government spending does not, a decline in productivity would increase the deficit.

In addition, when the government holds debt, a slowdown in GDP growth boosts the debt-to-GDP ratio and makes fiscal sustainability more difficult. If interest rates also decline, this

[7] These growth models relate the safe real rate to a representative consumer's discount factor and expected consumption growth; they tie the equilibrium rate to the trend rate of growth in consumption (and thus the economy).

effect will be muted or even reversed, depending on how much interest rates fall. If interest rates fall one for one with productivity growth, holding the primary deficit constant as a share of GDP, the debt-to-GDP ratio would not change very much with a productivity slowdown.

In the rest of this paper, I examine the implications of the downside productivity scenario on the federal and state and local outlooks.

Effect on Federal Revenues

Individual income taxes and payroll taxes are by far the most important components of federal revenues (figure 2a). How do they move with productivity?

Federal Individual Income Taxes

The individual income tax system in the United States is progressive and almost fully indexed to inflation, so that increases in inflation do not push people into higher tax brackets. However, the tax system is not indexed for real income growth. As productivity gains increase national income, more and more income is pushed into higher tax brackets, and tax collections increase. This phenomenon is known as "real bracket creep," because real growth causes average tax rates to creep up over time. In the June 2018 Long-Term Budget Outlook, the CBO estimated that real bracket creep would increase federal individual income taxes by 1.4 percent of GDP over the next 30 years (CBO 2018b).[8]

A slowdown in productivity growth would reduce real bracket creep. Given average annual growth of real labor productivity of 1.6 percent in the baseline and 1.0 percent in the low-productivity scenario, real income is 60 percent higher in the baseline and 35 percent higher in the low-productivity scenario after 30 years.[9] Assuming that the effects of real bracket creep rise linearly with income growth, rather than boosting tax revenues by 1.4 percent of GDP as in the baseline, real bracket creep under a low-productivity scenario would increase tax revenues by only about 0.8 percent of GDP.[10] By the 30th year of the low-productivity scenario, federal individual income tax revenues as a share of GDP would be about 0.6 percentage point lower than in the baseline. Assuming that individual income taxes decline linearly over time, the share of individual income taxes in GDP would rise 0.02 percentage points less a year under the low-productivity scenario than in the baseline, with the difference averaging 0.25 percent of GDP over 25 years.

Payroll Taxes

For payroll taxes, tax collections move close to one for one with wages (and hence productivity), because the tax rate is mostly flat. Social Security taxes (half levied on employers and half levied on employees) are equal to 12.4 percent of wages up to a cap ($128,400 in 2018). The cap is

[8] The average productivity growth assumed over the next 30 years is just slightly lower than in the 2017 projection.
[9] The CBO uses the GDP deflator to calculate real productivity growth and the chained-CPI to calculate real bracket creep. Both are projected to rise at roughly the same rate. The reduction in real productivity growth thus translates into about a one-for-one reduction in real taxable income.
[10] This estimate is a rough one, because the effects of productivity growth on real bracket creep are unlikely to be linear. Once all income is in the highest tax bracket, the system is no longer progressive, and real bracket creep ends.

adjusted annually, so that it rises with economy-wide average wages. Lower productivity growth that lowers wages equally across the board reduces Social Security taxes proportionately.[11]

For most workers, the Medicare tax is 2.9 percent of all wages (paid half by employers and half by employees). However, two types of Medicare taxes are levied only on high-income taxpayers, adding a progressive component to the Medicare tax. First, individual taxpayers with earnings of more than $200,000 and couples with earnings of more than $250,000 face an additional 0.9 percent tax on their earnings above those amounts. Second, taxpayers with income above these amounts face a 3.8 percent tax on net investment income. Although these taxes represent only a small share of payroll taxes (on the order of 2 percent in 2018), the thresholds are not indexed, so that over time they will affect a larger share of earners. The tax rate is low and the share small, however, so real bracket creep will have negligible effects on payroll tax collections.

Federal Tax Summary

Table 1 summarizes the effects of the downside productivity scenario on federal revenues. Only individual income taxes are likely to fall as a share of GDP from a slowdown in productivity growth, and the effect is not large, averaging less than 0.25 percent of GDP over 25 years.

Effect on State and Local Revenues

State and local governments collected revenues of $1.6 trillion in 2015 (figure 2b). Sales tax (35 percent) and property tax (31 percent) together accounted for about two-thirds of these revenues.

State Individual Income Taxes

The degree of progressivity in income taxes varies widely across states. According to Sammartino and Francis (2016), 41 states have a broad-based income tax; 33 of these states have a graduated rate structure with multiple tax brackets. In many states, the top tax bracket begins at a very low income level, however, so that most income is taxed at the highest tax bracket, leaving very little room for real bracket creep. In other states, tax rates rise measurably with income.

Table 2 reproduces the table on the variation in tax rates by income in Sammartino and Francis (2016). It shows that state tax rates are much lower than federal tax rates and vary much less. Thus although state tax collections as a share of GDP may decline with lower productivity growth, the effect is likely to be very small.

State and Local Property Taxes

Property taxes account for about a third of state and local tax revenue. Changes in the property tax base therefore have important implications for the health of state and local finances.
A simple model of the value of residential property would suggest that a change in productivity growth could affect the ratio of property values to GDP. If ones assumes that the value of real property is the discounted present value of housing rent, the value of real property is

[11] The earned income tax credit, which can offset payroll taxes paid by lower-income workers, is treated as part of the income tax scheme.

$$V = R \int_0^{\infty} e^{-(r-g)t} \quad (1)$$

which solves to

$$V = \frac{R}{(r-g)} \quad (2)$$

where *R* is housing rent, *r* is the interest rate, *g* is GDP growth, and *t* is time. If, as the data appear to indicate, rents move with GDP,[12] so that *R* = *b* * GDP,

$$V = \frac{b * GDP}{(r-g)} \quad (3)$$

and

$$\frac{V}{GDP} = \frac{b}{(r-g)}. \quad (4)$$

In steady state, when *r* and *g* are fixed, the property tax base is a constant proportion of GDP.

What happens when productivity growth falls? If interest rates move one for one with productivity growth, *r – g* will be unchanged, and a slowdown in productivity will not change the share of property taxes in GDP. However, if interest rates decline more than productivity growth, so that the denominator in equation (4) declines, a reduction in productivity growth can raise the share of property taxes in GDP, holding tax rates constant. If interest rates do not fall when productivity growth falls, a decline in productivity growth will lower the ratio of property taxes to GDP, putting pressure on state and local governments.

Sales Taxes

General sales taxes move one for one with consumption, which would move with productivity and GDP. Sales tax collections that are administered as a percent of sales are thus likely to be a constant share of GDP.

State and Local Tax Summary

State and local revenues will remain about constant as a share of GDP if interest rates move one for one with labor productivity growth, which seems like a reasonable base case. If interest rates do not move with productivity growth, states may see higher tax revenues relative to GDP.

Effect on Federal Noninterest Spending and Poverty

[12]The share of housing and utility services in consumption has been about 18 percent since 1980 (Bureau of Economic Analysis, 2018, Table 2.3.5 Personal Consumption Expenditures by Major Type of Product, https://bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&1910=x&0=-9&1921=survey&1903=6&1904=2015&1905=2017&1906=a&1911=0#reqid=19&step=3&isuri=1&1921=survey&1903=65).

The effect of a productivity slowdown on spending will depend on several factors, including program rules and the effects of productivity on relative prices, health care demand, and interest rates. To gauge the effects, it is necessary to examine each major element of government spending (figure 3a).

