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This paper studies the macroeconomic effects of seven key TCJA provisions, including the tax cuts for individuals and businesses, the bonus depreciation of equipment, the amortization of R&D expenses, and the limits on interest deductibility. I use a dynamic general equilibrium model with interest deductibility and accelerated depreciation. I find that, initially, the tax reform had a small positive impact on output and investment. In the medium term, however, the effect on output will diminish, and the effect on investment will turn negative. The tax reform will depress investment in R&D. Government debt will surge.

Keywords: Tax reform, tax multiplier, interest deductibility, accelerated depreciation, financial frictions.

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1 Introduction

In 2017, Congress passed the Tax Cuts and Jobs Act (TCJA), a complex tax reform that changed many aspects of the tax code, including a temporary decrease in the income tax rates for individuals and pass-through businesses, and a permanent decrease in the income tax rate for corporations. Most economic analyses estimate that the reform is having a small stimulative effect on economic activity, raising the level of real GDP by between 0 and 1 percent during the first 10 years (CBO 2018, Box B-2, and Barro and Furman 2018, Table 14). However, there is uncertainty about the size of the impact effect, and even greater uncertainty about the effect in the medium term, when the temporary provisions are set to expire.

This paper studies the effect of the TCJA on the levels of investment and output over the next decade. Using a dynamic general equilibrium model, I study the effect of seven key TCJA provisions: the tax cuts for individuals, pass-through businesses, and C corporations; the bonus depreciation of equipment; the amortization of R&D expenses; the tax on the corporate earnings held overseas; and the limits on interest deductibility. As some of these provisions have different effects on different sectors of the economy and different types of capital, I model four sectors (households, corporations, pass-throughs, and the government) and three types of capital (structures, equipment, and R&D). I introduce in the model interest deductibility and accelerated depreciation of capital, two features that, combined, play a key role for the effects of business income tax cuts. To capture the effects of the tax reform on the business cost of external funds, I introduce financial frictions in the corporate and pass-through sectors.

I find that the tax reform raised business output by 0.8 percent and GDP by 0.6 percent in 2018, mainly because of the stimulative effect of the tax cuts for individuals on the labor supply. The effects of the tax reform on output and GDP will diminish in the medium term. After 2026, when the individual income tax cuts are set to expire, business output will be only 0.2 percent above steady state.

As to the effect of the tax reform on investment, the impact effect was small (0.2 percent) because the various provisions worked in opposite directions: While the bonus depreciation of equipment, the income tax cuts for individuals, and the provision on corporate earnings held overseas worked to stimulate investment, the amortization of R&D expenses, the income tax cuts for businesses, and the limits on interest deductibility worked to depress investment. Cuts in the business income tax rate decrease investment because, in the presence of interest deductibility and accelerated depreciation, a business income tax reduces the user cost of capital and acts as a subsidy to investment. This result is of interest per se and is explained in Section 5.1.

In the medium term, the effect of the tax reform on investment will turn negative, mainly because of the switch from expensing to amortization of R&D expenses and the stricter limits on interest deductibility. After 2026, investment will be about 1.6 percent below steady state. While the effect of the tax reform on investment in equipment and structures will be negligible, the tax reform will persistently depress investment in R&D, largely because of the scheduled amortization of R&D expenses.

As a result of the tax reform, tax revenue has plunged and will remain below steady state until 2026, when income tax rates are set to increase, raising the ratio of government debt to GDP by 20 percentage points. Tax revenue will remain close to steady state after 2026, but government debt will continue to rise.

This paper is most closely related to the literature that uses dynamic general equilibrium models to study the macroeconomic effects of tax changes (for instance, House and Shapiro 2006, Fernández-Villaverde 2010, and Sims and Wolff 2018). What distinguishes this paper is the attention to key elements of the tax legislation and the tax reform that play a crucial role for the macroeconomic effects of the TCJA. In particular, this is the first dynamic general equilibrium model that features both interest deductibility and accelerated depreciation of capital. The combination of these two features makes a difference for the effects of business income tax cuts. Also, the effects of the bonus depreciation of equipment, the amortization of R&D expenses, and the limits on interest deductibility are key parts of the overall effect of the tax reform on output and investment.

There is a vast empirical literature that uses regressions and vector autoregressions to estimate the macroeconomic effects of tax changes.[1] Relative to this literature, my study

[1] The literature uses different methods to deal with the endogeneity of tax changes and to estimate

models various important provisions that distinguish the TCJA from past tax changes and tax reforms, including the corporate income tax cuts, the bonus depreciation of equipment, the amortization of R&D expenses, the provision on the corporate earnings held overseas, and the limits on interest deductibility. As we will see, these provisions make an important contribution to the overall effect of the tax reform.

Finally, this paper is complementary to Barro and Furman (2018), as it shares the same attention to the details of the tax legislation and tax reform, but focuses on a different horizon: While their focus is on the long-run steady state, my paper estimates the short-run and medium-run dynamics. They derive the long-run effects of the tax reform using a cost-of-capital neoclassical framework: First, they estimate the effects of the tax reform on the user costs of capital in the long run, and, then, they translate the long-run changes in user costs into long-run changes in capital-labor ratios and levels of real GDP, using a neoclassical model of production and investment. After estimating the long-run effects, they derive the transition path simply based on existing estimates of convergence rates toward long-run steady states. The short-run and medium-run dynamics that I estimate are very different from a smooth transition to the long-run steady state, as some of the provisions (including the temporary ones) have a larger impact in the shorter run than in the longer run. In addition, by modeling interest deductibility and accelerated depreciation together, I derive that the business income tax cuts have a contractionary effect, so the tax reform is less expansionary than in their estimates.

In the rest of the paper, Section 2 lists the seven TCJA provisions that are the subject of this study, Sections 3 and 4 describe, respectively, the model and calibration, Section 5 explains the results on the model mechanics and the effects of the seven TCJA provisions,

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the effects of exogenous tax changes on aggregate economic activity. Some studies regress output on historical exogenous tax changes identified with the Romer-and-Romer narrative approach (Romer and Romer 2010; Favero and Giavazzi 2012). Other studies estimate the causal effect of tax changes on output with instrumental-variable methods, using as instruments either some estimates of exogenous tax shocks (Blanchard and Perotti 2002; Caldara and Kamps 2017), or the historical exogenous tax changes identified with the Romer-and-Romer narrative approach (Barro and Redlick 2011; Mertens and Ravn 2013 and 2014). Another method is to identify tax shocks with sign restrictions on the impulse responses of vector autoregressions (Mountford and Uhlig 2009). In Mertens and Smetters (2018, Table 1), Mertens summarizes the implications of this literature for the effects of the 2017 tax reform. Overall, this literature predicts a sizable effect on output growth for 2018, and more modest effects afterward. Parameters, however, are imprecisely estimated, so the uncertainty surrounding these estimates is large.

and Section 6 concludes.

2 TCJA provisions

In this paper, I study the effects of the following seven TCJA provisions:

1. The income tax rate for C corporations has been permanently reduced from 35 percent to 21 percent. The net operating loss deduction is now limited to 80 percent of taxable income and to carryforwards (no carrybacks). The domestic production activities deduction has been repealed.

2. The tax system for C corporations has changed: C corporations are now taxed on their domestic income, while they were previously taxed on their worldwide income. Foreign earnings were taxed at the time of repatriation. To transition to the new tax system, corporations became subject to a one-time tax on their earnings held overseas (15.5 percent on liquid assets and 8 percent on illiquid assets), payable in installments over eight years, regardless of whether the earnings are repatriated.

3. Individual income tax rates have been temporarily reduced. These tax cuts will expire in 2026.

4. Income tax rates for pass-through businesses (sole proprietorships, partnerships and S corporations) have been reduced similarly to the ones for individuals, since pass-through businesses are taxed as individuals. In addition, pass-through businesses can now deduct 20 percent of their income (subject to an income limit). These provisions will also expire in 2026.

5. The bonus depreciation of investment in equipment and software has been expanded from 50 percent to 100 percent, extended to 2022, and will be phased out between 2023 and 2026. The bonus depreciation has been at least 50 percent since 2003.

6. Starting in 2022, R&D expenses will need to be amortized over five years. Currently, they can be immediately fully expensed (i.e., treated as an expense and deducted from income).

7. Interest deductibility has been permanently limited to 30 percent of earnings. Until 2021, the limit is 30 percent of earnings before interest, taxes, depreciation, and amortization (EBITDA), but starting in 2022, the limit will be 30 percent of earnings before interest and taxes (EBIT); so the limit will become more stringent. Amounts that cannot be deducted in the current year can be carried forward. There are some exemptions for smaller taxpayers.

3 Model

To capture the details of the tax legislation and tax reform, I model an economy with four sectors (households, C corporations, pass-throughs, and the government), and three types of capital (structures, equipment, and R&D). The category labeled equipment in the model includes not only equipment but also intellectual property products other than R&D (mainly software).

There is a continuum of representative households, C corporations (corporations for short), and pass-throughs. Corporations and pass-throughs are owned by agents that are distinct from households and maximize their own utility function. The measure of households is equal to one. The measures of corporations and pass-throughs are, respectively, $\omega^C \in (0, 1)$ and $\omega^P \equiv 1 - \omega^C$, so the total measure of businesses is equal to one, and there is one business per household.

Let P_t denote the price level in period t, and let $\pi_t \equiv P_t/P_{t-1} - 1$ be the inflation rate. The inflation rate is assumed to be positive and constant over time.

3.1 Corporations

Corporations and pass-throughs are modeled in a very similar way. In this section, I describe the modeling of corporations, while, in the next section, I will list the few differences between corporations and pass-throughs.

3.1.1 Economic and accounting depreciation

A key feature introduced to study the effects of the tax reform is the difference between economic and accounting depreciation. Economic depreciation refers to the way physical capital depreciates over time, while accounting depreciation refers to the way accounting capital is depreciated for tax purposes.

Let S, E, R denote, respectively, structures, equipment, and R&D. For $i = S, E, R$, let k_t^i be capital of type i, and let x_t^i be investment in type-i capital. Capital depreciates at the constant economic depreciation rate $\delta^i > 0$. Its law of motion is

$$k_{t+1}^i = (1-\delta^i)k_t^i + x_t^i - \frac{\psi^i}{2}\left(\frac{k_{t+1}^i - k_t^i}{\bar{k}^i}\right)^2 \bar{k}^i \qquad \text{for } i = S, E, R, \tag{1}$$

where the last term is an investment adjustment cost, with $\psi^i > 0$, and $\bar{k}^i > 0$ are the steady-state levels of the three types of capital.

Accounting depreciation is modeled differently from economic depreciation. For tax purposes, a fraction $\chi_t^i \geq 0$ of investment can be immediately depreciated, and the remaining part can be depreciated at the rate $\tilde{\delta}^i > 0$. I assume that $\tilde{\delta}^i > \delta^i$, to capture the fact that the tax system allows the use of an accelerated depreciation method to depreciate assets. In addition, to replicate the half-year convention, accounting capital is assumed to begin depreciating in the middle of the year in which investment occurs. Then, the fraction of investment that is depreciated in the year in which investment occurs is:

$$\kappa_t^i \equiv \chi_t^i + (1-\chi_t^i)\frac{1}{2}\tilde{\delta}^i \qquad \text{for } i = S, E, R. \tag{2}$$

Because of the difference between accounting depreciation and economic depreciation, we need to keep track of accounting capital separately from physical capital. Let $\tilde{K}_t^i$ be the nominal accounting capital available at the beginning of period t, before accounting depreciation is subtracted and investment is added. Then, nominal accounting depreciation is

$$Z_t^i = \tilde{\delta}^i \tilde{K}_t^i + \kappa_t^i P_t x_t^i \qquad \text{for } i = S, E, R,$$

and the law of motion of nominal accounting capital is

$$\begin{aligned}\tilde{K}^i_{t+1} &= \tilde{K}^i_t + P_t x^i_t - Z^i_t \\ &= (1-\tilde{\delta})\tilde{K}^i_t + (1-\kappa^i_t)P_t x^i_t \qquad \text{for } i = S, E, R.\end{aligned}$$

Dividing the previous equations by the price level P_t, we obtain

$$z^i_t = \tilde{\delta}^i \frac{\tilde{k}^i_t}{1+\pi_t} + \kappa^i_t x^i_t \qquad \text{for } i = S, E, R, \tag{3}$$

$$\tilde{k}^i_{t+1} = (1-\tilde{\delta}^i)\frac{\tilde{k}^i_t}{1+\pi_t} + (1-\kappa^i_t)x^i_t \qquad \text{for } i = S, E, R, \tag{4}$$

where $\tilde{k}^i_t \equiv \tilde{K}^i_t / P_{t-1}$ is real accounting capital and $z^i_t \equiv Z^i_t / P_t$ is real accounting depreciation.

