US Fiscal policy during and after the coronavirus

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Abstract. COVID-related government outlays will increase the level of government debt. A macroeconomic model, calibrated to the US, quantitatively assesses potential responses to this higher debt. In terms of economic welfare, reducing debt through capital incomes tax hikes is the least desirable option considered: the associated tax base is small, and anticipating such a tax increase reduces capital accumulation. There is little to choose between fiscal austerity through government spending cuts versus raising labour income tax rates. Accommodating higher government debt is welfare-improving but still requires substantial fiscal austerity owing to higher debt servicing costs.

Résumé. Politique fiscale des États-Unis avant et après le coronavirus. Les dépenses gouvernementales liées à la COVID-19 entraîneront une augmentation de la dette publique. Un modèle macroéconomique calibré sur les États-Unis permet d’évaluer de façon quantitative les possibilités de réaction face à cet accroissement de la dette. En termes de bien-être économique, augmenter les taxes sur les revenus du capital pour réduire la dette est la solution la moins souhaitable, non seulement parce que l’assiette fiscale correspondante est petite, mais aussi parce que l’anticipation de ces hausses entraîne une diminution de l’accumulation de capital. Il est bien difficile de trancher entre une austérité budgétaire caractérisée par une compression des dépenses publiques d’un côté, et une hausse des taux d’imposition des revenus du travail de l’autre. Faciliter l’augmentation de la dette publique entraînerait une amélioration du bien-être, mais nécessiterait quand même des mesures d’austérité budgétaire substantielles en raison des coûts de service de la dette plus élevés.

JEL classification: E62, H31, H63, H62

1. Introduction

The US fiscal response to COVID-19 has been massive: as discussed in section 2, all told the federal response amounts to $4.2 trillion, mostly in 2020 and 2021. To put this number into perspective, it represents over 19% of pre-pandemic GDP (2019). This fiscal stimulus will increase government debt levels. This paper quantitatively evaluates the effects of responding to higher
levels of government debt through adjustments in government spending, labour income taxation and capital income taxation.1

The model builds on neoclassical foundations with a representative household that holds government debt, elastically supplies labour and earns capital income. Much has already been written about the macroeconomic effects of the pandemic; see, in particular, the early and influential work of Eichenbaum et al. (2020). To more sharply focus on fiscal policy in the post-pandemic environment, the short-term effects of the pandemic are attributed to changes in total factor productivity. This approach is similar to how Gregory et al. (2020), looking at the post-pandemic recovery in frictional labour markets, model lockdowns as temporary declines in labour productivity. Government spending is valued in that the household receives utility directly from government spending, or public goods.2

In most macroeconomic models, there is but one real interest rate, and the discount factor is chosen as an average of the real risk-free return and the return on capital. In the current context, this practice implies that the return on government debt is much higher than is currently observed, driving up the government’s debt servicing burden. The end result is that interest payments on government debt are large, increasing the benefits of debt reduction. By the same token, standard practice leads to a return to capital that is lower than observed, distorting the sizes of both the capital stock and the capital income tax base.

With the above in mind, two features are introduced to the model, one to push the real bond rate below that implied by the discount factor, the other to drive the return to capital above. To start, because different government policies are evaluated on the basis of calculations of households’ lifetime utility, the discount factor continues to be calibrated to the average of the observed risk-free rate and the return to capital. The first feature introduced is a utility yield to holding government bonds. This utility yield may reflect households’ desire for liquidity, although, like money-in-the-utility function, the micro-foundations are left unspecified. This utility yield of bonds raises the effective return above the pecuniary return. The second feature is an investment adjustment cost. As in Kaplan et al. (2020), the investment adjustment cost is not measured in output or the return to capital. Consequently, the measured return to capital is below its “true” return.

During and immediately after the pandemic, government fiscal policy is given by Congressional Budget Office (CBO) estimates, summarized in section 2. The model predicts that government debt will rise from 105% of output in

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1 Explicit default is not considered. Given Federal Reserve independence, inflationary financing is also ruled out. Relatively little tax revenue is raised from sales taxes, and none at the federal level.

2 An alternative means of giving value to government spending is giving it a productive role.
2019 to around 140% at the end of 2024. Starting in 2025—not too long after the pandemic—the government chooses a path for one of its policy instruments (government spending, labour income taxes, capital income taxes) to satisfy a simple feedback rule specifying larger budget surpluses when government debt is above target as in Auray et al. (2019). This fiscal feedback rule calls for substantial fiscal austerity; for example, cuts that put government spending more than 14% below trend. Such fiscal austerity results in output running well below trend for many years. In fact, the anticipation of future austerity drives output below trend in the years leading up to the onset of debt reduction measures.

In terms of household welfare, capital income tax-based austerity is the least preferred option for two reasons. First, the capital income tax base is small not only because capital’s share of income is smaller than that of labour but also because of the tax deductibility of depreciation. Second, anticipating that the government will raise the capital income tax rate, households reduce their capital accumulation because the future return to capital will be lower. This second observation reflects the well-known finding in the public finance literature that factors of production that are elastically supplied should not be taxed too heavily (Ramsey 1927). The small capital income tax base necessitates a hefty increase in the tax rate, while the effects on capital investment lead to substantial macroeconomic disruptions, which are very costly.

The choice between cutting government spending and boosting the labour income tax rate depends on the elasticity of substitution between private and public goods in utility. When it is difficult for households to substitute between these two goods—as under the baseline calibration—households prefer austerity via labour income taxation in order to avoid a drop in the provision of public goods. Conversely, when private and public goods are very substitutable, the distortions of labour income taxation are more important because households can easily substitute into private consumption goods in the face of a contraction in public goods.