Discretionary Spending

It is hard to know how to project discretionary spending on a "current law" basis, because discretionary spending is subject to annual appropriations by legislators rather than controlled by program rules. CBO makes different assumptions about discretionary spending for the first 10 years of its projection than for its last 20 years. Over the first 10 years, CBO projects that discretionary spending will fall as a share of GDP. Through 2021, spending is controlled by the caps on discretionary budget authority specified in the Budget Control Act of 2011 (and later amendments, including relevant provisions of the recently enacted Bipartisan Budget Act of 2018) and will not change with GDP. For 2022–28, CBO assumes that discretionary budget authority increases with inflation.[13] Under those assumptions, it projects that discretionary spending will decline from 6.3 percent of GDP in 2017 to 5.4 percent in 2028. For its long-range projection (2028–47), CBO assumes that discretionary spending will remain roughly constant as a share of GDP at its 2028 level.

Under CBO's procedures, a slowdown in productivity that starts next year would mean that discretionary spending would rise a little relative to GDP, because over the next 10 years, projected discretionary spending would be unchanged while GDP growth slowed. A slowdown in productivity growth of 0.6 percentage point would increase the share of discretionary spending in 2028 to 5.7 percent, 0.3 percentage point higher than in the baseline. Spending would be assumed to stay at 5.7 percent of GDP throughout the remainder of the long-term forecast.

Social Security

Social security benefits are indexed to wages, so benefits decline when productivity falls. However, benefits for retirees are indexed to the CPI, not real wages, so they are unaffected by a productivity slowdown (put another way, retirees do not get the benefits of real wage growth once they retire and unaffected when wage growth slows). When productivity growth falls, government spending on Social Security benefits falls, too, albeit by less than GDP, thereby raising the share of Social Security in GDP.

The 2017 Social Security Trustees report contains information on the effects of productivity growth on benefits (Board of Trustees 2017). It shows that a decline in real wage growth from 1.2 to 0.6 percent (using the CPI deflator to define real wages) increases the share of Social Security spending in GDP by 0.3 percentage points on average over the next 25 years.[14] Because inflation using the CPI deflator is about 0.4 percentage points higher than inflation using the GDP deflator, this sensitivity analysis indicates what would happen to Social Security spending were annual labor productivity growth to fall from 1.6 to 1.0 percent.

[13] Budget authority allows agencies to contract to spend certain amounts; some of that spending may actually occur in later years.

[14] Board of Trustees (2017, Table VI.D4) shows the effect on taxable payroll. Table VI.G5 shows the relationship between taxable payroll and GDP. I assume this relationship is invariant to productivity changes.

This calculation ignores a number of potential effects, including the possibility that changes in productivity will affect life expectancy, fertility, labor force participation and hours, immigration, and the share of compensation that is taxable (which also affects benefits, which are based on taxable wages). These effects are not likely to have large effects on spending, however, particularly over the next 25 years.

More important is the assumption that a slowdown in productivity growth affects wages across the board. The wage base that determines Social Security taxes and benefits is capped. If productivity growth mostly affects wages at the top of the wage distribution, Social Security benefits would not decline as much with productivity growth, and the increase in Social Security outlays as a share of GDP would be larger than estimated here.

Medicare

Medicare spending increased from 1.2 percent of GDP in 1980 to 3.8 percent in 2015.[15] The forces driving the increase are largely the same as those driving up health spending in general. They include the effects of higher income on health care demand, improvements in technology, and relative price pressures. Analysts disagree about the importance of each of these factors (see, e.g., Technical Review Panel Report 2012, p. 47), mostly because they disagree about whether the observed increase in measured health prices represents true relative price increases or mismeasurement related to the lack of quality adjustments in health care services.

Regardless of why health spending has increased in the past, forecasting health spending is extremely difficult. It has tended to increase faster than GDP, but it cannot continue to do so forever (lest it take up all of GDP) and is therefore likely to eventually decelerate.

Both CBO and the Medicare Trustees develop detailed year-by-year forecasts for the first 10 years of the projection. Because of the way Medicare payments are set, both agencies would lower their projections of Medicare spending over the next 10 years if productivity growth were to slow.[16] The reduction would probably be roughly in line with GDP, although it is possible that Medicare spending would not slow quite as much.

The agencies take different approaches after the first 10 years. Acknowledging the inherent difficulty in making long-range projections of health spending, CBO has taken a formulaic approach. It assumes that the rate of excess cost growth in Medicare—defined as the difference between per beneficiary health spending and per capita GDP—will decline linearly from year 10 (2027) to year 30 of its forecast, and end at 1 (i.e., in 30 years per beneficiary spending is projected to rise 1 percentage points faster than per capita GDP).[17] Because of this one-for-one relationship between Medicare spending and GDP growth, a slowdown in productivity would have little effect on CBO's projection of Medicare spending as a share of GDP.

The Medicare Trustees take a slightly different approach, decomposing changes in health spending into its various factors. Doing so requires specifying and projecting the income elasticity of health spending, relative price inflation, and price elasticities. To slow spending over

[15] Medicare Spending Net of Beneficiary Premiums, CBO Historical Budget Data 2017.

[16] In particular, the payment rates for many parts of Medicare are set as equal to the growth in prices less the 10-year average of economy-wide multifactor productivity growth. The 10-year average would mean that Medicare payments would slow more slowly than GDP. But lower productivity growth would also lower demand for health spending, which would likely lead to some reduction as well.

[17] Long-Term Budget Outlook, March 2017, supplemental data, Table 8, Projected Excess Cost Growth, www.cbo.gov/about/products/budget-economic-data#1.

the projection future, the Trustees assume a falling income elasticity of demand and a rising price elasticity. Because they start their projection with an income elasticity of demand greater than 1, however, they would likely project that a fall in productivity would lead to a reduction in Medicare spending as a share of the economy. Over the first 25 years of their projection, this effect would likely be quite small. Assuming that Medicare spending grows in line with GDP is thus reasonable.

One question is whether the reduction in Medicare spending would mean a real reduction in health services. If medical prices increase because the health sector is labor intensive—and thus has slower labor productivity growth than the economy as whole (i.e., is subject to Baumol's Cost Disease; Baumol and Bowen 1966), a reduction in economy-wide productivity would lower the price of medical care, allowing spending to drop without a reduction in real benefits. If labor intensivity is not an important explanation for the rise in medical spending, a drop in productivity would lower Medicare spending by reducing real health care benefits.[18]

Other Mandatory Programs

Productivity growth can affect spending on means-tested programs (table 3) in two ways. First, reductions in productivity growth might increase the number of people whose income is low enough to make them eligible for the programs. Second, a change in productivity can affect the dollar value of the program benefits themselves.

Poverty

The official poverty rate—which is based on pretax cash income (including Social Security but excluding the benefits of tax credits like the earned income tax credit and in-kind benefits, such as Medicaid)—has remained flat since the late 1960s (figure 4). As the threshold that determines whether a family is poor is linked to inflation, not GDP growth, all else equal one might have expected poverty to decline.

Poverty rates might not move with productivity growth for several reasons. First, many poor people do not work very much. According to Semega, Fontenot, and Kollar (2017), only 11 percent of poor 18- to 64-year-olds worked full time in 2016, and only 38 percent had worked at all during the year. If people do not work, they will not benefit from real wage increases. Other sources of income that are counted as money income for the definition of the official poverty measure, such as Supplemental Security Income, are indexed only to inflation and thus will not increase with productivity growth. Furthermore, many poor people have income well below the poverty threshold. In 2016 about half of poor households had income less than 50 percent of the poverty threshold, meaning that even substantial increases in income would not have pushed them out of poverty.

Over the past few decades, changes in the distribution of wages have hurt people at the bottom of the distribution. Between 1979 and 2012, workers in the bottom 90 percent of the wage distribution saw increases in real annual wages of only 17 percent, while average wages increased about 35 percent, with the bulk of the increases going to people in the top 10 percent (Bivens et al. 2014). It is unclear whether the disconnect between productivity growth and

[18] Furthermore, to the extent certain industries do not contribute to productivity growth, a drop in economywide productivity of 0.6 percent would mean a larger drop in the industries that do contribute to productivity growth—and hence a larger drop in other types of consumption.

earnings reflects declining worker bargaining power, as Bivens et al. (2014) argue, or skill-biased technological change (meaning that productivity growth has been low for people at the bottom of the skills/earnings distribution), as Autor and Salomons (2017) claim.