3.1.2 Taxable income

Production is a function of the three types of capital and labor demand l_t:

$$y_t = A^C f(k^S_t, k^E_t, k^R_t, l_t), \tag{5}$$

where $A^C > 0$, $f(k^S, k^E, k^R, l) \equiv (k^S)^{\alpha^S}(k^E)^{\alpha^E}(k^R)^{\alpha^R} l^{1-\alpha}$, $\alpha \equiv \alpha^S + \alpha^E + \alpha^R$, $\alpha^S > 0$, $\alpha^E > 0$, $\alpha^R > 0$, and $\alpha < 1$. Revenue is equal to production, y_t, while wages are equal to the product between the wage rate, w_t, and labor demand, l_t. Earnings before interest and taxes, $EBIT_t$, are equal to revenue minus wages and accounting depreciation:

$$\begin{aligned}EBIT_t &= y_t - w_t l_t - \sum_{i=S,E,R} z^i_t \\ EBIT_t &= y_t - w_t l_t - \sum_{i=S,E,R}\left(\tilde{\delta}^i \frac{\tilde{k}^i_t}{1+\pi_t} + \kappa^i_t x^i_t\right),\end{aligned} \tag{6}$$

where the last step uses equation (3).

Let B_t be the nominal level of corporate debt issued in period $t-1$, let $b_t \equiv B_t / P_{t-1}$ be the corresponding real level, and let r^C_{t-1} be the nominal interest rate on the corporate debt. Then, in period t, the nominal level of interest expenses is $r^C_{t-1} B_t$, and the real level is

$r^C_{t-1}B_t/P_t = r^C_{t-1}b_t/(1+\pi_t)$.

Let $\zeta_t \in (0,1]$ denote the fraction of interest expenses that can be deducted for tax purposes. Then, taxable income, $\mathcal{I}_t$, is equal to the difference between EBIT and the amount of interest expenses that can be deducted:

$$\mathcal{I}_t = EBIT_t - \zeta_t \frac{r^C_{t-1}b_t}{1+\pi_t}$$
$$\mathcal{I}_t = y_t - w_t l_t - \sum_{i=S,E,R}\left(\tilde{\delta}^i \frac{\tilde{k}^i_t}{1+\pi_t} + \kappa^i_t x^i_t\right) - \zeta_t \frac{r^C_{t-1}b_t}{1+\pi_t}, \quad (7)$$

where the last step uses equation (6). Corporate income taxes are $\tau^C_t \mathcal{I}_t$, where $\tau^C_t \in (0,1)$ is the corporate income tax rate.

3.1.3 Optimization problem

Corporate income and newly issued debt are used to pay taxes, repay existing debt, and distribute dividends. The corporate budget constraint is

$$d_t + \frac{(1+r^C_{t-1})b_t}{1+\pi_t} + \tau^C_t \mathcal{I}_t = y_t - w_t l_t - \sum_{i=S,E,R} x^i_t + b_{t+1} + T^C. \quad (8)$$

On the right-hand side, the first three terms represent revenue minus wages and investment expenses, the next term is newly issued debt, and the last term, T^C, is a constant lump-sum government transfer that may be positive or negative (introduced to calibrate the steady-state level of corporate debt). On the left-hand side, the first term is dividends, $d_t > 0$, the second term is gross-of-interest debt repayments, and the last term represents corporate income taxes.

Corporate owners receive dividends, d_t, pay dividend taxes at the rate $\tau^d_t \in (0,1)$, and consume the rest:

$$c_t = (1-\tau^d_t)d_t. \quad (9)$$

The corporate owners' optimization problem is:

$$\max_{\left\{c_t,d_t,y_t,l_t,b_{t+1},\mathcal{I}_t,\{x_t^i,k_{t+1}^i,\tilde{k}_{t+1}^i\}_{i=S,E,R}\right\}_{t=0}^{\infty}} E_0\sum_{t=0}^{\infty}(\beta^C)^t u(c_t) \tag{10}$$

subject to (1), (4), (5), (7), (8) and (9),

where the utility function is such that $u'(c)\equiv c^{-\gamma}$, $\gamma>0$, and $\beta^C>0$.

Appendix A derives an equivalent optimization problem and the first-order conditions. From the first-order conditions, one can derive:

$$1 = E_t\left\{\frac{\beta^C u'(c_{t+1})(1-\tau_{t+1}^d)}{u'(c_t)(1-\tau_t^d)}\,\frac{1+(1-\zeta_{t+1}\tau_{t+1}^C)r_t^C}{1+\pi_{t+1}}\right\}. \tag{11}$$

3.1.4 Financial frictions

The tax reform affected the balance sheet, credit spread, and cost of external funds of businesses. To capture these effects, I introduce financial frictions, assuming that the credit spread paid by a business increases with the leverage of the business.

Specifically, I introduce a financial frictions wedge, ξ_t, between the bond payoff paid by corporations in period t, $1+r_t^C$, and the bond payoff received by households, $1+\tilde{r}_t^C$:

$$1+\tilde{r}_t^C \equiv \frac{1+r_t^C}{1+\xi_t}. \tag{12}$$

The difference between what is paid by corporations and what is received by households, $(r_t^C-\tilde{r}_t^C)b_t/(1+\pi_t)$, is transferred to households in a lump-sum way.

The wedge is approximately equal to the difference $r_t^C-\tilde{r}_t^C$, which in equilibrium is equal to the spread between the corporate bond yield and the government bond yield. With a larger wedge, corporations have to offer households a higher interest rate in equilibrium, which makes the cost of external funds higher, and investment lower.

I assume that, in equilibrium, the wedge is an increasing function of leverage:

$$\xi_t = \tilde{A}^C h_t^\rho \tag{13}$$

$$h_t \equiv \frac{(1+r_t^C)b_{t+1}/(1+\pi_{t+1})}{k_{t+1}}, \tag{14}$$

(with $\tilde{A}^C > 0$ and $\rho > 0$), so corporations face a higher cost of external funds when their leverage is higher. This assumption captures the relationship between the risk premium and leverage that is generated by various agency costs, including the costs associated with asymmetric information, moral hazard and debt overhang.

3.2 Pass-throughs

Pass-throughs are modeled in the same way as corporations, except for the following: there is no dividend tax rate, so $c_t = d_t$ replaces equation (9) in the optimization problem for pass-throughs; the values of A^P, $\tilde{A}^P$, β^P, τ_t^P, and T^P are different from the values of A^C, $\tilde{A}^C$, β^C, τ_t^C, and T^C, as described later in the section on calibration; and the equilibrium values of r_t^P may be different from the equilibrium values of r_t^C (while $\tilde{r}_t^P = \tilde{r}_t^C$ in equilibrium).

In what follows, the values that solve the optimization problem for corporations are denoted by the superscript C (for example, $\{c_t^C, x_t^{S,C}\}$), while the values that solve the problem for pass-throughs are denoted by the superscript P (for example, $\{c_t^P, x_t^{S,P}\}$).

3.3 Households

Households consume c_t^H and lend $\tilde{b}_{t+1}^P$ to pass-throughs, $\tilde{b}_{t+1}^C$ to corporations, and D_{t+1} to the government. They receive a constant endowment of goods, y^H (introduced to calibrate the ratio of business output to GDP); supply labor, n_t^H; receive wages, $w_t n_t^H$; and receive gross-of-interest debt repayments from pass-throughs, corporations, and the government. They pay personal income taxes on wages and interest at the individual tax rate τ_t^H, and receive lump-sum government transfers, T_t^H. They receive a lump-sum transfer, $\mathcal{H}_t$, that is equal, in equilibrium, to the difference between the bond payoff paid by businesses and the bond payoff received by households:

$$\mathcal{H}_t = \omega^C(r^C_{t-1} - \tilde{r}^C_{t-1})\frac{b^C_t}{1+\pi_t} + \omega^P(r^P_{t-1} - \tilde{r}^P_{t-1})\frac{b^P_t}{1+\pi_t}. \quad (15)$$

Then, the households' budget constraint is:

$$c^H_t + \tilde{b}^C_{t+1} + \tilde{b}^P_{t+1} + D_{t+1} = y^H + (1-\tau^H_t)w_t n^H_t + \frac{1+(1-\tau^H_t)\tilde{r}^C_{t-1}}{1+\pi_t}\tilde{b}^C_t + \frac{1+(1-\tau^H_t)\tilde{r}^P_{t-1}}{1+\pi_t}\tilde{b}^P_t + \frac{1+(1-\tau^H_t)\tilde{r}^G_{t-1}}{1+\pi_t}D_t + \mathcal{H}_t + T^H_t. \quad (16)$$

The households' optimization problem is:

$$\max_{\left\{c^H_t, n^H_t, \tilde{b}^C_{t+1}, \tilde{b}^P_{t+1}, D_{t+1}\right\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} (\beta^H)^t [u(c^H_t) - v(n^H_t)] \quad (17)$$

subject to (16),

where the utility function $u(c)$ is the same as the one for corporations and pass-throughs, $v(n) \equiv \Phi n^{1+1/\varphi}$, $\Phi > 0$, $\varphi > 0$, and $\beta^H > 0$.

The first-order conditions are:

$$\frac{v'(n^H_t)}{u'(c^H_t)} = (1-\tau^H_t)w_t \quad (18)$$

$$1 = E_t\left\{\frac{\beta^H u'(c^H_{t+1})}{u'(c^H_t)} \frac{1+(1-\tau^H_{t+1})\tilde{r}^j_t}{1+\pi_{t+1}}\right\} \qquad \text{for } j = C, P, G. \quad (19)$$

3.4 Government

The government issues debt, D_{t+1}, and collects tax revenue, $\mathcal{T}_t$ (net of taxes on government debt interest) from corporations, pass-throughs, and households:

$$\mathcal{T}_t = \omega^C\tau^d_t d^C_t + \omega^C\tau^C_t\mathcal{I}^C_t + \omega^P\tau^P_t\mathcal{I}^P_t + \tau^H_t w_t n_t + \tau^H_t\frac{\tilde{r}^C_{t-1}\tilde{b}^C_t + \tilde{r}^P_{t-1}\tilde{b}^P_t}{1+\pi_t}. \quad (20)$$

It uses the proceeds to finance government spending, G; distribute lump-sum transfers to corporations, pass-throughs, and households; and repay gross-of-interest debt to households:

$$G + \omega^C T^C + \omega^P T^P + T_t^H + \frac{1 + (1 - \tau_t^H)\tilde{r}_{t-1}^G}{1 + \pi_t} D_t = \mathcal{T}_t + D_{t+1}. \tag{21}$$

I assume that the lump-sum transfers to households, T_t^H, respond to changes in government debt and adjust so that government debt is stationary and an equilibrium exists. Provided that an equilibrium exists, the timing of the adjustment in T_t^H affects only the evolution of government debt, and does not matter for the dynamics of the other variables (Ricardian equivalence).

3.5 Equilibrium conditions

Let business output, y_t^B, be the sum of corporate and pass-through output:

$$y_t^B \equiv \omega^C y_t^C + \omega^P y_t^P, \tag{22}$$

and let GDP be the sum of business and nonbusiness output:

$$GDP_t \equiv y^H + y_t^B. \tag{23}$$

Since y^H is constant over time, percent changes in GDP are proportional to percent changes in business output, scaled by a factor equal to the ratio of business output to GDP.

The equilibrium condition for the goods market equates the demand for private consumption, government spending, and investment to GDP:

$$c_t^H + \omega^C c_t^C + \omega^P c_t^P + G + \omega^C \sum_{i=S,E,R} x_t^{C,i} + \omega^P \sum_{i=S,E,R} x_t^{P,i} = GDP_t. \tag{24}$$

The other equilibrium conditions equate demand and supply in the labor market, in the market for corporate debt, and in the market for debt of pass-throughs:

$$\omega^C l_t^C + \omega^P l_t^P = n_t^H \tag{25}$$

$$\tilde{b}_{t+1}^C = \omega^C b_{t+1}^C \tag{26}$$

$$\tilde{b}_{t+1}^P = \omega^P b_{t+1}^P. \tag{27}$$

4 Calibration

In this section, first I describe how parameters are set to model the steady state that was prevailing before the tax reform, and then I describe how the policy parameters are changed to model the tax reform.