What if fiscal austerity is delayed until, say, 2029? Interest payments on debt lead to a higher debt–output ratio, which entails greater austerity when the time comes. Nevertheless, delaying austerity is welfare-improving under either government spending or labour income taxation: for these policy instruments, the magnitude of macroeconomic disturbances do not depend too much on when austerity starts, and discounting implies benefits to delay. On the other hand, waiting to implement capital income tax hikes gives households longer to decumulate capital, and the postponing effects of austerity lower household welfare.

Given the deleterious effects of fiscal austerity, perhaps the government should simply accommodate the higher debt. Doing so nonetheless requires fiscal austerity because the government will have higher debt servicing costs (the interest payments on the larger stock of debt). In fact, in this case the initial government spending cut is 3/4 of that called for when the government seeks to eventually return debt to its pre-pandemic level of 105% of output.
This scenario requires either permanent government spending cuts, or permanent tax hikes. Despite these long-run effects, a higher debt target improves household welfare.

The global pandemic has launched a tsunami of economic research, and any attempt to summarize this literature would be inadequate and incomplete. In the macroeconomics literature, the interested reader is pointed to the papers building on Eichenbaum et al. (2020), who set the standard for integrating epidemiology and macroeconomics. Key to this literature is how social and economic decisions affect the progress of the disease, and how COVID-19 influences those decisions. As mentioned earlier, the short-term effects of the pandemic are subsumed by total factor productivity.

More related is the fiscal austerity literature, much of which focuses on sovereign debt default (for example, Bi 2012), which probably is not relevant for the United States. More pertinent are works studying the macroeconomic effects of tax adjustments to high public debt. Auray et al. (2016) are motivated by the run-up in government debt in the so-called GIIPS group (Greece, Ireland, Italy, Portugal, Spain) following the 2007-08 financial crisis. They use a small open economy model to explore the implications of debt reductions, finding that the welfare benefits are modest. Mendoza et al. (2014) are similarly motivated by the effects of higher European government debt following the financial crisis. They model fiscal austerity in a two regions open economy setting with one region being the GIIPS group, the other the remaining large EU countries. Mendoza et al. are particularly interested in the strategic interactions between the two regions. Auray et al. (2019) analyze a number of fiscal austerity scenarios for a closed economy with labour market search frictions, calibrated to the US economy. They find a central role for labour market frictions.

Section 2 summarizes the US federal fiscal response to COVID-19. The model is developed in section 3 and calibrated in section 4. Fiscal austerity results are presented and discussed in section 5. Conclusions are drawn in section 6.

2. **US fiscal policy**

As of May 2021, the US fiscal policy response to the global pandemic has taken the form of six pieces of federal legislation:

1. March 6, 2020: H.R. 6074, Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020
2. March 18, 2020: H.R. 6201, Families First Coronavirus Response Act
3. March 27, 2020: H.R. 748, Coronavirus Aid, Relief and Emergency Security (CARES) Act
4. April 24, 2020: H.R. 266, Paycheck Protection Program and Health Care Enhancement Act
5. December 27, 2020: H.R. 133, Coronavirus Response and Supplemental Appropriations Act, 2021
6. March 11, 2021: H.R. 1319, American Rescue Plan Act of 2021

The CBO provides cost estimates for each of these Acts over a 10-year horizon. To more easily summarize these costs, I have categorized each item in the cost estimates as one of: government spending, unemployment compensation, transfers, labour income or capital income. Online appendix A details how each item was categorized. For the most part, this categorization is straightforward, although a careful reading of the documents accompanying the cost estimates, or even the actual legislation, were necessary. One item that deserves note is the treatment of deferring employer contributions for payroll taxes. Because these payments are deferred, I chose to treat them as akin to loans made to firms in 2020 and 2021 with repayment in 2022 and 2023. For this reason, these deferred taxes are unallocated, in the same way that the loans under the Payroll Paycheck Protection program are not classified (although associated expenses are).³

Figure 1 shows that the US fiscal policy response to the pandemic was most active in 2020 and 2021. At this vantage point, this observation seems quite natural because the US is on track to vaccinate all who are willing to be vaccinated by mid-2021. That said, transfers are still projected to be large in 2022, as is government spending. Overall, the fiscal response to the coronavirus are over by around 2025.

Summing over the entire 2020–2030 horizon, figure 1 shows that transfers are the largest single component of the fiscal response, followed by government spending and capital tax relief. The flows going to capital can be attributed to the subsidies and loans forgiven under the Payroll Protection Program (and its continuation in subsequent acts). By historic standards, the labour tax relief and unemployed payments may be large, but compared with the other categories of fiscal policy they appear quite modest.

It is helpful to put some of these numbers into perspective. Capital tax relief in fiscal year 2020 were $905.3 billion;⁴ my updating of calculations in Gomme et al. (2011) place total capital income taxes paid in 2019 at $700 billion. In other words, pandemic capital tax relief was nearly 130% of taxes paid in 2019; for 2021, the figure is 23%. In contrast, in 2020, labour tax relief amounted to 3.5% of labour income taxes paid in 2019 and 4.4% in 2021.

Alternatively, the fiscal stimulus can be expressed relative to 2019 GDP. Pandemic government spending in 2020 amounted to 2.0% of 2019 GDP, while capital tax relief constituted 4.2%. By way of comparison,

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³ The Payroll Paycheck Protection program included provisions to forgive loans provided firms met certain conditions. In this case, the loan would be treated as a transfer to firm owners. Details like this are left to the CBO to sort out.

⁴ Fiscal year 2020 ended September 30, 2020.
unemployment compensation amounted to 1.0% of GDP, transfers 1.4% and labour tax relief 0.5%. These percentages understate the size of the pandemic relief because these expenditures occurred in the second half of fiscal year 2020. For 2021, the pandemic-induced increase in transfers is 3.4% of 2019 GDP; the next largest components are government spending (1.5%) and unemployment compensation (1.3%). Summing the figures, pandemic relief in 2020 amounted to 9.0% of 2019 GDP, and 7.0% in 2021. By almost any
measure, pandemic-related fiscal response was huge. All told, the stimulus adds up to $7.2 trillion, or 19.4% of 2019 GDP.