If changes in productivity growth occur primarily at the top of the wage distribution, a slowdown in productivity may have little effect on poverty and eligibility for means-tested programs. For the purposes of this exercise, I assume that the downside productivity scenario is one in which productivity growth declines uniformly across the board. To gauge the impact of such a change in wage on poverty rates, I use results from Hoynes, Page, and Huff Stevens (2006), who estimate a regression model that examines the impact of changes in median wages and wage inequality on nonelderly poverty rates (They use the ratio of wages at the 50th percentile and the 20th percentile as a measure of wage inequality). Holding wage inequality (and the fraction of women working, which also has an important effect on poverty) constant, they find that a 10 percent increase in the real median weekly wage lowered the poverty rate by 1.1 percentage points between 1980 and 2003.

A decline in the annual growth of real wages from 1.2 to 0.6 percent would lower real wages by 14 percent after 25 years. Using the Hoynes Page, and Huff Stevens (2006) results, this decline would lead to a 1.5 percentage point increase in the nonelderly poverty rate after 25 years, an increase of about 11 percent. I assume that eligibility for programs tied to federal poverty guidelines (even if tied to 125 percent of poverty) would also increase by this amount after 25 years. On average over 25 years, then, I assume that eligibility for poverty-based programs would increase by about 5 percent.

Means-Tested Government Programs

With this estimate, I can gauge the likely impacts of a productivity slowdown on means-tested government programs.

Medicaid, Children's Health Insurance Program, and Affordable Care Act exchange subsidies

Medicaid, the Children's Health Insurance Program (CHIP), and Affordable Care Act exchange subsidies tie eligibility to federal poverty guidelines, which are indexed only to inflation. Hence a slowdown in productivity growth would likely increase spending on these means-tested health programs as a share of GDP because of the increase in poverty.

A similar reasoning to that used for Medicare suggests that a slowdown in productivity would not affect per person health spending for Medicaid, CHIP, or the tax subsidies provided under the Affordable Care Act relative to GDP. However, changes in family income can affect the number of people eligible for these programs and the benefit amount they receive.

Refundable Part of Earned Income and Child Tax Credits

Most of the earned income credit that is received is through a tax refund. For most recipients, their benefit makes their income tax liability negative.

About half of the child tax credit is refundable. In 2017 the refundable parts of these two tax credits amounted to $90 billion, or about 2 percent of federal outlays (Maag 2017). Refundable tax credits are technically classified as spending. CBO's estimates of the effects of

productivity growth on tax revenues (real bracket creep) do not include the effects of real growth on the refundable part of the earned income tax credit.

The earned income tax credit is a tax credit for low-income working families. The credit amount is equal to a fixed percentage of earnings (until the credit reaches its maximum, at which point it begins to phase out). The credit thresholds are indexed for inflation, not real wage growth, so reductions in productivity raise the number of people receiving the credit and the share of the credit that is refundable.

In general, the benefit amount is tied to earnings, so a decline in earnings reduces benefit amounts about one for one with earnings. The maximum credit is indexed to inflation, however, so for people receiving the maximum benefit, the amount increases relative to earnings when productivity slows. On the whole, earned income tax credit outlays would likely increase by a very small amount relative to GDP if productivity growth were to decline.

Supplemental Nutrition Assistance Program (SNAP)

To be eligible for SNAP, households generally have to meet income tests that require that their gross income be less than 130 percent of the poverty threshold.[19] Because poverty guidelines are indexed to CPI, increases in productivity growth that raise family income can reduce the number of families eligible for the program.

The benefit amount is calculated as the monthly allotment less 30 percent of household income (because households are expected to spend 30 percent of their income on food). The monthly allotment is tied to the cost of the Department of Agriculture's Thrifty Food plan and is therefore effectively indexed by food prices. A reduction in productivity growth would not affect the monthly allotment, but it could lower household income and so raise benefit amounts slightly for families.

Supplemental Security Income (SSI)

SSI is based on poverty or disability. Few SSI recipients have wage income, so eligibility is unlikely to be affected by changes in productivity growth. SSI is indexed to inflation, so that benefits rise as a share of GDP if productivity growth declines.

Federal Noninterest Outlays and Poverty Summary

Table 4 summarizes the effects of a slowdown in productivity growth on federal government outlays. To calculate the effect on Medicaid, I use the Hoynes, Page, and Stevens (2006) poverty estimate as a measure of the effect on eligibility. Because I do not have detailed breakdowns of the CBO's projections of other mandatory spending (mandatory spending excluding Social Security and major health programs by category), I do not know what CBO assumes in the baseline, making it is difficult to make a detailed estimate of the effects of the downside

[19] In addition, there is a requirement that net monthly income (income less a number of deductions) be less than 100 percent of the poverty threshold and that families not have assets exceeding certain amounts. Families receiving Temporary Assistance for Needy Families, Supplemental Security Income, or, in some places, general assistance do not have to meet income tests. See www.fns.usda.gov/snap/eligibility#Income.

productivity scenario. But CBO's projections show that other mandatory spending is declining as a share of GDP (an average of 0.2 percent less over the next 25 years; table 4). Instead of separately estimating benefit and eligibility effects category by category, I assume that the decline in CBO's projection of other mandatory spending is attributable to the effects of real GDP growth; because productivity growth in the downside scenario is about half that in the baseline, I assume that other mandatory spending declines by half as much. Adding the effects, I find that when productivity slows, outlays increase by about 0.8 percent of GDP on average over the next 25 years.

Effect on State and Local Noninterest Spending

Figure 3b reports the composition of state and local spending out of own funds. This spending is net of charges (e.g., higher education is net of student-paid tuition) that is not financed by federal grants (e.g., only the state share of Medicaid, rather than the part paid for by the federal government that flows through to states as federal grants, is included).

Most state and local spending is discretionary and appropriated annually. In addition, most states have balanced budget requirements. As a result, in some sense, "current law" spending automatically declines when the tax base shrinks. A key question is how difficult it will be for states and localities to continue to balance their budgets in the face of slower productivity growth.

The big ticket items for state and local governments are education (about 40 percent of total spending out of own revenues), Medicaid and other health spending (19 percent), and public safety (12 percent). As much of this spending represents compensation for state and local workers, state and local government expenditures will likely decline with GDP, as competition between state and local governments and the private sector for employees should equilibrate wages. If private sector wage growth declines in response to lower productivity growth, the growth in government compensation should decline as well.

As in the case of health care, an important policy question is the extent to which this decline in spending will represent a price decrease, because of a less intense Baumol effect or a decrease in real services. Even with some quality adjustments, measured productivity in the K–12 education sector has generally been negative (figure 5). If these quality adjustments are adequate, education spending increases, because of the need to maintain comparability in wages with other more productive sectors. In this case, government spending on education will decline with lower productivity growth without any loss in the real quantity/quality of education. If this low measured productivity growth reflects mismeasurement, a slowdown in productivity growth may result in slower productivity growth in education as well. In this case, the reduction in spending would also be accompanied by a cutback in real education services.

Medicaid

The largest mandatory state program (in the sense that states can change spending only by changing program rules) is Medicaid, which in 2015 represented about 15 percent of state-own spending (other health spending includes spending on hospitals and public health, which is discretionary). The Medicaid program is a joint federal/state program, in which the federal government pays at least half (more in lower-income states). On average, in 2016 the federal government paid 63 percent of Medicaid costs (CMS 2016).

Medicaid spending as a share of GDP is likely to increase a little if productivity growth declines, because eligibility should increase somewhat faster than in the baseline. States will have to cut other programs in order to maintain their balanced budget requirements. Using the methodology adopted for determining the change in federal Medicaid spending, I estimate that a slowdown in productivity growth that increases poverty and hence Medicaid eligibility will increase state Medicaid spending by about 2.5 percent on average over 25 years, equal to 0.4 percent of own-spending. As a share of GDP, the increase represents about 0.1 percent.