4.1 Parameters and steady-state values

The parameters and steady-state values are listed in Table 1.

One period is one year. A few parameter values are set in line with the literature. The households' preferences discount factor is set to $\beta^H = 0.96$, the relative risk aversion parameter is set to $\gamma = 2$, the Frisch elasticity of labor supply is set to $\varphi = 0.5$, and the parameter Φ is set so that $n = 1/3$.

The tax rates for corporations and pass-throughs are set to $\tau^C = 0.38$ and $\tau^P = 0.352$, following the estimates (comprehensive of federal and local taxation) by Barro and Furman (2018). The tax rate for households is set to $\tau^H = 0.32$, the sum of 29 percent, the effective marginal federal tax rate on labor income estimated by CBO (2018), and 3 percent, the average state income tax. The dividend tax rate is set to $\tau^d = 0.15$. All interest expenses are deductible in the steady state, so $\zeta = 1$.

The inflation rate, π, is equal to 2 percent. The parameters $\tilde{A}^C$ and $\tilde{A}^P$ are set so that the financial frictions wedge is equal to $\xi = 0.01$, implying a credit spread of about 1 percent, approximately equal to the average corporate bond spread (Flannery, Nikolova, and Öztekin 2012, Table 1). Then, the values of $\tilde{r}^C$, r^C and β^C for corporations are determined by the steady-state versions of the households' first-order conditions (19), the equation defining the financial friction wedge (12), and the corporations' first-order conditions (11):

$$\begin{aligned}1 &= \beta^H \frac{1+(1-\tau^H)\tilde{r}^C}{1+\pi} \\ 1+\tilde{r}^C &= \frac{1+r^C}{1+\xi} \\ 1 &= \beta^C \frac{1+(1-\tau^C)r^C}{1+\pi}.\end{aligned}$$

The values of $\tilde{r}^P$, r^P and β^P for pass-throughs are similarly determined. The resulting values for the preferences discount factors for owners of corporations and pass-throughs are, respectively, $\beta^C = 0.9617$ and $\beta^P = 0.9533$.[2]

The economic depreciation rates of structures, equipment, and R&D are, respectively, $\delta^S = 0.04$, $\delta^E = 0.16$, and $\delta^R = 0.2$, to match, approximately, the BEA estimates of the average age of the three types of capital (27 years for structures; 6 years for equipment, software, and originals; and 5 years for R&D).

The fractions of initial investment that can be immediately depreciated are set as follows: for equipment, $\chi_t^E = 0.5$, to replicate that a 50 percent bonus depreciation was allowed before the tax reform; for R&D, $\chi_t^R = 1$, to replicate that investment in R&D could be fully expensed before the tax reform; and for structures, $\chi_t^S = 0$, to replicate that the bonus depreciation was not allowed for structures.

The accounting depreciation rates for structures and equipment are set equal to double the economic depreciation rates, $\tilde{\delta}^S = 0.08$, $\tilde{\delta}^E = 0.32$, to approximate the fact that most businesses use accelerated depreciation (double declining balance method changing to straight line method at the point at which depreciation deductions are maximized). The accounting depreciation rate for R&D, $\tilde{\delta}^R$, does not play any role in the steady state because investment in R&D can be fully expensed (i.e., $\chi_t^R = 1$).

The exponent of the production function is set to $\alpha = 0.35$, in line with standard values

[2]To understand the relationships between the preferences discount factors, notice the following. The fact that ξ is positive tends to push β^C below β^H (a higher credit spread raises the cost of funds for corporations and implies a higher discount rate for corporate owners). In contrast, the fact that τ^C is greater than τ^H tends to push β^C above β^H (with interest deductibility, a higher corporate income tax rate lowers the cost of funds for corporations and implies a lower discount rate for corporate owners). With our parameter setting, the second effect outweighs the first, and β^C is slightly higher than β^H. For pass-throughs, the first effect outweighs the second, and β^P is slightly lower than β^H.

in the literature. To set α^i, for $i = S, E, R$, I follow a procedure similar to the one used in the literature to set α. Consider the following steady-state first-order conditions for the economy without taxes and financial frictions:

$$MPK^i \equiv \alpha^i \frac{y}{k^i} = \frac{1}{\beta^H} - (1 - \delta^i) \qquad \text{for } i = S, E, R,$$

where MPK^i is the marginal product of capital. Assuming that taxes and financial frictions raise the marginal product of capital proportionally for the three types of capital,

$$MPK^i \equiv \alpha^i \frac{y}{k^i} \propto \left(\frac{1}{\beta^H} - (1 - \delta^i) \right) \qquad \text{for } i = S, E, R,$$

where $\propto$ is the proportionality symbol. Substituting $x^i = \delta^i k^i$,

$$\alpha^i \propto \left(\frac{1}{\beta^H} - (1 - \delta^i) \right) \frac{1}{\delta^i} \frac{x^i}{y} \qquad \text{for } i = S, E, R.$$

In 2017, the ratios of private investment to business output were approximately $x^S/y = 0.04$ for structures, $x^E/y = 0.11$ for equipment and intellectual property products other than R&D, and $x^R/y = 0.03$ for R&D. These ratios, the previously set values for α, β^H and δ^i, and the constraint $\alpha \equiv \alpha^S + \alpha^E + \alpha^R$ imply $\alpha^S = 0.11$, $\alpha^E = 0.19$, and $\alpha^R = 0.05$.

The investment adjustment cost parameters are set equal to $\psi^i = 10$, for $i = S, E, R$, in line with common values used in models with a unique type of capital.

The production parameters are set so that $GDP = 100$ and $y^B = 75$, to match the fact that in 2013 the business sector represented about 75 percent of gross value added (BEA, National Income and Product Accounts, Table 1.3.5). More specifically, the production function scale parameters, A^C and A^P, are set so that $y^C = y^P = 75$. The two parameters are different because the tax rates are different for corporations and pass-throughs, implying different first-order conditions and capital levels. With this choice, business output, y^B, is also equal to 75: $y^B = \omega^C y^C + \omega^P y^P = 75$. Then, the endowment received by households is set to $y^H = 25$, so that $GDP = y^H + y^B = 100$.

The measures of corporations and pass-throughs are set to $\omega^C = 0.43$ and $\omega^P = 0.57$ so that corporate output $\omega^C y^C$ represents 43 percent of business output, y^B, and pass-through output represents the remaining 57 percent. This setting matches the fact that in 2013 C corporations and pass-through businesses accounted for, respectively, 43 percent and 57 percent of net business income (IRS, SOI Tax Stats - Integrated Business Data, Table 1, available at https://www.irs.gov/statistics/soi-tax-stats-integrated-business-data).

The lump-sum government transfers to corporations and pass-throughs, T^C and T^P, are set to target the levels of debt, b^C and b^P. In turn, the levels of debt are set to $b^C = 12.85$ and $b^P = 17.38$, so that the coverage ratio, defined as the ratio of EBIT to interest expenses, is 3.7 for both corporations and pass-throughs, matching the average coverage interest ratio for U.S. nonfinancial corporate publicly-traded firms (Palomino et al. 2019).

I set the exponent of the wedge function, ρ, so that the wedge, ξ, increases by 0.80 percentage points (equal to one standard deviation of the credit spread, Flannery, Nikolova, and Öztekin 2012, Table 1) when leverage, h, increases by 44 percent (equal to the ratio of one standard deviation to the mean of leverage, Flannery, Nikolova, and Öztekin 2012, Table 1). Equivalently, the semi-elasticity, $\xi\rho$, of the wedge to leverage is set to $0.0080/0.44 = 0.0181$. Since $\xi = 0.01$, this implies $\rho = 1.81$.

Government spending, G, is set to 18 percent of GDP. The lump-sum government transfers to households, T^H, are set so that government debt, D, is equal to 76 percent of GDP, to match gross federal debt held by the public as a percentage of GDP in 2017.

As a result of the calibration, investment is 17 percent of GDP (3.2 percent in structures, 10.7 percent in equipment, and 3 percent in R&D) and consumption is 65 percent of GDP (1.5 percent of corporate owners, 2.6 percent of pass-through owners, and 61 percent of households).

4.2 Changes in policy parameters to model the tax reform

Before detailing the modeling of the tax reform, let's first address the modeling of agents' expectations about the future of the TCJA provisions.

The estimated current impact of the tax reform depends on the current expectations of economic agents about the future of the TCJA provisions. Unfortunately, there is large uncertainty about the future of the TCJA provisions—partly because of political uncertainty—and large uncertainty about agents' current expectations. On the one hand, there will be political pressure to make the temporary provisions on individual income tax rates permanent, to extend the bonus depreciation of equipment, and to mitigate the switch from expensing to amortizing R&D expenses. On the other hand, the rise in government debt will create pressure in the opposite direction, and may even lead to a partial repeal of the corporate tax rate cuts.

To focus on a case where agents' current expectations are plausible, I construct a scenario as an average of plausible future scenarios (called plausible-expectations scenario), and I assume that agents' current expectations are consistent with that scenario, i.e., they have perfect foresight. I also show the results for the scenario where the TCJA provisions will be as prescribed by current legislation (called current-legislation scenario), and agents' current expectations are consistent with it, i.e., agents have perfect foresight in this scenario as well. Comparing the two scenarios will provide information about the sensitivity of the results to changes in expectations.

In what follows, I begin describing the parameter settings for the current-legislation scenario, and then I describe the parameter settings for the plausible-expectations scenario.

4.2.1 Current-legislation parameter settings

The parameter settings that model the tax reform in the current-legislation scenario are described by the dashed lines in Figure 1.

To model the scheduled bonus depreciation for equipment, I set $\chi_t^E = 1$ for the years 2018-2022, then $\chi_t^E = 0.8, 0.6, 0.4, 0.2$, respectively, for the years 2023-2026, and finally $\chi_t^E = 0$ from 2027 on (first subplot of Figure 1).

The amortization of R&D expenses starting in 2022 is modeled by keeping $\chi_t^R = 1$ for the years 2018-2021, and then setting $\chi_t^R = 0$ from 2022 on (second subplot of Figure 1). The value for the accounting depreciation rate for R&D is set to $\tilde{\delta}^R = 0.2$, to model that R&D expenses will need to be amortized over five years ($\tilde{\delta}^R$ does not play any role unless $\chi_t^R < 1$).

Turning to the permanent corporate income tax cut, Barro and Furman (2018, Table 4 and page 275) estimate that the tax rate on corporate income dropped by 11 percentage points, taking into account the new limits on net operating loss carrybacks and carryforwards, as well as other details of the tax legislation. Following their estimate, I model the corporate income tax cut as a permanent drop by 11 percentage points from $\tau^C = 0.38$ to $\tau^C = 0.27$ from 2018 on (third subplot of Figure 1).

As to the temporary tax cut for pass-throughs, Barro and Furman (2018, Table 4 and page 283) estimate a drop by 4.1 percentage points, reflecting the limits on the pass-through deduction. Following their estimate, I assume a temporary cut by 4.1 percentage points, and set $\tau^P = 0.311$ in the years 2018-2025, followed by a return to $\tau^P = 0.352$ from 2026 on (fourth subplot of Figure 1).

As to the temporary individual tax cut, Barro and Furman (2018, page 298) estimate a cut in the average marginal income tax rate of about 2.3 percentage points. Following their estimate, I model the individual tax cut as a temporary drop by 2.3 percentage points to $\tau^H = 0.297$ in the years 2018-2025, followed by a return to $\tau^H = 0.32$ from 2026 on (fifth subplot of Figure 1).

The provision on corporate earnings held overseas amounts to a lump-sum tax cut for corporations, since the earnings held overseas were subject to a higher tax rate (35 percent) under the old tax system, and became subject to a lower tax rate (15.5 percent on liquid assets and 8 percent on illiquid assets). The lump-sum tax cut is equal to the product of the tax rate cut and the amount of overseas earnings. The amount of earnings held overseas is, approximately, \$2.6 trillion (McKeon 2017). Assuming that one third of assets held overseas are liquid, the tax rate cut is equal to $0.35 - (1/3 \times 0.155 + 2/3 \times 0.08) = 0.245$. The product of the tax rate cut and the amount of overseas earnings is \$637 billion, corresponding to 3.3 percent of GDP, so I model the provision as a lump-sum tax cut for corporations equal to 3.3 percent of GDP. Since corporations can pay the new tax in installments over eight years, I assume that the lump-sum tax cut is equally spread over the eight years starting in 2018 (sixth subplot of Figure 1).