3. Economic environment

The representative household receives utility from private consumption goods, $c_t$, public goods, $g_t$, and holding government bonds, $d_t$, and disutility from working, $h_t$. Its lifetime utility is

$$
\sum_{t=0}^{\infty} \beta^t U(c_t, g_t, d_t, h_t), \quad 0 < \beta < 1. \tag{1}
$$

As discussed in the introduction, bonds-in-the-utility function is introduced to deliver a return on government debt, $R_t^d$, that reflects the low returns typically paid on government debt.

The household’s date $t$ budget constraint is

$$
c_t + x_t + d_{t+1} + T_t = (1-\tau^h_t)w_t h_t + (1-\tau^k_t) r_t k_t + \tau^d_t R_{t-1}^d d_t + \pi_t. \tag{2}
$$

The first term on the right-hand side is after-tax labour income: the tax rate is $\tau^h_t$ and $w_t$ is the real wage. After-tax capital income is the second term: $\tau^k_t$ is the capital income tax rate and $r_t$ the real rental rate. The next term is the capital consumption allowance, which reflects the tax deductibility of depreciation; $\delta$ is the depreciation rate. The final two terms on the right-hand side are principal plus interest on government debt and profit income.

On the left-hand side of equation (2), the household uses its resources to buy private consumption goods, invest in new capital, purchase newly issued government debt and pay a lump-sum tax. The law of motion for capital is

$$
k_{t+1} = (1-\delta) k_t + x_t - \varphi(x_t), \tag{3}
$$

where $\varphi(x_t)$ is a (weakly) convex investment adjustment cost function: $\varphi' > 0, \varphi'' \geq 0$.

The household’s Euler equations are

$$
(1-\tau^h_t)w_t U_1(c_t, g_t, d_t, h_t) + U_3(c_t, g_t, d_t, h_t) = 0, \tag{4}
$$

$$
\frac{U_1(c_t, g_t, d_t, h_t)}{1-\varphi'(x_t)} = \beta U_1(c_{t+1}, g_{t+1}, d_{t+1}, h_{t+1}) \times \left[ 1 - \tau^k_{t+1} r_{t+1} + \tau^k_t \delta + \frac{1-\delta}{1-\varphi'(x_{t+1})} \right], \tag{5}
$$

$$
U_1(c_t, g_t, d_t, h_t) = \beta \left[ U_1(c_{t+1}, g_{t+1}, d_{t+1}, h_{t+1}) R_t^d + U_3(c_{t+1}, g_{t+1}, d_{t+1}, h_{t+1}) \right]. \tag{6}
$$

Equation (4) is a typical labour supply condition, while equations (5) and (6) govern capital and bond accumulation, respectively. From equations (5) and (6), the return arbitrage condition for this economy is
\[
(1 - \varphi'(x_t)) \left[ (1 - \tau_{t+1}^k) r_{t+1} + \tau_{t+1}^k \delta + \frac{1 - \delta}{1 - \varphi'(x_{t+1})} \right] = R_d^t + \frac{U_2(c_{t+1}, d_{t+1}, h_{t+1})}{U_1(c_{t+1}, d_{t+1}, h_{t+1})}.
\]

On the right-hand side of equation (7), the marginal rate of substitution term raises the effective return on bonds above their pecuniary return, \( R_d^t \); meanwhile, on the left-hand side, investment adjustment costs reduce the overall return to capital, thereby pushing up the measured return, \( R_{k_{t+1}}^t \equiv 1 + (1 - \tau_{t+1}^k)(r_{t+1} - \delta) \). This latter mechanism is similarly used by Kaplan et al. (2020) to drive a wedge between the return to capital and bond yields.

The representative firm solves a sequence of static profit maximization problems:

\[
\pi_t = y_t - r_t k_t - w_t h_t, \text{ where } y_t = F(k_t, h_t; z_t); \tag{8}
\]

\( z_t \) is productivity. The first-order conditions are

\[
r_t = F_1(k_t, h_t; z_t) \text{ and } w_t = F_2(k_t, h_t; z_t). \tag{9}
\]

Finally, on the government side, debt evolves according to

\[
d_{t+1} = R_{d_{t-1}}^d d_t + \text{Def}_t, \tag{10}
\]

where the primary deficit is

\[
\text{Def}_t = g_t - \tau^h w_t h_t - \tau^k (r_t - \delta) k_t - T_t. \tag{11}
\]

During and for a few years after the pandemic, fiscal policy variables are taken as given. Once the coronavirus crisis has passed, government fiscal policy is determined by a feedback rule:

\[
\frac{\text{Def}_t}{y_t} - \frac{\text{Def}}{y} = -\omega \left[ \frac{d_t}{y_{t-1}} - \frac{d}{y} \right], \tag{12}
\]

where \( d/y \) is the long-run target for the government debt–output ratio and \( \text{Def/y} \) is the corresponding target for the deficit–output ratio. When operational, the feedback rule prescribes smaller deficits when debt is above target; the parameter \( \omega \) determines how quickly the debt–output ratio returns to target. It is well known that the debt dynamics of equations (10) and (11) are unstable absent a feedback rule like equation (12).