Defined Benefit Pensions

Most state and local governments offer their employees a defined-benefit pension plan. These plans operate much like Social Security, in the sense that the initial benefit depends on final wages and thus moves one for one with productivity growth. As with Social Security, once employees retire, their benefits move with inflation (in general) but almost never with wage growth. A slowdown in productivity growth will thus increase the share of GDP accounted for by state and local expenditures on the pensions of already-retired employees.
Unlike Social Security, state and local pension plans are largely prefunded (with the extent of prefunding depending on the rate used to discount the liabilities, an issue of long-standing debate). The comparison with Social Security may seem inapt, as Social Security is largely unfunded and benefits are paid mostly out of current taxes, not assets. When considering the impact of a productivity slowdown on state and local budgets as a whole, not only on their pension plans, however, it is easier to think of the pension plans as fully unfunded and to count the assets in the plan as state and local assets whose returns depend on interest rates.[20] I show the effects of slower productivity growth (and lower interest rates) on federal and state and local debt in the next section.

One caveat to this methodology is that it assumes that competitive forces determine the real compensation costs of state and local employees (including the costs of providing their pensions). A decline in interest rates raises the costs of providing defined-benefit pensions. This analysis (implicitly) assumes that this increase is offset by reductions in other compensation or by a paring back of pension benefits. If it is not, a reduction in the interest rate would raise employee compensation costs, having much larger negative effects on state and local budgets.

I use the Social Security Trustees' estimate of the effects of lower productivity to gauge the likely effects of lower productivity on state and local pension obligations. In 2016 state and local pension benefit payments amounted to $304 billion, or about 1.6 percent of GDP and 20 percent of state and local tax revenue. If, like Social Security, state and local pension benefits climb with population aging, these benefits will be about 20 percent higher on average over the next 25 years then they are today, or about 1.9 percent of GDP.[21] For Social Security, a 0.6 percentage point reduction in labor productivity increases the average spending on Social

[20] Social Security also has a trust fund, but budget analysts, including CBO, prefer to analyze the unified budget rather than distinguishing between on-budget (excluding Social Security) and off-budget (Social Security) surpluses and deficits.

[21] There are no annual projections of state and local pension payments, making it hard to know whether or when payments will rise. On the one hand, the share of employment in the state and local sector has been fairly constant since 1970, suggesting that the pattern of demographic change in that workforce should mirror that of the workforce overall. On the other hand, state and local governments have made more changes to the generosity of pension benefits than has Social Security, and the age of retirement is often much lower for state and local workers than it is for Social Security.

Security benefits by 5 percent, on average, over 25 years, implying that slower productivity growth will increase state and local pension spending by about 0.1 percent of GDP, or about 1 percent of state and local revenues.

State and Local Noninterest Outlays Summary

State and local noninterest outlays should move almost one for one with productivity, so that a slowdown in productivity should not create substantial fiscal stresses. Some small increases in Medicaid and pension expenditures as a share of GDP will require some offsets, but they appear minor.

Effect of Changes in Productivity on Spending on Interest and Debt

Federal Level

The federal debt has increased sharply in recent years. In 2018 it stood at about 78 percent of GDP and is projected to increase sharply, surpassing 130 percent of GDP by 2043 (CBO 2018b). Increases in primary deficits arising from slower productivity would lead to further acceleration in the ratio of debt to GDP. If interest rates fall along with productivity, however, these effects will be muted and possibly even reversed.

To gauge these effects, I calculate the deficit- and debt-to-GDP ratios under a number of scenarios. In all of them, I assume that productivity growth is 0.6 percentage point lower than in the CBO baseline. I estimate that this slowdown in productivity growth will lower federal revenue by about 0.25 percent of GDP and increase spending by about 0.8 percent of GDP, increasing the primary deficit by 1.0 percent of GDP, on average, over the next 25 years (see tables 1 and 4). Figure 6 compares the primary deficits in the CBO's baseline and the low-productivity simulation.

To see the effects of lower interest rates, I run these simulations under the three interest rate assumptions described above: no effect, a one-for-one reduction in interest rates, and a two-for-one reduction in interest rates. Not all the US debt is rolled over each year, so some of the interest rate effects take time to materialize. The average maturity of marketable US debt is five years.[22] As a rough adjustment for the interest rate delays, I start lowering interest rates only in 2023.

Without an interest rate adjustment, the slowdown in productivity growth increases the debt-to-GDP ratio at the end of 25 years from 130 percent in the baseline to 173 percent (figure 7 and table 5). If interest rates fall one for one with GDP, the debt-to-GDP ratio climbs less dramatically, reaching 159 percent by 2042.[23] Even if interest rates fall two for one, the slowdown in productivity still worsens the fiscal outlook. In this case, however, the effect is not large. Instead of reaching 130 percent of GDP, as in the baseline, debt reaches 146 percent of GDP.

[22] Treasury Presentation to TBAC, Office of Budget Management, Fiscal Year 2015 Q3 Report, www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Documents/August2015TreasuryPresentationToTBAC.pdf.

[23] This estimate is a bit higher than the effects of lower productivity growth that CBO reports. It shows a decline in productivity growth of about the same magnitude as the one studied here, increasing the debt-to-GDP ratio in 2042 to 149 percent of GDP. Because CBO gives few details about its methodology, it is hard to know the sources of the difference.

This exercise includes both the effects of lower productivity on primary deficits and the effects of lower interest rates and GDP on debt dynamics. If I assume no changes in primary deficits as a share of GDP from lower productivity growth, a reduction in productivity growth that lowers interest rates one for one has almost no effect on the ratio of debt to GDP. In contrast, a two-for-one interest rate reduction lowers the debt-to-GDP ratio to about 120 percent of GDP after 25 years (Mehrotra 2018 finds a similar result).

State and Local Level

In contrast to the federal government, the state and local sector is a net lender once pension assets are included and unfunded pension liabilities are omitted.[24] According to the most recent Financial Accounts of the United States, ignoring the unfunded liabilities of state and local pension plan, the net assets of the state and local sector totaled $2.9 trillion in 2016, about 15 percent of GDP.[25] A decline in productivity growth that does not lower the return to capital will increase the asset to GDP ratio, because the value of assets will be unaffected but GDP growth will be slower.[26] Holding interest rates constant, a decline in productivity growth will improve the financial position of state and local governments, partially offsetting the effects identified above. In particular, holding interest rates constant, a 0.6 percentage point decline in productivity would allow the sector to increase its spending by 0.006 * 15 percent of GDP, or about 0.1 percent of GDP each year.[27]

A decline in interest rates would hurt the state and local sector (because it is a net lender), with the extent depending on the types of assets the sector holds. If pension plans held long-term fixed-rate securities, they would not be much affected by changes in interest rates (they would be hedged). But most of the holdings of state and local pension plans are not in fixed-income securities: About 75 percent of the funds are held in assets that are vulnerable to interest rate declines.[28]

Assuming that 75 percent of the state and local sector's assets would experience lower rates of return should interest rates decline, I estimate that a 0.6 percentage point reduction in interest rates would lower state and local revenues by about 0.07 percent of GDP, almost fully offsetting the benefits received from the slower productivity growth. If interest rates fell by twice as much as productivity growth, the net effect would be to increase the stress on state and local

[24] Increases in pension payments will likely make the sector less of a net saver.

[25] Board of Governors of the Federal Reserve System, Federal Reserve Statistical Release, Z.1 Financial Accounts of the United States, Flow of Funds, Balance Sheets, and Integrated Macroeconomic Accounts, June 7, 2018, www.federalreserve.gov/releases/z1/20180607/z1.pdf.

[26] For a change in productivity not to affect interest rates and the marginal return to capital, capital intensity must fall. If it does, even though the physical product of existing capital falls when productivity falls, wages will fall as well. The drop may be enough to fully offset the decline in the physical product of capital.