With regard to the limits on interest deductibility, there is large uncertainty about how the limits are affecting the ability of businesses to deduct their interest expenses. Barro and Furman (2018, pages 275-276) assume that the limits on interest deductibility are constraining 5 percent of investment in the initial years (when the limit is 30 percent of EBITDA), and will constrain 15 percent of investment in the long run (when the limit will be 30 percent of EBIT). Motivated by their assumption, I approximate the limits on the deductibility of interest expenses by setting $\zeta_t = 0.95$ for the years 2018-2021, followed by $\zeta_t = 0.85$ for the years from 2022 on (seventh subplot of Figure 1).

The final point regards the funding of the tax reform and the evolution of government debt. As stated in Section 3, I assume that the lump-sum government transfers to households, T_t^H, adjust to make government debt stationary and insure the existence of an equilibrium. This assumption implies that, after the tax reform, the transfers decrease enough to balance the government's intertemporal budget constraint, so the tax reform is financed by cuts in government transfers to households. The timing of the adjustment in T_t^H does not affect the dynamics of any variable, except for government debt, D_t. Intuitively, if the transfers decrease in the initial years of the tax reform, the path of government debt is lower than in the case where the transfers decrease in the distant future. To be able to evaluate the costs of the tax reform in terms of increases in government debt, I assume that all of the adjustment in T_t^H takes place in the distant future, after 20 years, i.e., the transfers remain constant and equal to their steady-state value for the initial 20 years, and they decrease only afterwards. With this assumption, the path of government debt in the initial 20 years is entirely the result of the tax reform.

4.2.2 Plausible-expectations parameter settings

The parameter settings that model the tax reform in the plausible-expectations scenario are described by the solid lines in Figure 1.

For the corporate income tax cuts, the plausible-expectations scenario is the average of the current-legislation scenario and a scenario where the cuts are repealed in 2026. The provision on corporate earnings held overseas is modeled in the same way as in the current-legislation scenario. For the other provisions, the plausible-expectations scenario is the average of the current-legislation scenario and the hypothetical scenario where the current settings of the TCJA provisions are extended permanently.

More specifically, the bonus depreciation of equipment is modeled by setting $\chi_t^E = 1$ for the years 2018-2022, then $\chi_t^E = 0.9, 0.8, 0.7, 0.6$, respectively, for the years 2023-2026, and finally $\chi_t^E = 0.5$ from 2027 on. The amortization of R&D expenses is modeled as $\chi_t^R = 1$

for the years 2018-2021, followed by $\chi_t^R = 0.5$ from 2022 on (with $\tilde{\delta}^R = 0.2$). To model the tax cuts for corporations, pass-throughs, and individuals, I set $\tau^C = 0.27$, $\tau^P = 0.311$, and $\tau^H = 0.297$ in the years 2018-2025; and then $\tau^C = 0.325$, $\tau^P = 0.3315$, and $\tau^H = 0.3085$ from 2026 on. The limits on the interest deductibility are modeled as $\zeta_t = 0.95$ for the years 2018-2021, followed by $\zeta_t = 0.9$ from 2022 on.

As in the current-legislation scenario, the transfers, T_t^H, remain constant and equal to their steady-state value for the initial 20 years, and they decrease only afterwards.

5 Results

As we are going to see in this section, the effect of most TCJA provisions on investment is quite intuitive. The exceptions are the income tax cuts for corporations and pass-throughs, which have the somewhat surprising effect of decreasing investment. It is helpful, then, to begin this section explaining why a business income tax cut can decrease investment (Section 5.1). After that, I will study the effect of each TCJA provision considered separately (Section 5.2), and their cumulative effect (Section 5.3).[3] Finally, I will examine how the model results depend on various assumptions and parameter values (Section 5.4).

5.1 Why a business income tax cut can decrease investment

The reason why a cut in the business income tax rate can decrease investment is that, in the presence of interest deductibility and accelerated depreciation, a business income tax acts as a subsidy to investment, so the tax cut reduces the subsidy. In the rest of this section, I will illustrate this point.[4]

[3]The effect of the tax reform is obtained by, first, log-linearizing the model around the steady state prevailing before the tax reform, and then solving the model with Paul Klein's function solab.m, available at his website http://paulklein.ca/newsite/codes/codes.php.

[4]Notice that the results in this section refer to changes in the business income tax rate, not to other changes that affect the business income tax liability, for instance, changes in depreciation allowances or investment tax credits. In fact, while cuts in the business income tax rate can discourage investment, increases in depreciation allowances and investment tax credits stimulate investment, even though all of these policy changes decrease the business income tax liability. For this reason, the results in this section are consistent with the empirical results in Mertens and Ravn (2013). They estimate that exogenous cuts in the corporate income tax liability stimulate investment, but their results refer to cuts that are mostly associated with increases in depreciation allowances and investment tax credits—changes in the corporate income tax rate play some role for only 3 of the 16 exogenous tax changes they use in their study.

As is well known, in standard models without interest deductibility, a business income tax raises the user cost of capital and acts as a tax on investment. There are two ways to mitigate or solve the problem. First, allowing businesses to deduct investment expenses early on (accelerated depreciation, bonus depreciation, or other forms of depreciation faster than the normal economic life of capital) creates a tax shield that mitigates the contractionary effect of the tax on investment. In the limit, if all investment expenses can be immediately deducted (full expensing of investment), the business income tax can become neutral, as can be shown in standard models. Second, allowing businesses to deduct interest expenses creates an additional tax shield that lowers the cost of funding investment, and can, by itself, make the business income tax neutral. The combination of the two tax shields (interest deductibility and some form of accelerated depreciation) can make the tax act as a subsidy to investment. The subsidy is larger for the types of capital for which tax depreciation is faster than economic depreciation.

That the tax system can end up subsidizing investment is a concept that tax analysts are familiar with. For instance, while writing about the different tax treatments of corporate equity vs. debt finance, Sullivan (2012) points out:

> Corporate investment funded primarily with debt can have an effective tax rate close to zero, while corporate investment funded primarily with equity is effectively taxed close to the statutory rate. Other tax breaks in the code, like accelerated depreciation, result in a parallel downward shift in effective tax rates.
>
> The combination of debt finance and excessive tax depreciation can easily result in negative effective corporate tax rates on investment. In the extreme, 100 percent debt financing and expensing result in an effective tax rate equal to -35 percent [i.e., minus the statutory rate]. (Sullivan 2012)

The just-described relationships between interest deductibility, accelerated depreciation, income taxes, and investment can be illustrated with a variety of standard models. I will illustrate them with a partial-equilibrium simplified version of the model used in this paper.

Consider a version of the model with one type of capital, no labor, no investment adjustment costs, no inflation, no dividend taxes, and no lump-sum transfers. Also, suppose that the business income tax rate τ_t, the first-year depreciation fraction κ_t, the interest deductibility fraction ζ_t, and the interest rate r_t are exogenous and constant.

In this model, the optimization problem of a business owner, analogous to problem (32), is:

$$\max_{\left\{d_t, b_{t+1}, x_t, k_{t+1}, \tilde{k}_{t+1}\right\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t u(d_t) \tag{28}$$

$$\text{subject to: } d_t + (1 - \tau\kappa)x_t + (1 + r - \zeta\tau r)b_t = (1 - \tau)Af(k_t) + \tau\tilde{\delta}\tilde{k}_t + b_{t+1}$$

$$k_{t+1} = (1 - \delta)k_t + x_t$$

$$\tilde{k}_{t+1} = (1 - \tilde{\delta})\tilde{k}_t + (1 - \kappa)x_t,$$

where $f(k)$ is a strictly increasing, strictly concave production function.

In this case, Appendix B derives that the path of capital is constant and determined by condition (37).

In the case of no interest deductibility ($\zeta = 0$), condition (37) becomes:

$$\left(\frac{1 - \tau\kappa}{1 - \tau} r + \tilde{\delta}\right) \frac{r + \delta}{r + \tilde{\delta}} = Af'(k_{t+1}). \tag{29}$$

As long as $\kappa < 1$, the business income tax raises the user cost of capital and discourages investment. In particular, in the standard case of normal depreciation ($\kappa = 0$ and $\tilde{\delta} = \delta$), condition (29) becomes:

$$\frac{r}{1 - \tau} + \delta = Af'(k_{t+1}),$$

which is the equation that determines investment and capital in standard models without interest deductibility.

One way to mitigate the effect of the tax on investment is to allow some form of accelerated depreciation. For instance, condition (29) implies that k_{t+1} increases with $\tilde{\delta}$ (as long as $\kappa < 1$), and increases with κ. In the limit, if we allow for immediate full expensing of investment ($\kappa = 1$), condition (29) becomes

$$r + \delta = Af'(k_{t+1}),$$

so the business income tax becomes neutral.

Another way to modify the effect of the income tax on investment is to allow interest deductibility. In the case of interest deductibility ($\zeta = 1$), condition (37) becomes:

$$\left[(1-\tau\kappa)r + \tilde{\delta}\right] \frac{(1-\tau)r+\delta}{(1-\tau)r+\tilde{\delta}} = Af'(k_{t+1}). \tag{30}$$

In the benchmark case of normal depreciation ($\kappa = 0$ and $\tilde{\delta} = \delta$), condition (30) becomes:

$$r + \delta = Af'(k_{t+1}),$$

so interest deductibility makes the business income tax neutral.

When interest deductibility and some form of accelerated depreciation are combined, the business income tax reduces the user cost of capital and acts as a subsidy to investment. For instance, if $\tilde{\delta} = \delta$ but $\kappa > 0$, then condition (30) becomes:

$$(1-\tau\kappa)r + \delta = Af'(k_{t+1}),$$

so the tax acts as a subsidy to investment, and a tax cut decreases investment. Similarly, if $\kappa = 0$ but $\tilde{\delta} > \delta$, then condition (30) becomes:

$$(r+\tilde{\delta})\frac{(1-\tau)r+\delta}{(1-\tau)r+\tilde{\delta}} = Af'(k_{t+1}),$$

so, again, a tax cut decreases investment.

The result that a tax cut decreases investment may be mitigated or overturned in models with different features. For instance, if businesses were subject to financial frictions, a tax cut would mitigate these frictions and reduce the cost of external funds, thereby encouraging investment. Also, in a general equilibrium model, the interest rate, r_t, on borrowed funds would respond to the tax cut and decline as investment decreases, mitigating the decrease in investment.

In the end, whether a tax cut increases or decreases investment depends on the overall model, its features, and its parameter values. In the general equilibrium model used in this paper, which features interest deductibility, accelerated depreciation, financial frictions, and an endogenous interest rate, the combination of the two tax shields makes the tax on business income act as a subsidy to investment for both corporations and pass-throughs. The subsidy is largest for R&D (which can be fully expensed in the steady state), smallest for structures, and in between for equipment (which benefits from a 50 percent bonus depreciation in the steady state). Since the business income tax acts as a subsidy, a tax cut decreases investment by decreasing the subsidy.

5.2 Effect of each individual TCJA provision

Figures 2-8 show, respectively, the effect of the seven TCJA provisions. In this section, I will focus on the plausible-expectations scenario (solid line), and only consider the current-legislation scenario (dashed line) to see how the effect of a provision in the impact period depends on agents' current expectations about the future of that provision.

Beginning with the bonus depreciation of equipment, the main effect of the provision is, as could be expected, to stimulate investment in equipment (Figure 2, solid line). The effect fades away as the bonus depreciation returns to the steady-state value of 50 percent. Investment in structures and R&D is stimulated as well, although to a lesser extent. As investment increases, labor demand and output increase. The effect on tax revenue is negative in the initial years, but turns positive in later years as output increases and the bonus depreciation returns to steady state. Government debt, however, remains elevated. The impact effect of the provision on investment, labor, and output would be smaller if agents were expecting the bonus depreciation to converge to zero, below steady state (Figure 2, dashed line).

Turning to the amortization of R&D expenses, its macroeconomic effects are, in many ways, the opposite of the effects of the bonus depreciation of equipment (Figure 3, solid line). The main effect is, as could be expected, to depress investment in R&D. The effect is especially strong after 2022, when the provision is scheduled to begin, but is present before-hand as well. The provision indirectly discourages investment in structures and equipment as well, although to a lesser extent. The negative effect on aggregate investment is sizeable and persistent. As investment decreases, labor demand and output decrease. Tax revenue spikes in 2022, when the provision is scheduled to begin, and then returns to steady state as output decreases. Government debt drops starting in 2022. The impact effect of the provision on investment, labor and output would roughly double if agents were certain about the switch to the amortization of R&D expenses (Figure 3, dashed line).