The definition is a competitive equilibrium is standard; goods market clearing is

\[
c_t + g_t + x_t = F(k_t, h_t; z_t). \tag{13}
\]

4. Calibration

The utility function is

\[
U(c, d, h) = \ln \left( \left[ \theta c^{\frac{1}{\gamma}} + (1 - \theta) g^{\frac{1}{\gamma}} \right]^{\frac{1}{\gamma}} \right) + \xi \ln(d) - h^{1+1/\theta}. \tag{14}
\]
There are several considerations going into the choices reflected in the utility function. First, so that the labour supply elasticity can be set to a value within the range estimated in the microeconomic literature, preferences exhibit a constant Frisch labour supply elasticity, given by $\theta$. Given this choice, the logarithmic forms for the other terms is the most straightforward way to write down constant Frisch labour supply elasticity preferences. Second, the elasticity of substitution between private and public goods is important when the government is considering debt reduction through government spending cuts. The baseline sets the elasticity of substitution between private and public goods to 2/3 which means that the two goods are less substitutable than Cobb-Douglas. Below, results are also presented when the elasticity is 2 in which case private and public goods are more easily substituted. Finally, the weight on private goods, $\vartheta$, is set such that, in steady state, the marginal utilities of private and public goods are equalized. An implication of setting the value of $\vartheta$ in this way is that the steady-state allocation between private and public goods is efficient.

As is typical in the macroeconomics literature, production is Cobb-Douglas:

$$F(k, h; z) = z k^a h^{1-a}. \tag{15}$$

Investment adjustment costs are given by

$$\varphi(x_t) = \psi x_t. \tag{16}$$

While quadratic adjustment costs are more common in the macroeconomics and international finance literatures, the purpose of introducing adjustment costs is not to dampen investment fluctuations, but to increase the measured return to capital. The adjustment costs need to be nearly linear in investment, or else the volatility of the bond rate is implausibly large.

A model period is a quarter; the simulations below are insensitive to this choice. The model is calibrated to observations for the US just prior to the pandemic on the assumption that the US economy was near its steady state, with total factor productivity, $z$, normalized to one.\(^5\) The calibration targets and sources are summarized in table 1 and, where applicable, are expressed annually. The tax rates and labour supply elasticity have direct counterparts in the model. The value of the labour supply elasticity, 1/2, represents a compromise between the very low estimates for men and the somewhat higher ones for women. The discount factor, $\beta$, is set to the quarterly analogue of 0.96, which, in a more typical macroeconomic model, would deliver a steady-state real interest rate of 4% per annum. The parameters $\alpha$, $\delta$, $\psi$ and $\xi$ are calibrated so that the steady state of the model matches the targets in table 1; their values are given in table 2. The steady-state lump-sum tax is set so that

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5 For ease of presentation, the model abstracts from growth. Consequently, deviations from steady state are more properly thought of as deviations from a balanced growth path.
the government budget constraint is satisfied given the debt–output ratio and government share of output.

The value of $\omega$ in the fiscal policy feedback rule equation (12) determines the magnitude of the fiscal policy response to higher debt and, consequently, the speed of debt reduction. To ensure that the value of $\omega$ is empirically relevant, I use the estimated value of 0.054 for the longest sample, 1916-1995, in Bohn (1998). Because a model period is a quarter, while Bohn used annual data, his estimate is divided by four, giving the value $\omega = 0.0135$.

The model is solved as a two-point boundary problem (Fair and Taylor 1983); see Auray et al. (2016) for details. One boundary is the initial pre-pandemic steady state; the other is a “no change” condition that endogenously determines the terminal steady state. Between these two boundaries, I need to specify what happens to total factor productivity and to fiscal policy.

During 2020, model total factor productivity, $z_t$, is set so that the model’s time path for the logarithm of output matches the deviations from a linear trend line computed using data between 2010Q1 and 2019Q4. During 2020, total factor productivity is as much as 8.5% below trend (to match the deviation of output from trend, −10.7%), although by the end of 2020, model total factor productivity is only 2.2% below trend. Starting in 2021, model total factor productivity converges to steady state according to

$$\ln z_t = \rho \ln z_{t-1}.$$

### TABLE 1
Calibration targets

| Target                                      | Value | Source                                                      |
|---------------------------------------------|-------|-------------------------------------------------------------|
| Capital share                               | 30%   | Gomme and Rupert (2007), updated                           |
| Depreciation                                | 6.8%  | Gomme and Rupert (2007), updated                           |
| Return to capital, 2010–2019                | 7.55% | Gomme et al. (2011), updated                               |
| Return on government debt, 2010–2019       | 0.85% | 10-year treasury inflation-indexed security, FRED FII10   |
| Frisch labour supply elasticity             | 0.5   | Typical labour supply estimates                            |
| Labour income tax, 2019                     | 29.3% | Gomme and Rupert (2007), updated                           |
| Capital income tax, 2018                    | 22.52%| Gomme and Rupert (2007), updated                           |
| Debt–output ratio, 2019                     | 1.05% | FRED GFDEGDQ1885                                          |
| Government share of output, 2019            | 17.49%| FRED A822RE1Q156NBEA                                      |

**NOTE:** FRED: Federal Reserve Economic Data, Federal Reserve Bank of St. Louis, with FRED identifier as indicated.

### TABLE 2
Parameter values

| Parameter | $\alpha$ | $\delta$ | $\psi$ | $\xi$ | $\theta$ | $\beta$ | $\zeta$ | $\omega$ |
|-----------|----------|----------|--------|-------|----------|---------|---------|---------|
| Value     | 0.3      | 0.0175   | 0.2263 | 0.0408| 0.8806   | 0.9898  | 0.6667  | 0.0135  |
To ensure fairly rapid convergence back to steady state, the autoregressive parameter, $\rho$, is set to 0.8.\(^6\)

The evidence presented in figure 1 on the US fiscal policy response to the pandemic guides the setting of fiscal policy in the model. When legislation passed into law in the first half of a month, I assume the measures take effect in that month; otherwise, they start in the following month. The CBO’s cost estimates are for government fiscal years; I apportion these equally to the remaining months of a given fiscal year. Monthly figures are, then, aggregated to obtain quarterly values.