[27] To maintain a stock of assets relative to GDP, the sector can consume $(i - g) * A$, where A is the assets-to-GDP ratio, i is the interest rate, and g is the rate of growth. When g declines, consumption can decrease. To see this another way, think about how much one would have to save for retirement if the amount of income one wanted in retirement was dependent on final wages. With slower productivity growth, the amount of saving relative to current wages would decline, because retirement needs would decline much more than current income (because the decline in productivity growth compounds over time.)

[28] According to the Financial Accounts, 65 percent of the assets of state and local pension plans in 2016 were corporate equities and 6 percent were mutual funds. Plans held about 25 percent of their assets in Treasuries, Government Sponsored Enterprises, and corporate and foreign bonds. The accounts do not report on the average maturity of those holdings.

governments, as the interest rate effects (0.14 percent of GDP) would be larger than the benefits of slower productivity growth. In this case, property values would likely increase, leaving the sector relatively immune to productivity changes.

Concluding Remarks

A slowdown in productivity growth will lower living standards, increase poverty, and worsen the fiscal outlook for federal, state, and local governments. A reduction in labor productivity growth of 0.6 percentage points a year (from 1.6 to 1.0 percent) would increase primary deficits relative to GDP, because some outlays are invariant to changes in productivity growth and revenues are tied more than one for one with productivity growth, so that a productivity slowdown lowers revenues more than it lowers GDP. These increased deficits imply that the federal debt will reach 146–173 percent of GDP by 2042, compared with the baseline estimate of 130 percent of GDP. The range is attributable to differences in assumptions about the relationship between productivity growth and interest rates, which is subject to a great deal of uncertainty.

It is much harder to project the long-term fiscal outlook of the state and local sector, as it is more complicated and studied far less. Still, it is possible to get some idea of the effects slower productivity might have on the sector. In general, state and local tax revenues are less tied to productivity growth than are federal revenues, because the state and local income tax system is less progressive than the federal system and sales taxes and property taxes make up a much larger fraction of tax collections. The relationship between interest rates and productivity is important as well, because the value of the property tax base should depend on how much interest rates change in response to a productivity slowdown. Assuming a one-for-one relationship, changes in productivity should have little effect on state and local revenues. There is also likely to be some upward pressure on state and local spending relative to GDP, stemming from the somewhat heavier burden of pension spending and increased eligibility for Medicaid and other poverty-related programs, but these increases are likely to be small.

Interest and debt dynamics move in opposite directions for the state and local sector and the federal sector. Because the state and local sector is a net lender, reductions in productivity increase the stock of assets relative to GDP and reductions in interest rates lower asset returns relative to GDP. If interest rates moves one for one with productivity growth, there is little effect on the fiscal outlook of the state and local sector.

References

Andrews, D., C. Criscuolo, and P.N. Gal. 2016. *The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy*. OECD Productivity Working Paper 2016-05. Paris: OECD Publishing.

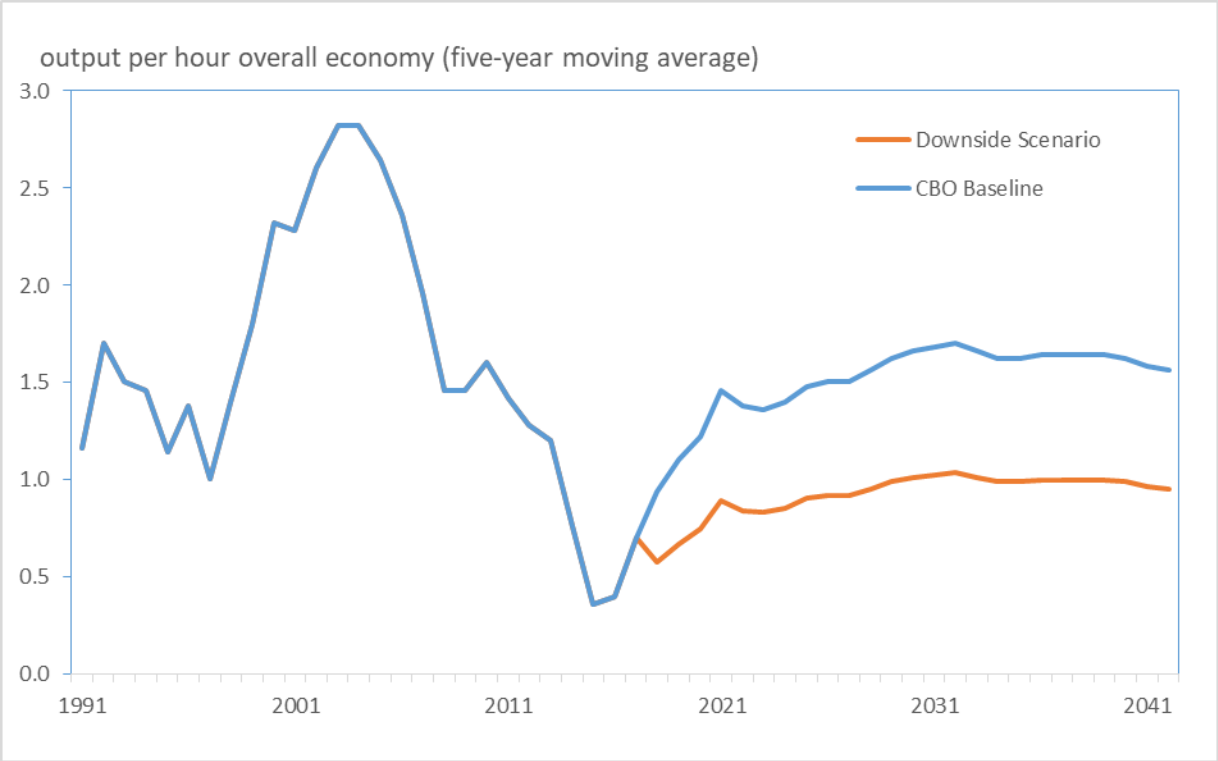
Auerbach, Galen, and Krupkin. 2018. *The Federal Budget Outlook: Even Crazier after all these Years*. Tax Policy Center (April). Washington: Urban Institute and Brookings Institution. Available at www.brookings.edu/wp-content/uploads/2018/04/es_20180423_budgetoutlook.pdf.

Autor, David, and Anna Salomons. 2017. Robocalypse Now: Does Productivity Growth Threaten Employment? In *Investment and Growth in Advanced Economies*. Proceedings of