As explained in Section 5.1, the main effect of the corporate income tax cut is to decrease corporate investment (Figure 4, solid line). The combination of interest deductibility and accelerated depreciation makes the business income tax act as a subsidy to investment, so a tax cut decreases the subsidy and reduces investment. The medium-term effect is larger for the types of capital for which tax depreciation is faster than economic depreciation (largest for R&D, smallest for structures, and in between for equipment). Following the tax cut, the corporate credit spread declines, which mitigates the decline in corporate investment. As corporate investment decreases, pass-through investment increases, although to a smaller extent. Aggregate investment declines, with the effect fading away over time. Tax revenue drops, and government debt increases. The decrease in investment would be slightly smaller if agents were certain that the corporate tax cuts were permanent (Figure 4, dashed line).

The macroeconomic effects of the income tax cut for pass-through businesses are analogous to the ones of the corporate income tax cut (Figure 5, solid line). Pass-through investment drops, corporate investment increases, but to a smaller extent, and aggregate investment decreases, with the effect fading away over time. The medium-term effect is largest for R&D, smallest for structures, and in between for equipment. The credit spread for pass-through businesses declines, mitigating the decrease in investment. Tax revenue drops, and government debt increases. The decrease in investment would be slightly larger if agents were certain that the tax cuts would expire after 2025 (Figure 5, dashed line).

The individual income tax cuts have a powerful positive effect on households' labor supply (Figure 6, solid line). As labor increases, investment and output expand. Investment in all types of capital is stimulated. This is the most expensive provision: tax revenue drops sizeably and persistently, and government debt surges. Agents' current expectations about the future of the provision don't make a large difference for the impact effect of the provision on investment and output (Figure 6, dashed line).

The provision on corporate earnings held overseas is modeled as a lump-sum tax cut for corporations in the years 2018-2025 (Figure 7, solid line). Its main effect is to strengthen corporate balance sheets, mitigate the financial frictions, reduce the corporate credit spread and cost of funds, and stimulate corporate investment. As corporate investment increases, pass-through investment decreases, although to a smaller extent. Aggregate investment, labor demand and output increase, and the effect is persistent. Tax revenue drops in the years 2018-2025, but increases afterwards, because of the expansionary effects of the provision. Nevertheless, government debt continues to increase even after 2026.

The main effect of the limits on interest deductibility is to depress investment (Figure 8, solid line). The effect is sizeable and long-lasting. Labor demand and output decline as well. Tax revenue increases, and government debt declines. The effect on investment, labor, and output would be larger if agents were expecting that, after 2022, the provision would be implemented as prescribed by current legislation (Figure 8, dashed line).

5.2.1 Impulse response functions to policy shocks

Before turning to the cumulative effect of the TCJA provisions, notice that Figures 2-8 provide additional helpful information, once they are interpreted in an alternative way. Not only do those figures show the effect of the seven TCJA provisions, but they also show the impulse response functions of the model to various unanticipated policy changes.

For instance, the solid line of Figure 2 plots the impulse response function to a temporary increase in the bonus depreciation of equipment. Interpreted this way, the figure shows that an unanticipated temporary increase in bonus depreciation has a large positive effect on investment and a smaller positive effect on labor and output, at the cost of reducing tax revenue and raising government debt.

Also, the dashed lines of Figures 4-6 plot, respectively, the impulse response functions to a permanent decrease in the corporate income tax rate, a temporary (8-year) decrease in the pass-through income tax rate, and a temporary (8-year) decrease in the individual income tax rate. The figures show that unanticipated decreases in income tax rates reduce tax revenue and raise government debt. However, while individual income tax cuts tend to stimulate investment, business income tax cuts tend to depress it, consistent with the results derived in Section 5.1.

5.3 Cumulative effect of the TCJA provisions

Figure 9 displays the cumulative effect of the seven TCJA provisions.

Focusing on the plausible-expectations scenario (solid line of Figure 9), initially, the tax reform had a positive impact on labor and output. Business output increased by 0.8 percent in 2018, implying that GDP increased by 0.6 percent. Households' labor supply increased by 1.3 percent. Among the various TCJA provisions, the income tax cut for individuals was the one contributing the most to the initial increase in labor and output.

In the medium term, the effect of the tax reform on the levels of labor and output will diminish. In particular, the positive impact will drop after 2026, as the individual income tax rate increases. While labor will remain almost 1 percent above steady state, output will be only 0.2 percent above steady state.

Turning to the effect of the tax reform on investment, the impact effect was small (0.2 percent) because the various provisions worked in opposite directions. The provisions that stimulated investment were: the bonus depreciation of equipment (by increasing investment in equipment); the individual tax cuts (by increasing the labor supply); and the provision on corporate earnings held overseas (by decreasing the spread and the business cost of funds). The provisions that depressed investment were: the switch to R&D amortization (by decreasing investment in R&D); the business income tax cuts (by decreasing the interest deduction and raising the cost of funds); and the limits on interest deductibility (by raising the cost of funds).

In the medium term, the effect of the tax reform on investment will turn negative because the provisions that will encourage investment (the individual tax cuts and the provision on corporate earnings held overseas) will be more than offset by the provisions that will discourage investment (the switch to R&D amortization and the limits on interest deductibility). The main factors behind the decline in the effect are the switch from expensing to amortization of R&D expenses in 2022, the phase-out of the 100 percent bonus depreciation for equipment between 2023 and 2026, and the increase in the individual tax rate in 2026. After 2026, investment will be about 1.6 percent below steady state, driven by the 7 percent drop in investment in R&D that is caused by the switch from expensing to amortization of R&D expenses.

As a result of the tax reform, tax revenue plunged in the impact period, mainly because of the provision on corporate earnings held overseas, the bonus depreciation of equipment, and the individual tax cuts. Tax revenue will remain below steady state until 2026 when the tax cuts are expected to decrease, raising the ratio of government debt to GDP by 20 percentage points. Tax revenue will remain close to steady state after 2026, but government debt will continue to rise. The large increase in government debt is expected to be financed by large future cuts in government transfers to households, which will take place in the distant future, after 20 years, beyond the time horizon plotted in the figures.

It is interesting to compare these results with the effects of the tax reform estimated by CBO (2018). CBO's estimates, which are made under the assumption that the current legislation will not change, include: the effect of all of the TCJA provisions; the effect on residential investment, government spending, and net exports; and a counter-cyclical response of monetary policy. CBO (2018, Table B-2) estimates that the tax reform raises the level of real GDP by about 0.7 percent on average over the first 10 years. The effect is hump-shaped, with a peak of 1 percent in 2022. The effect on potential total labor hours is about 0.1 percent smaller than the one on real GDP, while the effect on private nonresidential fixed investment is about three times larger than the one on real GDP. Relative to CBO's estimates, I estimate a larger effect on labor, partly because of a higher Frisch elasticity of labor supply, and a smaller effect on investment, partly because of the negative effect of the business income tax cuts on investment.

It would also be interesting to compare the model predictions with the dynamics of the data so far. Unfortunately, the effect of the tax reform in the data is concealed by the effect of other shocks, including the increase in business confidence that followed the election of President Trump in November 2016, and the increase in tariffs and related economic policy uncertainty in 2018. Although economic growth was higher in 2018 than in 2017, the pickup began in the third quarter of 2017, before the announcement of the tax reform. In particular, the quarterly growth rates of nonfarm business output and real GDP rose in the third quarter of 2017, remained elevated until the third quarter of 2018, and then declined. Because of this pattern, the extent to which the increase in economic growth in 2018 can be attributed to the tax reform is unclear.

5.4 Sensitivity of results

Let's begin with three related but distinct questions. How does the current effect of the tax reform depend on agents' current expectations about the future of the TCJA provisions? How will future unanticipated changes in the TCJA provisions affect the economy? What is the effect of the tax reform in the current-legislation scenario?

With regard to the first question, agents' current expectations about the future of the TCJA provisions make some difference for the estimated impact effect of the tax reform. For instance, if we compare the impact effect of the tax reform in the plausible-expectations scenario (solid line of Figure 9) and in the current-legislation scenario (dashed line of Figure 9), the estimated impact effect of the tax reform is somewhat different. In particular, if agents' expectations about the future of the TCJA provisions were consistent with current legislation, the impact effect of the tax reform on labor and output would be somewhat smaller, and the impact effect on investment would be negative. The difference is mainly due to different expectations about the future of the bonus depreciation of equipment, the amortization of R&D expenses, and the limits on interest deductibility (Figures 2-8).

Turning to the second question, future unanticipated changes in the TCJA provisions will have large effects on the economy. This can be easily seen by interpreting Figures 2-8 as the impulse response functions of the model to policy shocks, as suggested in Section 5.2.1. For instance, suppose that the 100 percent bonus depreciation is unexpectedly extended for four additional years, and then phased out. Then, the solid line of Figure 2 shows that investment will increase sizeably, labor and output will increase to a smaller extent, and government debt will further rise. Or suppose that the income tax cuts for individuals are unexpectedly extended for eight additional years. Then, the dashed line of Figure 6 shows that this unanticipated policy measure will have a large positive effect on investment, labor, and output, at the cost of a surge in government debt.

As to the third question, let's focus on the current-legislation scenario (dashed lines of Figures 2-9), which assumes that the future of the TCJA provisions will be as prescribed by current legislation, and agents anticipate it. In this case, tax revenue will return to steady state by 2022, and will be well above steady state for several years afterwards, helping to stabilize government debt. The improvement in fiscal conditions will be due to the expiration of the bonus depreciation of equipment, the amortization of R&D expenses, the expiration of the income tax cuts for individuals and pass-throughs, and the stricter limits on interest deductibility, only partially offset by the permanent corporate income tax cuts. However, macroeconomic conditions are worse in this scenario than in the plausible-expectations scenario. Labor supply will return to close to steady state in 2026, when the income tax cuts for individuals expire. Investment will plunge by 10 percent, because of the expiration of the bonus depreciation of equipment, the amortization of R&D expenses, and, to a lesser extent, the expiration of the income tax cuts for individuals and the stricter limits on interest deductibility. As investment and capital drop, output will decrease by more than 2 percent.

The sensitivity of the model results to parameter values is, overall, in line with what could be expected in calibrated dynamic general equilibrium models. For instance, one parameter value that is important for the results and over which there is some uncertainty is the Frisch elasticity of labor supply, φ. Figure 10 compares the plausible-expectations scenario for different values of φ. The estimated effects of the tax reform depend on φ in an intuitive way: Larger values of the Frisch elasticity of labor supply lead to a larger effect of the tax reform on labor and output. As a result, investment is slightly higher.

The model results also depend on the modeling of the seven TCJA provisions. The sensitivity of the results to the modeling of each provision can be inferred from Figures 2-8, which show the effect of each individual TCJA provision. For instance, I model the provision on corporate earnings held overseas as a lump-sum tax cut for corporations equal to 3.3 percent of GDP. One may judge that it should be modeled as a lump-sum tax cut equal to, say, half that size, perhaps because corporations, in the past, may have anticipated a provision with partly similar effects. In this case, the effect of the provision would be half of what is shown in Figure 7, and the other half should be subtracted from the cumulative effect of the seven TCJA provisions shown in Figure 9. Similarly, one can infer the sensitivity of the results to the modeling of the other provisions. Because the seven provisions tend to have opposite effects on output and investment, the size and sign of the overall effect of the tax reform depends on the assumptions that determine the relative strengths of the provisions.

Although the model incorporates the key mechanisms for the effect of the tax reform, it abstracts from three mechanisms that may play some role.

First, because the tax reform decreases the tax rate for corporations more than for pass-throughs, it may encourage some pass-through businesses to change their legal form into corporations (besides shifting the demand for labor and capital as captured by the model). Based on regressions of the corporate share of business income on the wedge between corporate and noncorporate business tax rates, a 10 percentage point drop in the differential between the income tax rates for corporations and pass-throughs is associated with an increase in the corporate share of about 3.4 percentage points (Prisinzano and Pearce 2018, Section III.3). In the plausible-expectations scenario, the long-run drop in the tax rate differential is only 3.35 percentage points, corresponding to an increase in the corporate share of about 1.1 percentage points. In the current-legislation scenario, the long-run drop in the tax rate differential is 11 percentage points, corresponding to a more significant increase in the corporate share of about 3.75 percentage points.