Pre-fiscal austerity, government spending and lump-sum taxes are computed as

\[
g_t = g + \frac{\text{Pandemic government spending at } t}{2019 \text{ GDP}} y, \]

\[
T_t = T - \frac{\text{Pandemic transfers at } t}{2019 \text{ GDP}} y,
\]

where variables without time subscripts denote steady state. In both cases, I need to “translate” the dollar figures reported in section 2 into model output—that is what the second term on the right-hand side of each equation is doing.

Next, tax rates are chosen to satisfy

\[
\tau^h_t w_t h_t = \tau^h w h - \frac{\text{Labour tax relief at } t}{2019 \text{ GDP}} y, \]

\[
\tau^k_t (r_t - \delta) k_t = \tau^k (r - \delta) k - \frac{\text{Capital tax relief at } t}{2019 \text{ GDP}} y.
\]

The right-hand sides of both expressions give tax revenues from either labour or capital income, expressed in units of model output. The tax rates, $\tau^h_t$ and $\tau^k_t$, adjust so that tax collections in the model lines up with the data.

Figure 2 gives a visual representation of the paths for deviations of government spending and lump-sum taxes from trend, along with total factor productivity.

### 5. Fiscal austerity

The choice of when to start applying fiscal austerity is arbitrary. The various pandemic-related measures summarized in figure 1 suggest that austerity should start no earlier than 2023. Given that the current Biden administration’s mandate ends in 2024, suppose that fiscal austerity starts in 2025, at which time fiscal policy must satisfy the feedback rule, equation (12).

Pre-fiscal austerity, the labour income tax rate drops as much as 4 percentage points (ppt) below its steady-state value of 29.3%. The inferred changes in

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\(^6\) The value of $\rho$ is smaller than used in business cycle analysis on the basis that the pandemic is not a “typical” Solow residual event.
capital income tax rates are more dramatic, falling to as little as $-29\%$ (49 ppt lower than steady state). It may seem remarkable that the model implies a negative capital income tax rate, but as discussed in section 2, capital income tax relief in 2020 exceeded total capital tax revenue for 2019.

The baseline scenario is the one in which the government adjusts its spending on public goods to reduce its debt. As shown by the solid red line in figure 3(h), the model predicts an increase in debt from 105\% of output to 120\% at the end of 2020, a 15 ppt increase. Debt continues to rise, reaching 140\% of output at the end of 2024. As reported in section 2, CBO estimates of the overall pandemic stimulus totalled $5.4$ trillion, which, on their own, would increase the debt–output ratio by 19.4 ppt. The extra 11 ppt reflects a combination of lower tax receipts (due to lower capital and labour income at unchanged tax rates) and a lower level of output (which mechanically boosts the debt–output ratio). By way of comparison, the Congressional Budget Office (2021) projects a 23 ppt increase in federal government debt over 2020, after which debt is projected to rise a mere 5 ppt over the remainder of the decade.7

Given that debt stands at 140\% of output at the end of 2024, the fiscal policy rule equation (12) calls for a swing in public spending from 2.1\% above trend to 14.2\% below trend starting early in 2025. Figure 3(g) shows that the government budget moves into surplus and debt starts to decline. However, as seen in figure 3(h), debt declines very slowly: 10 years into the fiscal austerity program, debt is still 136\% of output, 31 ppt above target. Consequently, at that date, government spending remains 11.3 ppt below trend.

7 Given that much of the increase in government expenditures occurs in 2021 and into 2022, it seems odd that the CBO projects essentially no increase in government debt between 2021 and 2030. One difference is that the debt projections are not specific to the pandemic expenditures. Perhaps the CBO anticipates higher tax revenues over these years than is implied by my model.
FIGURE 3: Fiscal austerity starting 2025

NOTES: Solid red line: government spending. Dotted blue line: labour income tax rate. Dashed black line: capital income tax rate. Output, consumption, labour, capital and government spending are expressed as percentage deviations from the pre-pandemic steady state; the rest are in levels. Returns are expressed per annum. [Color figure can be viewed at wileyonlinelibrary.com]
With government spending running above trend through to 2024, the assumed complementarity in utility between private and public goods ($\zeta = 2/3$) keeps households’ consumption close to trend. As a result, government spending crowds out private investment and the capital stock falls. With less capital, the real wage declines, a repercussion of which is that the labour input remains below trend, as does output. As discussed above, the advent of fiscal austerity in 2025 brings about a sharp decline in government spending. Private consumption also falls, again due to its complementarity with public goods. Now, output is freed up for investment and the capital stock starts its return to trend.

One factor in the very slow decline in the debt–output ratio is the increase in the real return on government debt. The gyrations in the real bond rate in 2020 and 2021 reflect similar movements in the after-tax return to capital resulting from the changes in the capital income tax rate. The real interest rate then settles at around 2% in 2023 and 2024, up from its steady-state value of 0.85%. This increase in the return on debt reflects the role of bonds-in-the-utility function: the run up in government debt reduces the marginal utility of holding debt; as a result, the spread between the returns to capital and bonds narrows. To the extent that the utility yield from bonds reflects a taste for liquidity, the increase in the bond rate accompanying higher debt levels reflects the abundance of liquidity. While there is no default in the model, this rise in the bond rate provides some idea of the likely effects of a higher default premium.

5.1. Labour income tax

Rather than cutting government spending, suppose that the government instead uses the labour income tax to satisfy the feedback rule equation (12). This scenario, given by the dotted blue lines in figure 3, leads to a slightly smaller level of debt at the end of 2024 (137% of output versus 140% for the baseline). The labour income tax rate increases by a modest 3.2 ppt.