the European Central Bank Forum on Central Banking, Sintra, Portugal, June 2–28. Available at www.ecb.europa.eu/pub/pdf/other/ecb.ecbforumcentralbanking2017.en.pdf.
Baumol, William, and William Bowen. 1966. *Performing Arts, The Economic Dilemma: A study of problems common to theater, opera, music, and dance.* New York: Twentieth Century Fund.
Bivens, Josh, Elise Gould, Lawrence Mishel, and Heidi Shierholz. 2014. *Raising America's Pay: Why It's Our Central Economy Policy Challenge.* Briefing Paper 378 (June 4). Washington: Economic Policy Institute.
Board of Trustees, Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds. 2017. *The 2017 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds.* Washington.
BLS (Bureau of Labor Statistics). 2016. *Labor Productivity Growth in Elementary and Secondary School Services: 1989-2012*. Washington. Available at www.bls.gov/opub/mlr/2016/article/labor-productivity-growth-in-elementary-and-secondary-school-services.htm.
CBO (Congressional Budget Office). 2017. *The 2017 Long-Term Budget Outlook* (March). Washington.
CBO (Congressional Budget Office). 2018a. *The Budget and Economic Outlook: An Update* (April). Washington.
CBO (Congressional Budget Office). 2018b. *The 2018 Long-Term Budget Outlook* (June). Washington.
CMS (Centers for Medicare and Medicaid Services). 2016. *2016 Actuarial Report on the Financial Outlook for Medicaid*. Baltimore, MD: Centers for Medicare and Medicaid Services. Available at www.cms.gov/Research-Statistics-Data-and-Systems/Research/ActuarialStudies/Downloads/MedicaidReport2016.pdf.
Furman, Jason, and Peter Orszag. 2018. *Slower Productivity and Higher Inequality: Are They Related?* Working Paper 18-4. Washington: Peterson Institute for International Economics.
Hamilton, James D., Ethan S. Harris, Jan Hatzius, and Kenneth D. West. 2015. *The Equilibrium Real Funds Rate: Past, Present, and Future*. Washington: Hutchins Center on Fiscal & Monetary Policy, Brookings Institution.
Hoynes, Hilary W., Marianne E. Page, and Ann Huff Stevens. 2006. Poverty in America: Trends and Explanations. *Journal of Economic Perspectives* 20, no 1.
Laubach, Thomas, and John Williams. 2015. *Measuring the Natural Rate of Interest Redux*. Hutchins Center Working Paper 15. Washington: Brookings Institution.
Lukasz, Rachel, and Thomas D. Smith. 2015. *Secular Drivers of the Global Real Interest Rate.* Staff Working Paper 571. London: Bank of England.
Maag, Elaine. 2017. *Refundable Credits: The Earned Income Tax Credit and the Child Tax Credit* (March 23). Washington: Tax Policy Center. Available at www.taxpolicycenter.org/sites/default/files/publication/139841/2001197-refundable-credits-the-earned-income-tax-credit-and-the-child-tax-credit_0.pdf.
Mehrotra, Neil. 2018 (forthcoming). Implications of Low Productivity Growth for Debt Sustainability. In *Facing Up to Low Productivity Growth*, ed. Adam S. Posen and Jeromin Zettelmeyer. Washington: Peterson Institute for International Economics.
Sammartino, Frank, and Norton Francis. 2016. *Federal-State Income Tax Progressivity*. Tax Policy Center (June). Washington: Urban Institute and Brookings Institution. Available at

www.taxpolicycenter.org/sites/default/files/publication/131621/2000847-federal-state-income-tax-progressivity.pdf.
Semega, Jessica L., Kayla R. Fontenot, and Melissa A. Kollar. 2017. Income and Poverty in the United States: 2016. *Current Population Report P60-25* (September). Washington: US Census Bureau.
Sheiner, Louise. 2018. *The Long-Term Impact of Aging on the Federal Budget*. Hutchins Center Working Paper 40. Washington: Brookings Institution.
Technical Review Panel on the Medicare Trustees Report. 2012. *Review of Assumptions and Methods of the Medicare Trustees*. Financial Projections (December). Baltimore, MD: Centers for Medicare and Medicaid Services.
US Census Bureau. 2017. *Historical Poverty Tables: People and Families-1959 to 2016*. Tables 13 and 22. Suitland, MD. Available at www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-people.html.

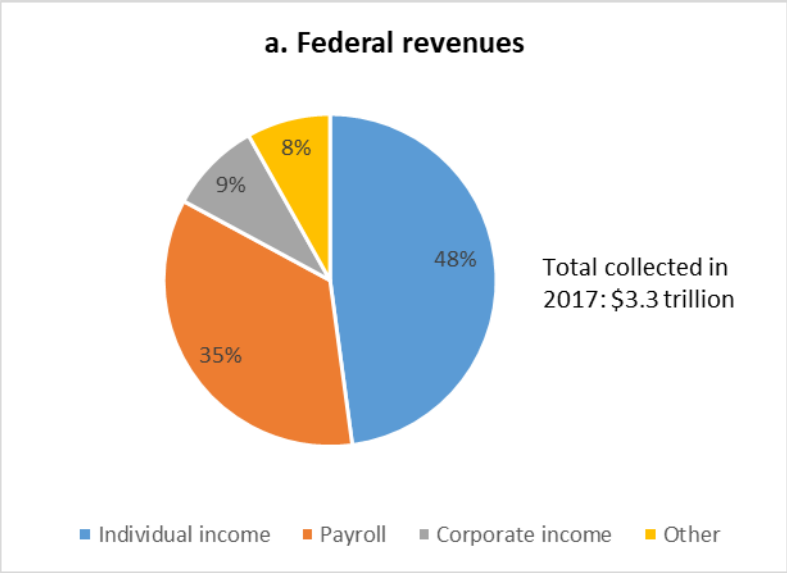
Figure 1 Labor productivity in the United States, 1991–2042



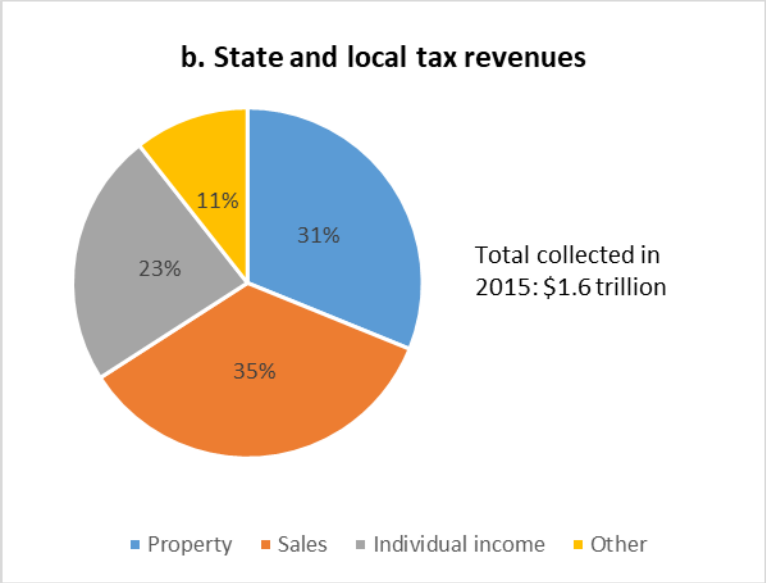
CBO = Congressional Budget Office

Source: Based on data from CBO (2017) supplementing www.cbo.gov/publication/52480.

Figure 2 Composition of federal, state, and local tax revenues in the United States, 2017

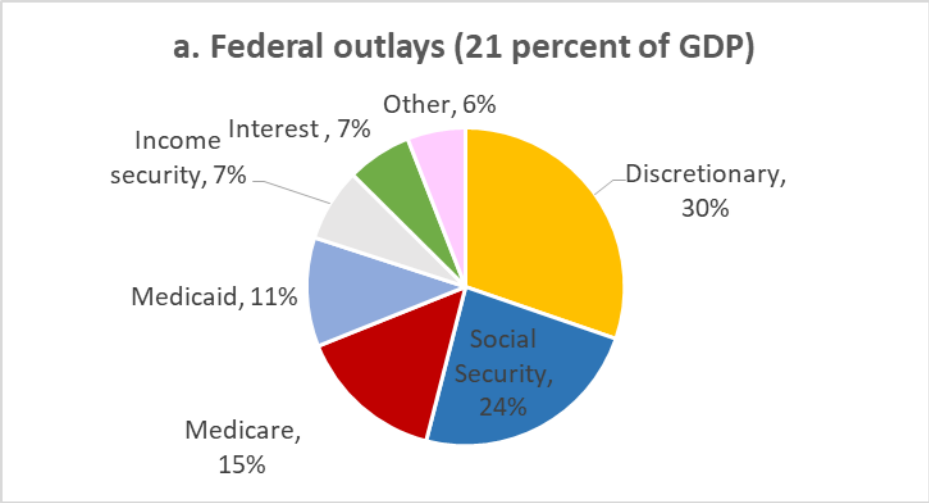


Source: CBO (2018a).