Second, inflation may respond to the tax reform, and monetary policy may respond to changes in output and inflation, thereby modifying the effects of the tax reform. It is plausible that monetary policy may mitigate the effect of the tax reform on output, by tightening in response to an increase in output. However, it is also possible that monetary policy may amplify the effect of the tax reform on output: For instance, monetary policy amplifies the effect of tax shocks on output, owing to its response to inflation, in the New Keynesian model of Sims and Wolff (2018, Figure 5).

Third, the model predicts that the tax reform will persistently depress investment in R&D, by about 7 percent. Following Romer (1990), the endogenous growth literature indicates that the drop in R&D investment may have a negative effect not only on the levels but also on the growth rates of productivity and output, although the uncertainty around this effect is especially large.

6 Conclusion

This paper has studied the macroeconomic effects of seven key TCJA provisions using a dynamic general equilibrium model that features corporate and pass-through sectors, different types of capital, financial frictions, accelerated depreciation, and interest deductibility.

According to the model, the tax reform had a positive impact on labor and output, mainly because of the income tax cuts for individuals. In the medium term, the effect on labor and output will diminish, as individual income tax rates increase. As to the effect on investment, the impact effect of the tax reform on investment was small because the various provisions worked in opposite directions: While the bonus depreciation of equipment, the income tax cuts for individuals, and the provision on corporate earnings held overseas raised investment, the amortization of R&D expenses, the income tax cuts for businesses, and the limits on interest deductibility lowered investment. In the medium term, the effect on investment will turn negative, mainly because of the scheduled amortization of R&D expenses and the stricter limits on interest deductibility.

There is large uncertainty about the future of the TCJA provisions, and future deviations of these provisions from their anticipated paths will have large macroeconomic effects. This paper has also derived results that will be useful to predict these effects. In the presence of interest deductibility and accelerated depreciation, a business income tax can act as a subsidy to investment, so cuts in the business income tax rate can decrease investment by decreasing the subsidy. An income tax cut for individuals stimulates the labor supply and raises investment and output, but government debt surges. An unanticipated increase in the bonus depreciation of capital is very effective in stimulating investment, and, to a lesser extent, labor and output. Stricter limits on interest deductibility depress investment and, to a lesser extent, labor and output.

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A Solution of problem (10)

Substituting the expression for $\mathcal{I}_t$ from equation (7) into the budget constraint (8), we obtain:

$$
\begin{aligned}
& d_t + \frac{(1+r^C_{t-1})b_t}{1+\pi_t} + \tau^C_t \left\{ y_t - w_t l_t - \sum_{i=S,E,R} \left(\tilde{\delta}^i \frac{\tilde{k}^i_t}{1+\pi_t} + \kappa^i_t x^i_t \right) - \zeta_t \frac{r^C_{t-1} b_t}{1+\pi_t} \right\} \\
& \quad = y_t - w_t l_t - \sum_{i=S,E,R} x^i_t + b_{t+1} + T^C \\
& d_t + \sum_{i=S,E,R} (1-\tau^C_t \kappa^i_t) x^i_t + \frac{(1+r^C_{t-1} - \zeta_t \tau^C_t r^C_{t-1}) b_t}{1+\pi_t} \\
& \quad = (1-\tau^C_t)(y_t - w_t l_t) + \tau^C_t \sum_{i=S,E,R} \tilde{\delta}^i \frac{\tilde{k}^i_t}{1+\pi_t} + b_{t+1} + T^C.
\end{aligned}
$$

Then, substituting the expression for y_t from equation (5), we obtain:

$$
\begin{aligned}
& d_t + \sum_{i=S,E,R} (1-\tau^C_t \kappa^i_t) x^i_t + \frac{(1+r^C_{t-1} - \zeta_t \tau^C_t r^C_{t-1}) b_t}{1+\pi_t} \\
& = (1-\tau^C_t)[A^C f(k^S_t, k^E_t, k^R_t, l_t) - w_t l_t] + \tau^C_t \sum_{i=S,E,R} \tilde{\delta}^i \frac{\tilde{k}^i_t}{1+\pi_t} + b_{t+1} + T^C. \qquad (31)
\end{aligned}
$$

Finally, substituting the expression for c_t from equation (9), the corporate owner's optimization problem (10) can be restated as:

$$
\max_{\left\{ d_t, l_t, b_{t+1}, \{x^i_t, k^i_{t+1}, \tilde{k}^i_{t+1}\}_{i=S,E,R} \right\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} (\beta^C)^t u((1-\tau^d_t) d_t) \qquad (32)
$$

subject to (31), (1), and (4).

Let λ_t, μ^i_t and ν^i_t be the Lagrange multipliers associated, respectively, with the constraints (31), (1), and (4). The first-order conditions with respect to d_t, l_t, b_{t+1}, x^i_t, k^i_{t+1}, and

$\tilde{k}^i_{t+1}$ are, respectively:

$$
\begin{aligned}
(\beta^C)^t u'(c_t)(1-\tau^d_t) &= \lambda_t \\
A^C \frac{\partial f(k^S_t, k^E_t, k^R_t, l_t)}{\partial l_t} &= w_t \\
\lambda_t &= E_t \frac{\lambda_{t+1}(1 + r^C_t - \zeta_{t+1}\tau^C_{t+1} r^C_t)}{1+\pi_{t+1}} \\
\lambda_t(1-\tau^C_t \kappa^i_t) &= \mu^i_t + (1-\kappa^i_t)\nu^i_t \\
\mu^i_t \left(1 + \psi^i \frac{k^i_{t+1} - k^i_t}{\bar{k}^i}\right) &= E_t \left\{ \lambda_{t+1}(1-\tau^C_{t+1}) A^C \frac{\partial f(k^S_{t+1}, k^E_{t+1}, k^R_{t+1}, l_{t+1})}{\partial k^i_{t+1}} \right. \\
&\quad \left. + \mu^i_{t+1}\left(1 - \delta^i + \psi^i \frac{k^i_{t+2} - k^i_{t+1}}{\bar{k}^i}\right) \right\} \\
\nu^i_t &= E_t \left\{ \lambda_{t+1}\tau^C_{t+1} \frac{\tilde{\delta}^i}{1+\pi_{t+1}} + \nu^i_{t+1} \frac{1-\tilde{\delta}^i}{1+\pi_{t+1}} \right\}.
\end{aligned}
$$

B Solution of problem (28)

The first-order conditions for the optimization problem (28) with respect to d_t, b_{t+1}, x_t, k_{t+1}, and $\tilde{k}_{t+1}$ are, respectively:

$$
\begin{aligned}
\beta^t u'(d_t) &= \lambda_t \\
\lambda_t &= E_t \left\{ \lambda_{t+1}(1 + r - \zeta\tau r) \right\} \\
\lambda_t(1-\tau\kappa) &= \mu_t + (1-\kappa)\nu_t \\
\mu_t &= E_t \left\{ \lambda_{t+1}(1-\tau) A f'(k_{t+1}) + \mu_{t+1}(1-\delta) \right\} \\
\nu_t &= E_t \left\{ \lambda_{t+1}\tau\tilde{\delta} + \nu_{t+1}(1-\tilde{\delta}) \right\},
\end{aligned}
$$

where λ_t, μ_t, and ν_t are the Lagrange multipliers associated with the three constraints.

The expectations can be dropped since the model is deterministic. After dropping the expectations, one can derive:

$$\beta\left(\frac{d_{t+1}}{d_t}\right)^{-\gamma} = \frac{\beta u'(d_{t+1})}{u'(d_t)} = \frac{\lambda_{t+1}}{\lambda_t}$$
$$1 = \frac{\lambda_{t+1}}{\lambda_t}[1+(1-\zeta\tau)r]$$
$$1-\tau\kappa = \frac{\mu_t}{\lambda_t} + (1-\kappa)\frac{\nu_t}{\lambda_t}$$
$$\frac{\mu_t}{\lambda_t} = \frac{\lambda_{t+1}}{\lambda_t}(1-\tau)Af'(k_{t+1}) + \frac{\mu_{t+1}}{\lambda_{t+1}}\frac{\lambda_{t+1}}{\lambda_t}(1-\delta)$$
$$\frac{\nu_t}{\lambda_t} = \frac{\lambda_{t+1}}{\lambda_t}\tau\tilde{\delta} + \frac{\nu_{t+1}}{\lambda_{t+1}}\frac{\lambda_{t+1}}{\lambda_t}(1-\tilde{\delta}).$$

The solution involves constant values for k_{t+1}, $\frac{d_{t+1}}{d_t}$, $\frac{\lambda_{t+1}}{\lambda_t}$, $\frac{\mu_t}{\lambda_t}$, and $\frac{\nu_t}{\lambda_t}$. In particular, letting $L \equiv \frac{\lambda_{t+1}}{\lambda_t}$, $M \equiv \frac{\mu_t}{\lambda_t}$, and $N \equiv \frac{\nu_t}{\lambda_t}$, one can derive:

$$1 = L[1+(1-\zeta\tau)r] \tag{33}$$
$$1-\tau\kappa = M + (1-\kappa)N \tag{34}$$
$$M = L(1-\tau)Af'(k_{t+1}) + ML(1-\delta) \tag{35}$$
$$N = L\tau\tilde{\delta} + NL(1-\tilde{\delta}). \tag{36}$$

With some manipulations,

$$M = \frac{(1-\tau)Af'(k_{t+1})}{1/L-(1-\delta)}$$
$$= \frac{(1-\tau)Af'(k_{t+1})}{1-\zeta\tau)r+\delta}$$
$$N = \frac{\tau\tilde{\delta}}{1/L-(1-\tilde{\delta})}$$
$$= \frac{\tau\tilde{\delta}}{(1-\zeta\tau)r+\tilde{\delta}}$$

Substituting the just-derived expressions for M and N into condition (34), we obtain:

$$\begin{aligned}
1-\tau\kappa &= \frac{(1-\tau)Af'(k_{t+1})}{1/L-(1-\delta)} + (1-\kappa)\frac{\tau\tilde{\delta}}{1/L-(1-\tilde{\delta})} \\
1-\tau\kappa &= \frac{(1-\tau)Af'(k_{t+1})}{(1-\zeta\tau)r+\delta} + (1-\kappa)\frac{\tau\tilde{\delta}}{(1-\zeta\tau)r+\tilde{\delta}} \\
(1-\tau\kappa)[(1-\zeta\tau)r+\tilde{\delta}] &= \frac{(1-\zeta\tau)r+\tilde{\delta}}{(1-\zeta\tau)r+\delta}(1-\tau)Af'(k_{t+1}) + (1-\kappa)\tau\tilde{\delta} \\
(1-\tau\kappa)(1-\zeta\tau)r+\tilde{\delta}-\tilde{\delta}\tau\kappa &= \frac{(1-\zeta\tau)r+\tilde{\delta}}{(1-\zeta\tau)r+\delta}(1-\tau)Af'(k_{t+1}) + \tau\tilde{\delta}-\tau\tilde{\delta}\kappa \\
(1-\tau\kappa)(1-\zeta\tau)r+(1-\tau)\tilde{\delta} &= \frac{(1-\zeta\tau)r+\tilde{\delta}}{(1-\zeta\tau)r+\delta}(1-\tau)Af'(k_{t+1}) \\
\frac{1-\tau\kappa}{1-\tau}(1-\zeta\tau)r+\tilde{\delta} &= \frac{(1-\zeta\tau)r+\tilde{\delta}}{(1-\zeta\tau)r+\delta}Af'(k_{t+1})
\end{aligned}$$

$$\left[\frac{1-\tau\kappa}{1-\tau}(1-\zeta\tau)r+\tilde{\delta}\right]\frac{(1-\zeta\tau)r+\delta}{(1-\zeta\tau)r+\tilde{\delta}} = Af'(k_{t+1}). \tag{37}$$