The macroeconomic effects of labour income taxation operate chiefly through the labour supply decision as reflected by the Euler equation (4). Anticipating an increase in the tax on labour income, households choose to work more prior to the tax increase when their after-tax wage is relatively high. The higher disutility of work is, then, associated with a reduction in household consumption that pushes up the marginal utility of consumption so that equation (4) is satisfied. This decrease in private consumption leads to less crowding out of investment, and so a higher capital stock. Once the tax increase takes effect, households sharply reduce their hours, from 0.6% above trend to 1.3% below. Output correspondingly falls from 0.5% below trend to 1.7% below.

As with government spending, this labour income tax scenario reduces government debt only very gradually. Indeed, a decade after the start of fiscal austerity, the debt–output ratio has fallen 1 ppt. Nonetheless, the labour income tax rate has eased back to 2.8 ppt above its pre-pandemic value.

Alternative government policies are evaluated via the usual Hicksian equivalent payment. Specifically, compute the constant fraction, $\mu$, of private
consumption that can be taken away from the representative household under an alternative policy (in this case, labour income taxation) that leaves the household as well off as the baseline (government spending):

$$\sum_{t=0}^{\infty} \beta^t U \left((1 - \mu)c^a_t, \ g^a_t, \ d^a_t, \ h^a_t\right) = \sum_{t=0}^{\infty} \beta^t U \left(c^b_t, \ g^b_t, \ d^b_t, \ h^b_t\right),$$

(17)

where $a$ superscripts denote variables under the alternative policy and $b$ superscripts under the baseline. By computing the welfare benefit relative to the baseline, the effects of the pandemic wash out in the sense that they are present under both the baseline and alternative policies.

As recorded on line 2 of table 3, fiscal austerity through labour income tax increases improves welfare by 0.2% of consumption relative to austerity via government spending cuts. This measured welfare benefit aggregates the utility benefits and costs of switching to labour income taxation. The costs are fewer private goods, on average more hours worked though the 2020s and slightly lower debt. Clearly, the benefits of enjoying more public goods more than offset the costs. By this metric, labour income taxation is preferred to government spending cuts.

5.2. Capital income tax

Now, what if fiscal austerity operates exclusively through the capital income tax rate? Under this scenario (the dashed black lines in figure 3), at the end of 2024 debt reaches 141% of output, marginally higher than the baseline. Given the relatively small size of the capital income tax base—a combination of capital’s lower share of income and tax deductibility of depreciation—in 2025 the capital income tax rises markedly, by 15.3 ppt. Once again, the leisurely progress on debt reduction keeps taxes high: by 2034, debt is still 133% of output, and the capital income tax rate is 12.2 ppt above its pre-pandemic level.

As shown in figure 3(f), the capital income hike starting in 2025 persistently lowers the after-tax return to capital after that date. These low returns discourage capital accumulation, and it is not until 2040 that the capital stock bottoms out. Notwithstanding this lower level of investment, with output persistently so far below trend, starting in 2025 consumption slides below trend.

The welfare cost of capital income tax-based fiscal austerity is 0.45%, again relative to spending cuts. Under the capital income tax, consumption of public goods is higher; in the short run, so is private consumption, while hours worked are lower. However, in the medium term, private consumption is substantially lower, while hours are higher, both of which lower utility. It is the medium-term consequences that drive the measured welfare cost.

This capital income tax scenario points to a vicious cycle: the anticipated increase in the capital income tax rate discourages capital accumulation in the years prior to fiscal austerity, which pushes up the debt–output ratio (for the reasons outlined above), which forces capital income tax rates even higher when fiscal austerity is ultimately applied.
5.3. Austerity delayed

The motivation for choosing 2025 as the start of fiscal austerity was that it corresponds to the end of the first mandate for the Biden administration. Suppose that austerity has to wait for the end of another presidential administration, starting instead in 2029. A summary of the key effects of delay are given in rows 4 to 6 of table 3; full time paths are presented in online appendix figure B.1. Waiting increases the debt–output ratio just prior to the application of fiscal austerity. The fallout from delay are larger spending cuts or tax increases that magnify the macroeconomic ramifications. Despite the larger macroeconomic consequences, delayed austerity can be welfare-improving: for example, under government spending cuts, the welfare benefit of waiting is 0.05% of consumption relative to starting austerity in 2025. Similarly, for labour income tax hikes, delaying austerity increases welfare. For these policy instruments, the effects of delaying austerity are not much affected by the delay, and discounting implies that pushing the pain of austerity into the future is welfare-enhancing. On the other hand, delaying capital income tax-based fiscal austerity slightly reduces welfare. Recall that such austerity

| Scenario          | Debt–output | Fiscal response | Output | Consumption | Hours | Welfare benefit |
|-------------------|-------------|-----------------|--------|-------------|-------|----------------|
| Start 2025        |             |                 |        |             |       |                |
| 1. Public goods   | 1.40        | −14.23          | −2.72  | −1.56       | −0.88 | 0.00           |
| 2. Labour         | 1.36        | 3.02            | −1.72  | −2.25       | −1.26 | 0.19           |
| 3. Capital        | 1.41        | 15.03           | −3.36  | 0.28        | −1.23 | −0.45          |
| Start 2029        |             |                 |        |             |       |                |
| 4. Public goods   | 1.49        | −16.80          | −3.10  | −1.52       | −1.14 | 0.04           |
| 5. Labour         | 1.43        | 3.48            | −1.34  | −1.52       | −1.54 | 0.38           |
| 6. Capital        | 1.51        | 18.03           | −4.06  | 0.49        | −1.55 | −0.47          |
| Increase bond rate|             |                 |        |             |       |                |
| 7. Public goods   | 1.45        | −24.07          | −4.28  | −1.41       | −1.92 | −0.85          |
| 8. Labour         | 1.38        | 5.25            | −2.29  | −2.60       | −2.36 | −0.08          |
| 9. Capital        | 1.47        | 25.51           | −5.42  | 1.99        | −2.55 | −1.83          |
| Higher debt–output target| | | | | | |
| 10. Public goods  | 1.39        | −10.39          | −2.31  | −1.50       | −0.60 | 0.30           |
| 11. Labour        | 1.36        | 2.33            | −1.52  | −2.16       | −0.90 | 0.44           |
| 12. Capital       | 1.40        | 11.56           | −2.89  | −0.08       | −0.94 | −0.24          |
| Stronger feedback |             |                 |        |             |       |                |
| 13. Public goods  | 1.41        | −26.86          | −3.70  | −2.29       | −1.54 | −0.42          |
| 14. Labour        | 1.36        | 5.95            | −2.67  | −2.56       | −2.85 | −0.30          |
| 15. Capital       | 1.43        | 28.10           | −4.41  | 1.05        | −1.87 | −0.68          |
| Higher private–public good elasticity | | | | | | |
| 16. Public goods  | 1.37        | −11.71          | −1.17  | 0.72        | −0.18 | 0.00           |
| 17. Labour        | 1.35        | 2.97            | −1.53  | −1.72       | −1.46 | −0.19          |
| 18. Capital       | 1.40        | 14.64           | −3.18  | 1.11        | −1.39 | −0.88          |