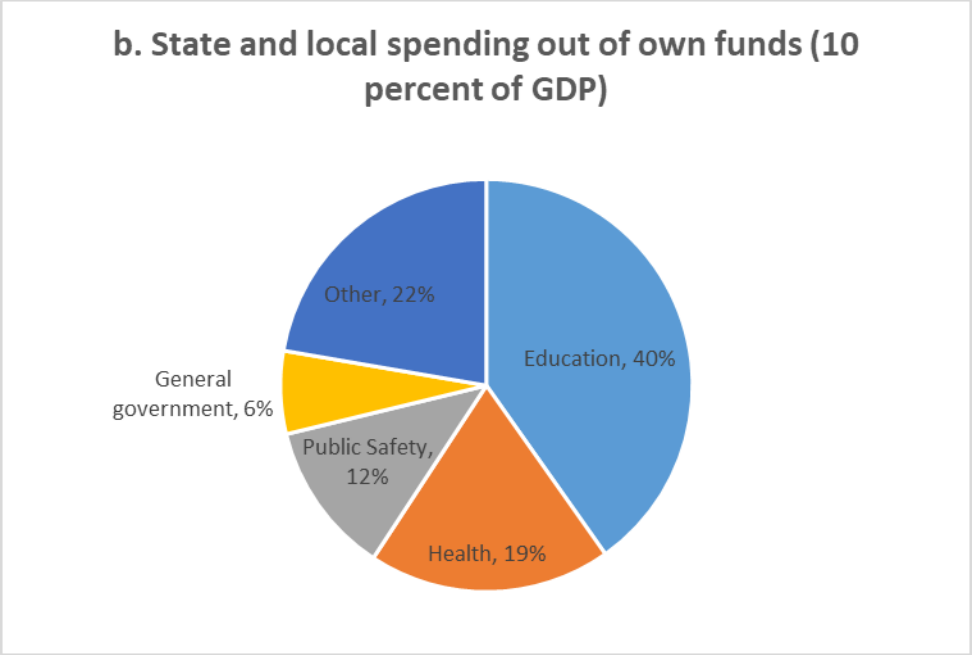


Source: Author's calculations based on US Census Bureau, State and Local Government Finances, Table 1.

Figure 3 Federal, state, and local government outlays in the United States, 2017

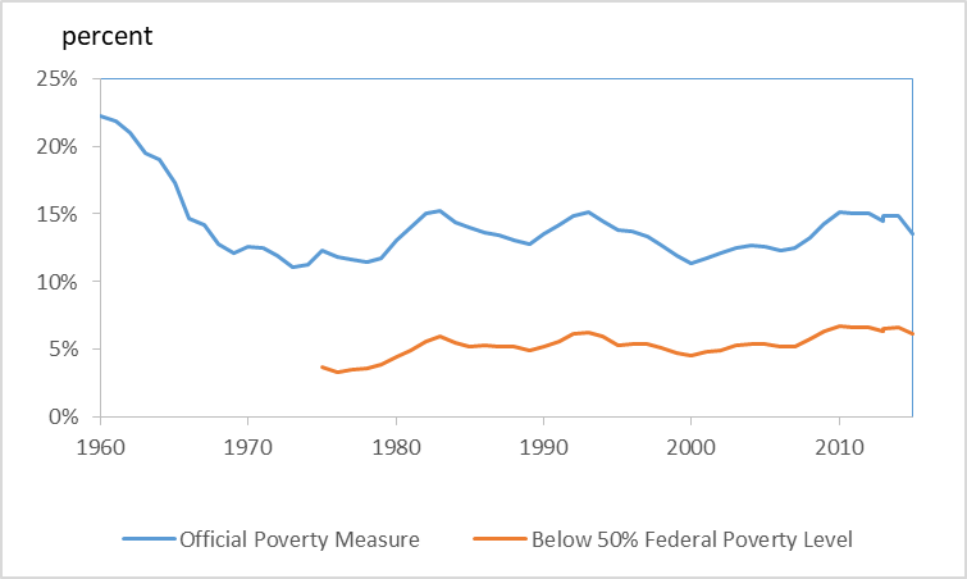


Source: CBO (2018b).



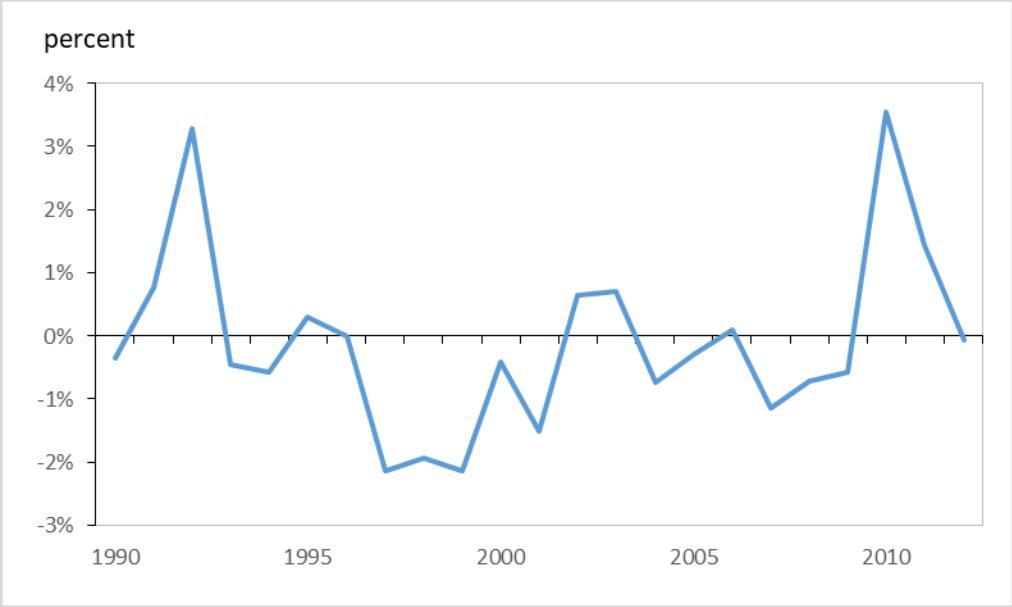
Note: Includes all spending less charges, utilities, liquor store revenue, and federal grants.
Sources: Author's calculations based on data from US Census Bureau, State and Local Government Finances, 2015, Table 1; Office of Management and Budget, Historical Table 12.2.

Figure 4 Poverty rate in the United States, 1960–2015



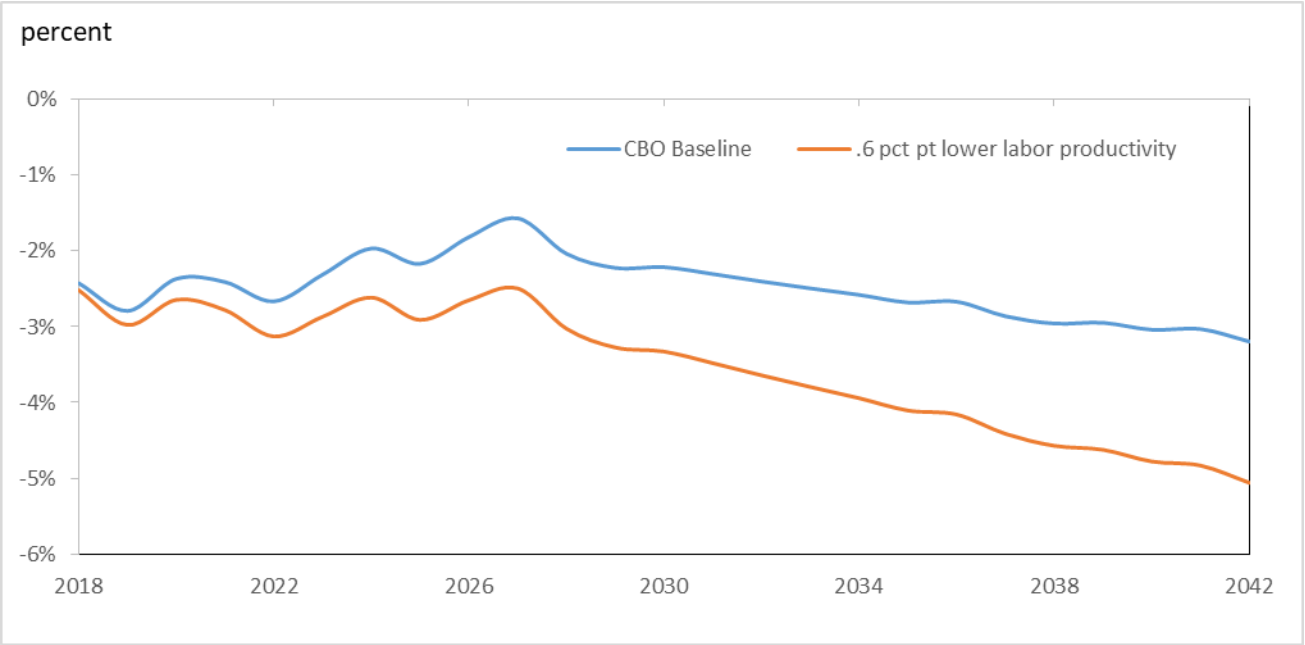
Source: US Census Bureau (2017).