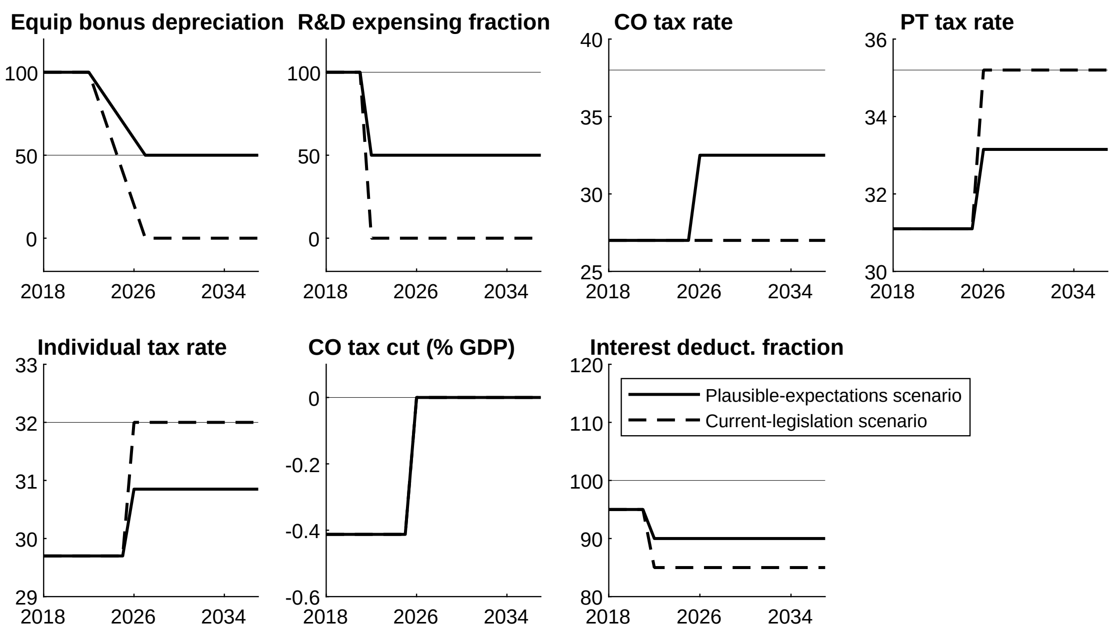

Figure 1: Changes in policy parameters designed to model the tax reform.

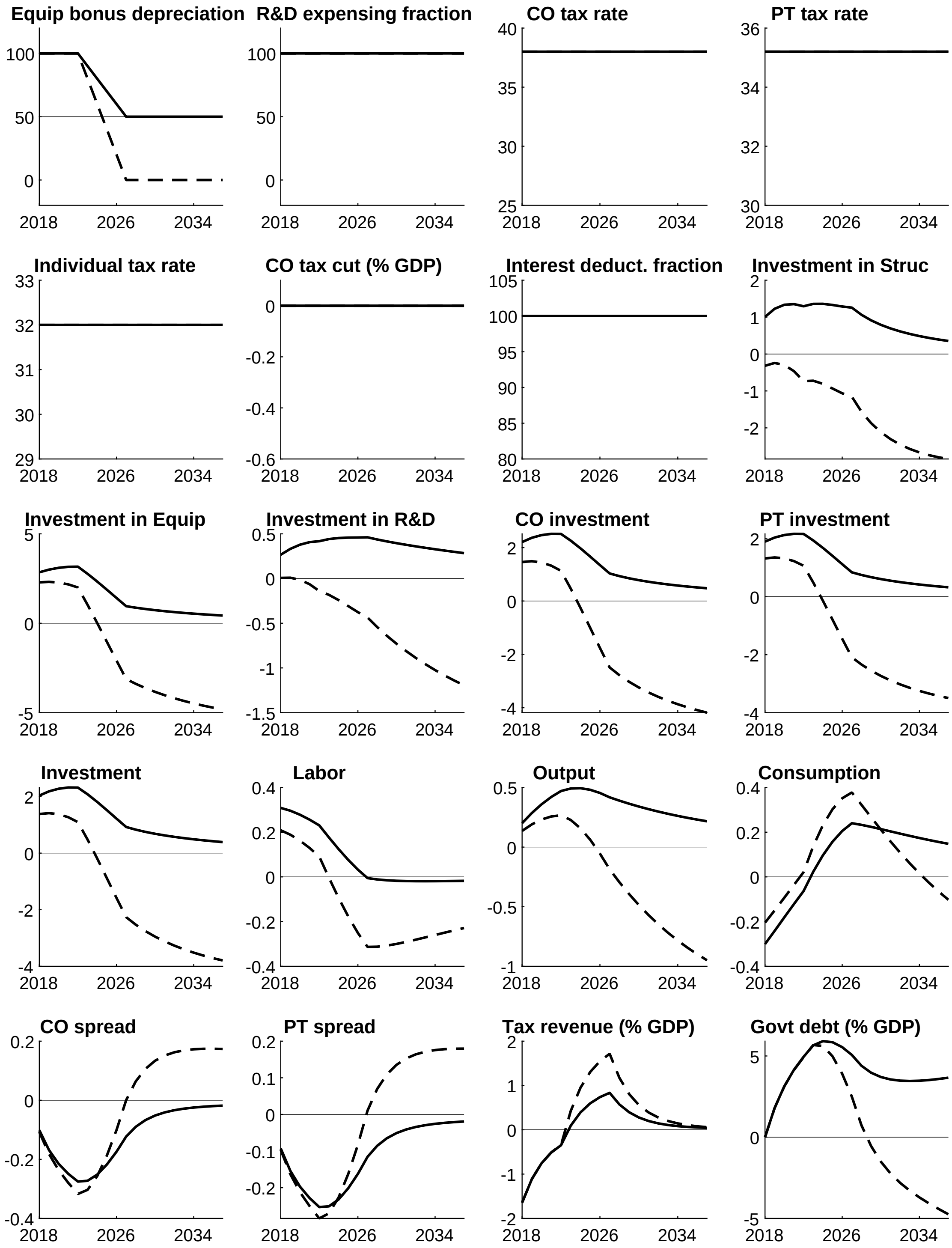

Figure 2: Effect of the temporary 100 percent bonus depreciation of equipment. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

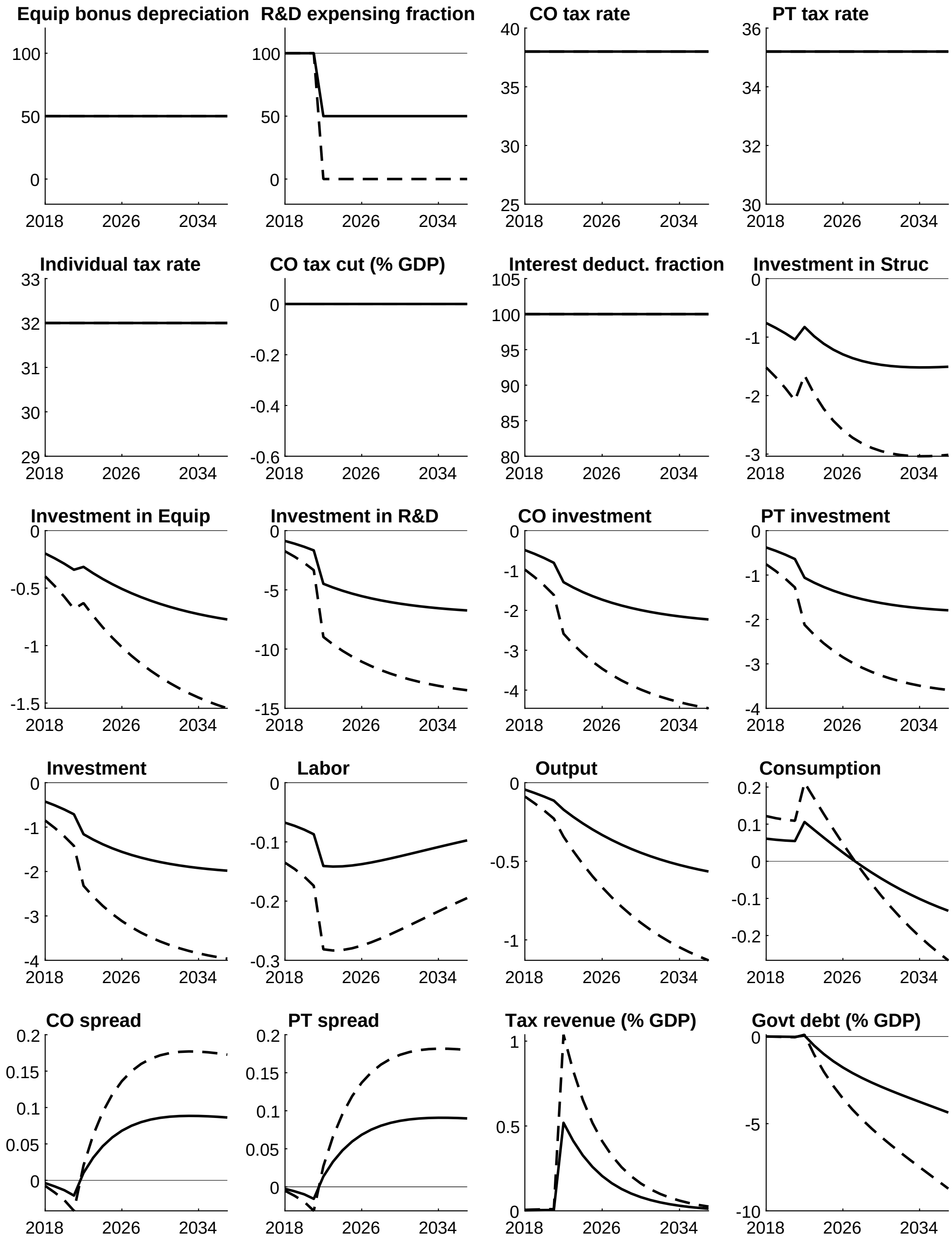

Figure 3: Effect of the scheduled switch to the amortization of R&D expenses. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

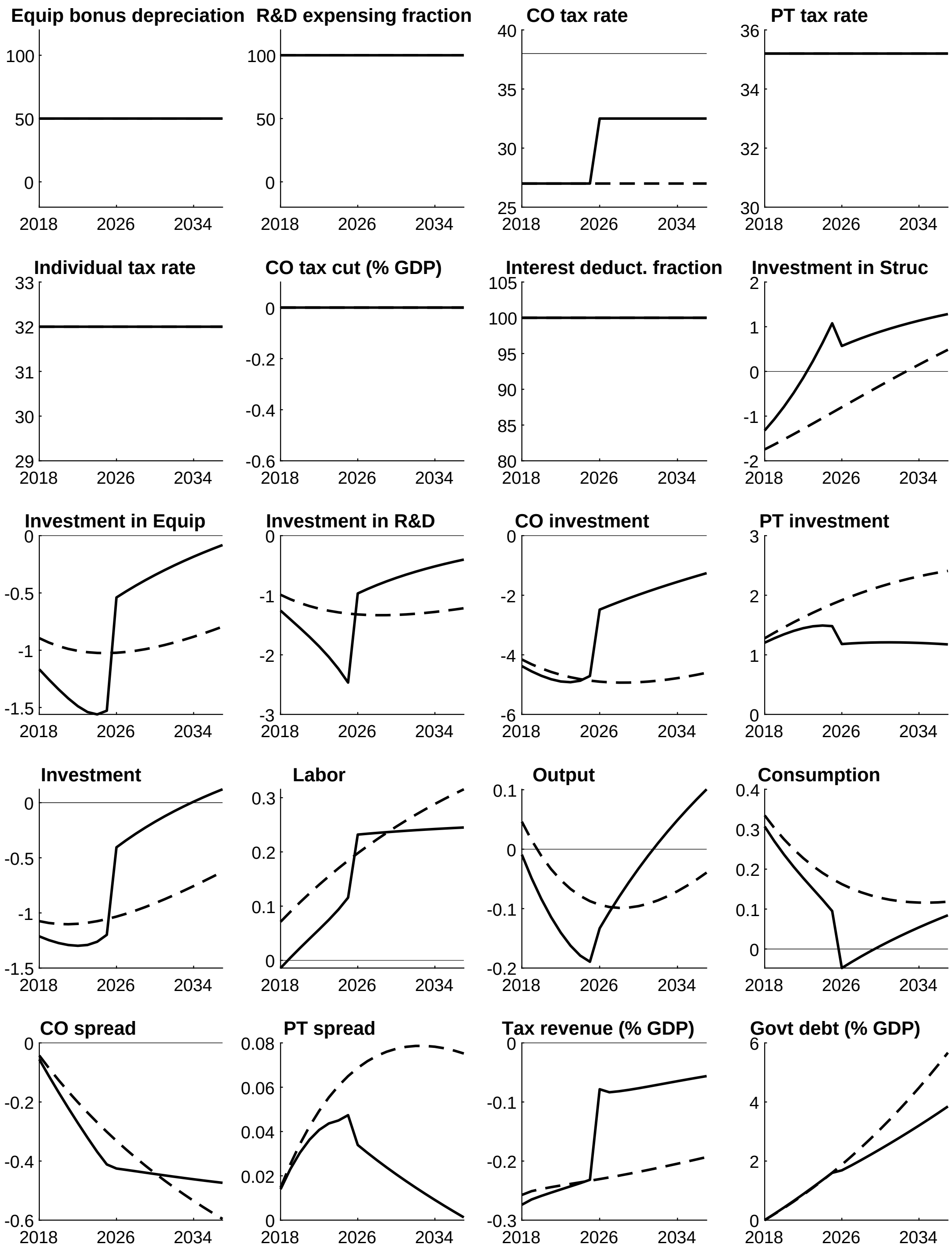

Figure 4: Effect of the income tax cuts for corporations. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