NOTES: Output, consumption and hours are expressed as percentage deviations from steady state at the start of fiscal austerity. The welfare cost is computed as the constant percentage increase in consumption for a particular policy that leaves households as well off as the baseline policy (an equal increase in both tax rates).
pushes down the after-tax return to capital. Part of the reason why delaying such austerity depresses welfare is that households have a longer period of time to decumulate capital, thereby amplifying the macroeconomic after-effects.

5.4. Higher bond rates

The current environment with low real government bond yields implies low debt servicing costs of higher debt. Suppose that these favourable conditions cease to hold and there is a permanent increase in government bond yields. This scenario is modelled by rapidly reducing the value of $\xi$, the households’ preference-for-debt parameter, so that, in the long term, the real bond yield rises from 0.85 to 2%. While the literal interpretation of reducing the value of this parameter is a decline in the public’s appetite for holding government debt, an alternative interpretation is that this scenario captures the likely effects of a change in attitudes in other countries for holding US government debt. Such a change in the bond rate necessitates altering the target deficit–output ratio in the fiscal policy feedback rule equation (12) because, in steady state, the government’s budget surplus must cover the higher interest payments on its debt.

As shown on lines 10 to 12 of table 3, such an increase the long-term bond rate pushes the debt–output ratio at the end of 2024 up by 1 to 6 ppt, and so requires greater fiscal austerity. However, the relatively small increase in the debt–output ratio belies the magnitude of the fiscal response. By way of example, the labour income tax rate initially rises by 5.3 ppt, not 3.0 ppt. Behind this enhanced fiscal response is the fact that higher long-run bond yields raise interest payments on the debt, which compels the government to run bigger budget surpluses; that is, either raise tax rates in the long run, or cut expenditures on public goods. In turn, this increased fiscal austerity is associated with substantially larger macroeconomic disruptions: table 3 tells the tale in terms of the impact effects on output, consumption and hours, while online appendix figure B.2 gives a more complete picture.

The change in the preference-for-bonds parameter, $\xi$, will affect lifetime utility of the representative household because the household receives less utility for a given level of government debt. In order to see through this effect, so as to focus squarely on the welfare consequences of the macroeconomic effects, the welfare costs reported in table 3 are computed using the initial value of $\xi$. The measured welfare costs of austerity are uniformly higher across all three policy instruments, with the largest change being recorded for the capital income tax. The larger welfare costs should not be too surprising in light of the greater fiscal austerity required by higher bond rates.

5.5. Raising the debt target

Thus far, the model predicts that fiscal austerity will require sizable tax rate increases that are economically very disruptive. Perhaps the government should simply accept a larger level of debt. Specifically, suppose that the
government sets its debt–output target to the actual debt–output ratio late in 2024 and makes an appropriate change to its deficit–output target as well.

Due to the effects of anticipations in determining the exact conditions in late 2024, the debt–output ratios at that time differ slightly from those obtained when the debt–output target remains 1.05. Despite accommodating the higher level of debt, substantial fiscal austerity needs to be applied. For example, government spending must initially be cut to 10.4% below trend; under the baseline, the cut was to 14.2% below trend. The smaller fiscal response associated with accommodating higher debt weakens short-term macroeconomic effects. However, in the longer term, either taxes must rise, or government spending fall due to the need to increase government budget surpluses owing to higher long-term debt servicing costs. First, higher debt in and of itself pushes up debt servicing costs. Second, higher debt reduces households’ marginal utility of debt, resulting in a long-term increase in the bond rate (from 0.85% to 1.6%), and so interest payments on debt. In the very long run, either government spending is permanently 9.0% below trend, the labour income tax rate is 2.3 ppt higher, or the capital income tax rate is 12.6 ppt higher.

The welfare implications of accommodating higher debt trade off less severe macroeconomic disruptions in the short term against fiscal policy changes that reduce household utility in the long term. Discounting gives larger weight to the short-run consequences and, for a given policy instrument, accepting a higher level of debt raises welfare. For instance, the welfare cost of labour income tax-based austerity rises from 0.2% to 0.45% of consumption.

5.6. Stronger feedback

An important determinant of how long it takes to reduce debt is the feedback parameter $\omega$ in the fiscal policy rule equation (12). Recall from section 4 that the value for $\omega$ was taken from empirical results in Bohn (1998). Indeed, the value used is the largest among Bohn’s estimates. The effects of doubling the value of $\omega$ are summarized on lines 13 to 15 and online appendix figure B.4. This change nearly doubles the magnitude of the initial changes in the policy instruments, and the short-term macroeconomic effects are commensurately larger. Of course, debt declines more precipitously; by way of example, for labour income taxes, debt falls to 123% of output by 2034 compared with 137% for the calibrated value of $\omega$. For each policy instrument, increasing the feedback parameter boosts the welfare cost of austerity.