Figure 5 Productivity growth of public K–12 educational services in the United States, 1990–2012



Source: US Bureau of Labor Statistics (2016).

Figure 6 Projected primary deficits in the United States under baseline and low productivity scenarios, 2018–42

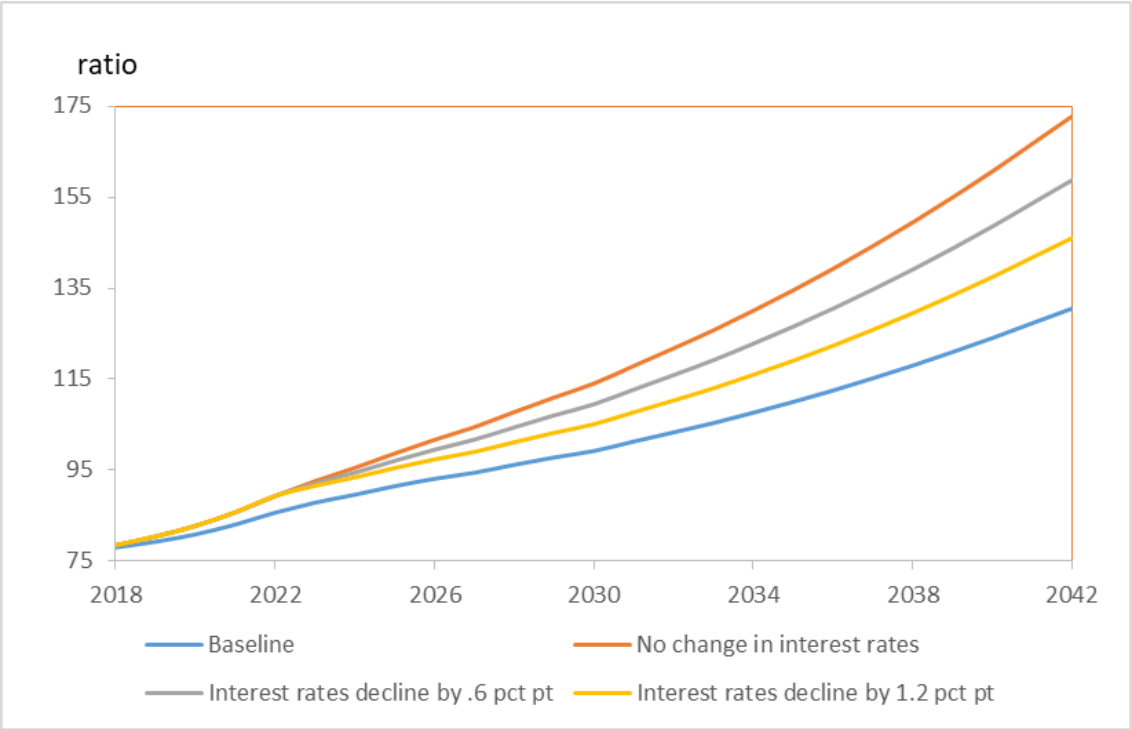


CBO = Congressional Budget Office

Note: For the CBO baseline, data for 2018–28 are from CBO (2018a). Out-years were calculated by extending revenues and spending by their respective growth rates in CBO (2017) (see footnote 5).

Source: Author's calculations based on CBO (2017, 2018a).

Figure 7 Projected debt-to-GDP ratios in the United States under baseline and downside low productivity scenarios, 2018–42



Source: Author's calculations based on CBO (2017, 2018a).

Table 1 Effect of slower productivity growth on federal revenues in the United States (percent)

Item	GDP share, 2018	Average share of GDP, 2018–42	Estimated change relative to GDP over 25 years
Taxes			
Individual income	8.2	9.6	–0.25
Payroll	5.9	6.1	0
Corporate	1.2	1.5	0
Other	1.4	1.2	0
Total revenues	16.6	18.4	–0.25

Source: Author's calculations based on CBO (2017, 2018a).

Table 2 Average federal and state income tax rates in the United States by expanded cash income percentile (percent)

Income level	Federal	State
Quintile		
Bottom	–4.8	0
Second	–1.9	0.7
Middle	2.9	1.3
Fourth	6.1	1.8
Top	13.1	3.0
All	8.1	2.2
Bracket		
80–90 percent	8	2.2
90–95 percent	10	2.5
95–99 percent	13.9	3.0
Top 1 percent	20.2	4.3

Source: Sammartino and Francis (2016).

Table 3 Mandatory federal spending in the United States, 2017

Program	**Spending** (billions of dollars)	**Share of total outlays** (percent)
Social Security	939	24
Medicare	591	15
Medicaid, State Children's Health Insurance Program, and Affordable Care Act exchange subsidies	439	11
Refundable earned income and child tax credits	83	2
Supplemental Nutrition Assistance Program (SNAP)	70	2
Supplemental Social Security (SSI)	55	1
Federal employee retirement	92	2
Veterans programs	105	3
Other	145	4
Total	2,519	63

Source: CBO (2017).

Table 4 Effect of slower productivity growth in the United States on federal outlays and primary deficits

Item	GDP share 2018 (percent)	Average share of GDP 2018–42 (percent)	Change in nominal benefit relative to GDP as a result of slower productivity growth	Change in eligibility as a result of slower productivity growth	Change relative to GDP over 25 years as a result of slower productivity growth (percent)
Noninterest outlays					
Discretionary	6.4	5.6	Higher	n.a.	0.24
Social Security	4.9	5.8	Higher	Unchanged	0.3
Medicare	2.9	4.4	Lower/unchanged	Unchanged	0.0
Medicaid, Children's Health Insurance Program (CHIP), Affordable Care Act exchange subsidies	2.3	2.6	Lower/unchanged	Higher	0.13
Other mandatory programs (Supplemental Nutrition Assistance Program, Earned Income Tax Credit, Child Tax Credit, other)	2.6	2.4	Higher	Higher	0.10
Total noninterest outlays	19.0	20.8			0.77
Revenues	16.6	18.4			–0.25
Primary deficit (outlays less revenues)	2.4	2.4			1.02

n.a. = not available
Source: Author's calculations based on CBO (2017, 2018a).

Table 5 Projected debt-to-GDP ratios in the United States under baseline and low productivity scenarios

		Low productivity scenario		
Item	**Baseline scenario**	**No interest rate adjustment**	**Interest rate adjustment is one for one**	**Interest rate adjustment is two for one**
Average annual productivity growth	1.2 percent	0.6 percent	0.6 percent	0.6 percent
2042 primary deficit as share of GDP	3.2 percent	5.1 percent	5.1 percent	5.1 percent
Interest rates	Baseline	Baseline	Baseline minus 0.6 percentage point	Baseline minus 1.2 percentage points
2042 debt-to-GDP ratio (percent)	130	173	159	146

Source: Author's calculations based on CBO (2017, 2018a).