5.7. The elasticity of substitution between private and public goods

The elasticity of substitution between private and public goods, $\zeta$, crucially determines how easily households can substitute between private and public goods. For the baseline, $\zeta$ was set to $2/3$ (low substitutability); here, its value is 2 (higher substitutability).
Start by considering government spending as the policy instrument. With households finding private and public consumption goods better substitutes, the period of big government spending, 2020–2024, is now associated with less private consumption. As a result, there is less crowding out of private investment, and so a higher capital stock. Debt at the end of 2024 now stands at 137% of output; previously, it was 140%. The large public spending cuts starting in 2025 are met with increases in private consumption, not reductions. With a higher capital stock, the real wage is close to trend and so hours worked are much closer to trend.

Next, fiscal austerity through the labour income tax rate leads to little change in the debt–output ratio relative to the baseline calibration. The initial increase in the labour income tax rate is, nonetheless, a bit smaller (2.98 ppt, down from 3.03 ppt), and the macroeconomic effects are similarly smaller. Yet, switching fiscal discipline from government spending to the labour income tax generates a welfare loss of 0.2%; previously, such a switch yielded a welfare benefit of 0.2%. To understand the difference in these welfare results, notice that spending-based austerity requires accepting a sizable drop in the provision of public goods, while austerity through labour income tax hikes is accompanied by larger labour supply distortions. The desirability of one policy instrument over another amounts to the relative sizes of these costs. When private and public goods are easily substituted ($\zeta = 2$), the cost to households of reduced public spending is low, which favours spending-based austerity.

The story is much the same for capital income tax-based austerity: the 2024 debt–output ratio is marginally smaller, and the capital income tax increase slightly smaller. The welfare cost of switching from government spending to capital income tax-based austerity rises from 0.45% ($\zeta = 2/3$) to 0.89% of consumption ($\zeta = 2$). Once again, the welfare cost calculus evaluates the loss in public goods against larger tax distortions. Given the similarity in the initial capital income tax hike, the tax distortions are quite similar across the two values of $\zeta$; when public and private goods better substitutes in utility, the cost of foregone public goods is lower and the household finds the distortions associated with capital income taxation more onerous.

6. Conclusion

One of the consequences of COVID-19 has been an expansion in US fiscal outlays that is unprecedented outside wartime. As documented in section 2, the overall fiscal stimulus adds up to $4.2 trillion (equivalent to 19.4% of US GDP for 2019) over a period of two or three years, a quarter of which is government spending. According to my model, this fiscal expansion will increase government debt from 105% of output to around 140%. Fiscal austerity starting in the mid-2020s, with the goal of restoring the debt–output ratio to its pre-pandemic level, will require a combination of large government spending cuts and/or sizable tax increases. Model results indicate that debt reduction is generally best applied through the labour income tax or spending cuts; there are
severe deleterious effects of capital income taxation both at the time the tax increases take place and in anticipation of these tax increases. The effect of expected reductions in the after-tax return to capital manifest themselves in lower capital accumulation in the years leading up to austerity applied through capital income taxes.

It is important to understand the model findings against the use of capital income taxes for what they are: cautioning against taxation of accumulated assets that are elastically supplied in all but the very short term. The case against raising capital income tax rates is not a case against progressive income taxation. Indeed, because the model features a representative agent, it is entirely silent on distributional aspects of taxation.

Restricting attention to either spending cuts or labour income tax hikes, model results indicate that delaying fiscal austerity enhances welfare. While dawdling leads to higher debt levels, and so greater austerity when the time comes, the differences in macroeconomic outcomes are relatively insensitive to the delay. The upshot is that the additional discounting associated with procrastinating sways the case in favour of waiting, at least for a few years. Arguably, even better is to accept permanently higher debt. On the one hand, higher debt results in permanent austerity in the long run, brought about higher debt servicing costs (the larger debt itself and higher real bond yields), so that the government runs permanently larger budget surpluses. On the other hand, accommodating higher debt dampens the short-term fiscal response, thereby diminishing the near-term macroeconomic disruptions. Again, due to discounting, the deleterious long-term effects of higher debt end up being less important than the short-run effects.

Of course, there are good reasons to reduce debt. One is the higher long-run real interest rate scenarios studied above. As with the higher debt cases, ones featuring a long-term rise in real bond rates require permanent fiscal austerity, again to deliver larger government budget surpluses. Faced with this risk, it may be better to reduce debt levels before real government yields rise.

Romer and Romer (2019) present a case against higher debt that goes beyond my analysis. Their case is built around maintaining “fiscal space.” The idea is that high debt levels leave governments with less leeway to respond to crises. Romer and Romer present evidence that, in the face of a financial crisis, countries with lower debt–output ratios respond with much more expansionary fiscal policy and suffer much less severe effects. Their explanation: when government debt is high, sovereign debt yields rise to prohibitively high values, constraining countries’ access to debt markets.

While the benefits of accommodating the higher level of government debt arising from increases in pandemic-related government outlays are modest, for the reasons stated above, there are good reasons to think that these benefits are overstated. Given a desire to reduce government debt, at the US federal level, the choices come down to government spending cuts, raising labour income taxes or boosting capital income taxes. Higher capital income tax levies are not a particularly good idea: the associated tax base is relatively
small and the required tax increases consequently large, as are the accompanying tax distortions. The choice between reducing expenditures on public goods and labour income tax hikes comes down to the elasticity of substitution between private and public goods in utility: the model comes down on the side of government spending cuts when the two goods are easily substituted.

**Supporting information**

Supplementary material accompanies this article.

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