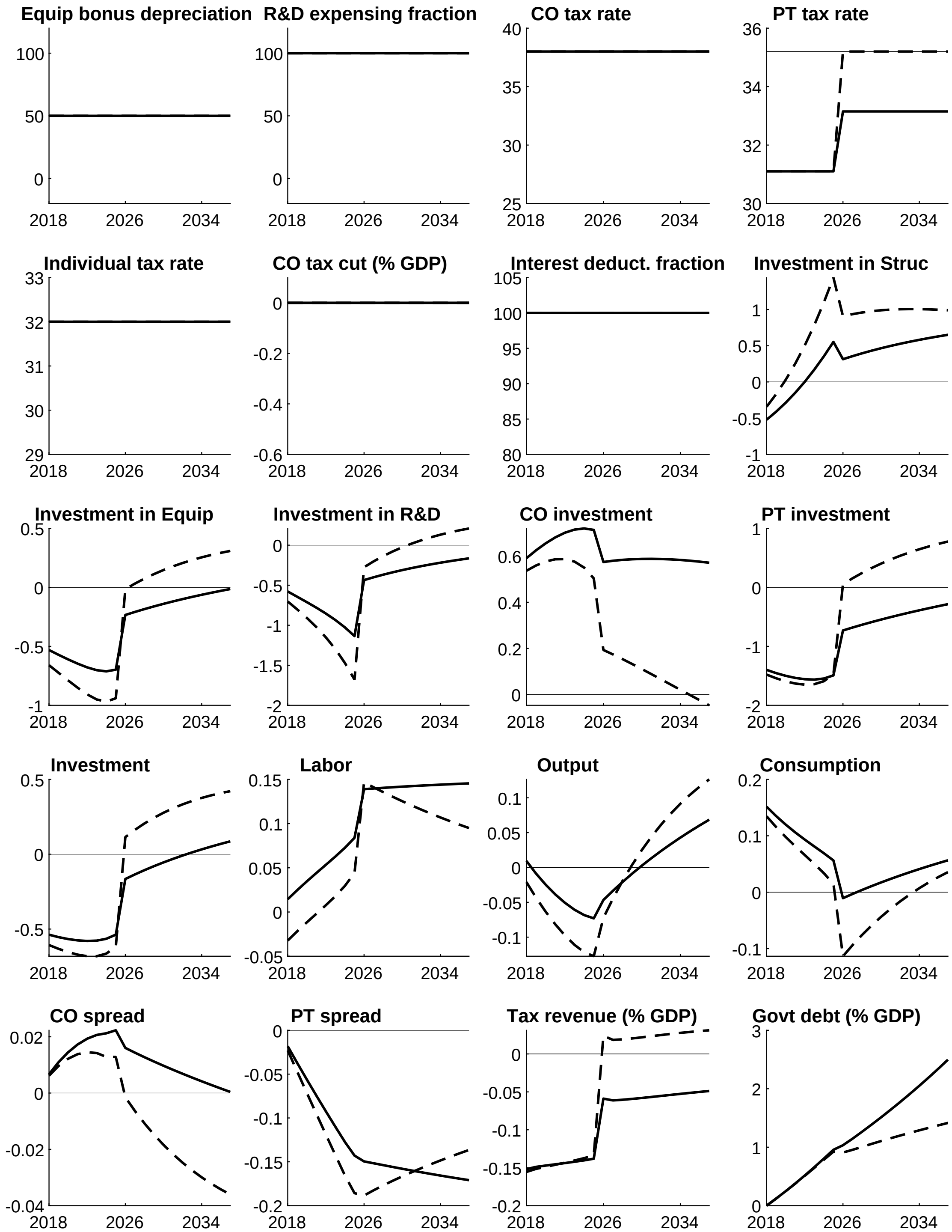

Figure 5: Effect of the income tax cuts for pass-through businesses. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

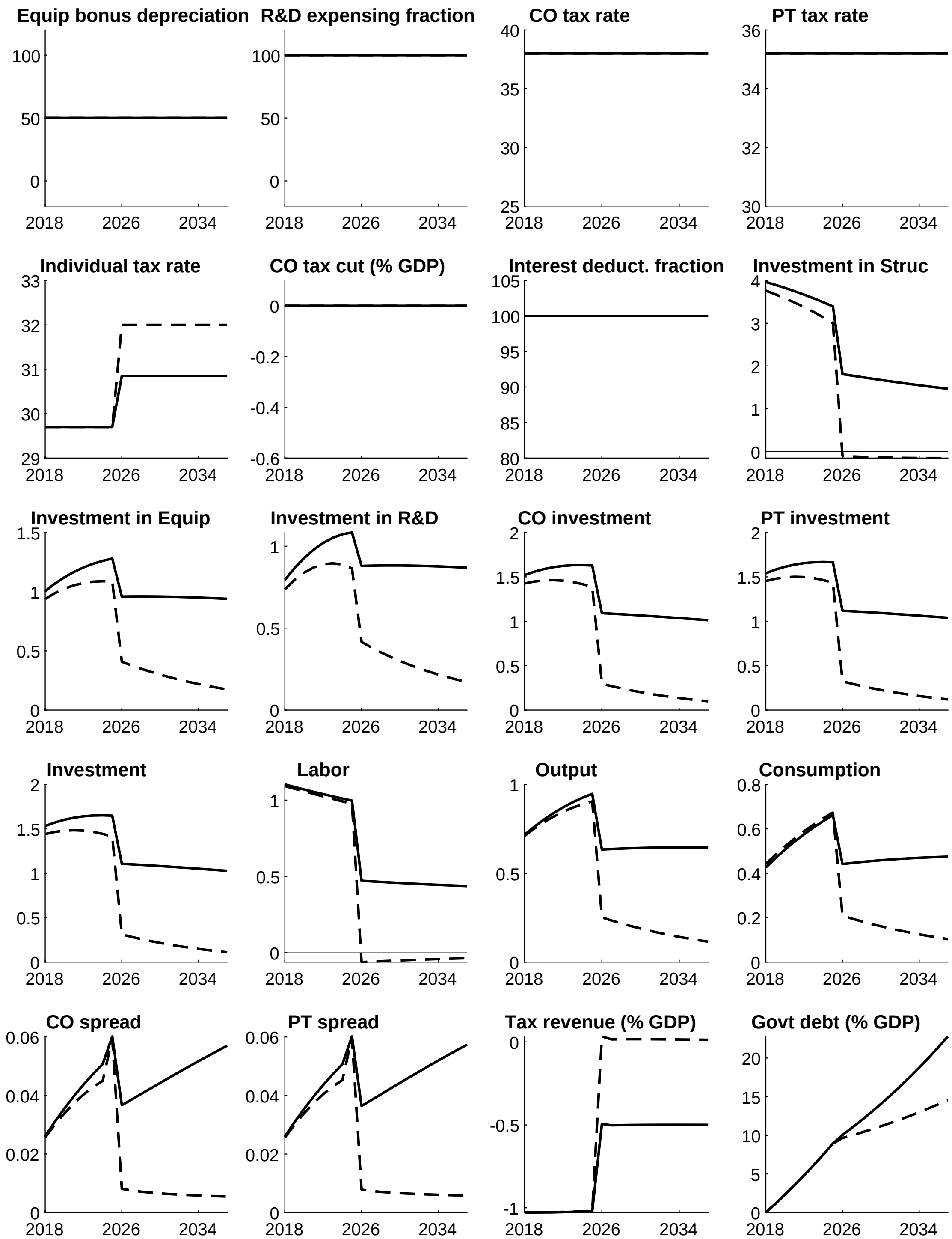

Figure 6: Effect of the income tax cuts for individuals. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

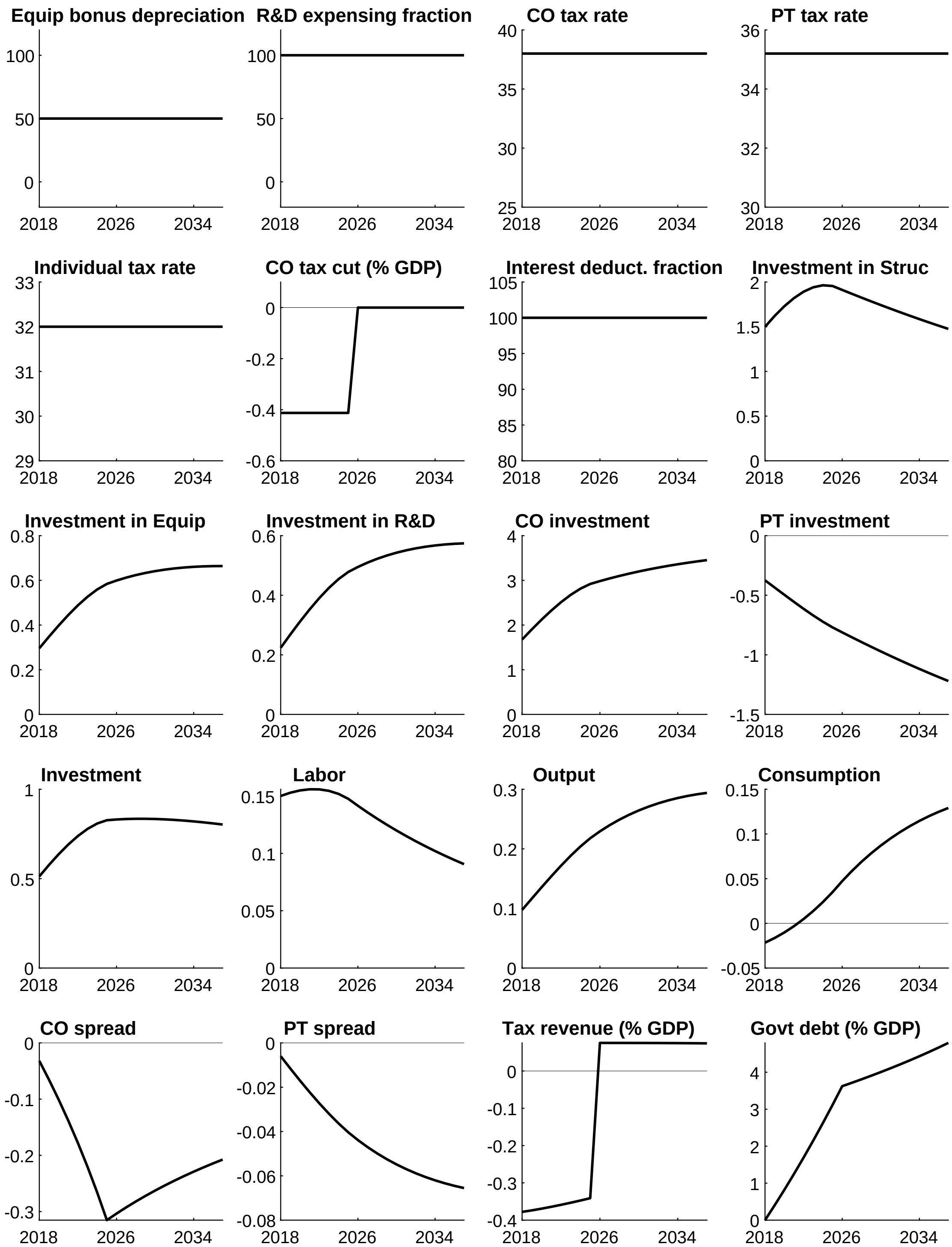

Figure 7: Effect of the provision on the corporate earnings held overseas. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

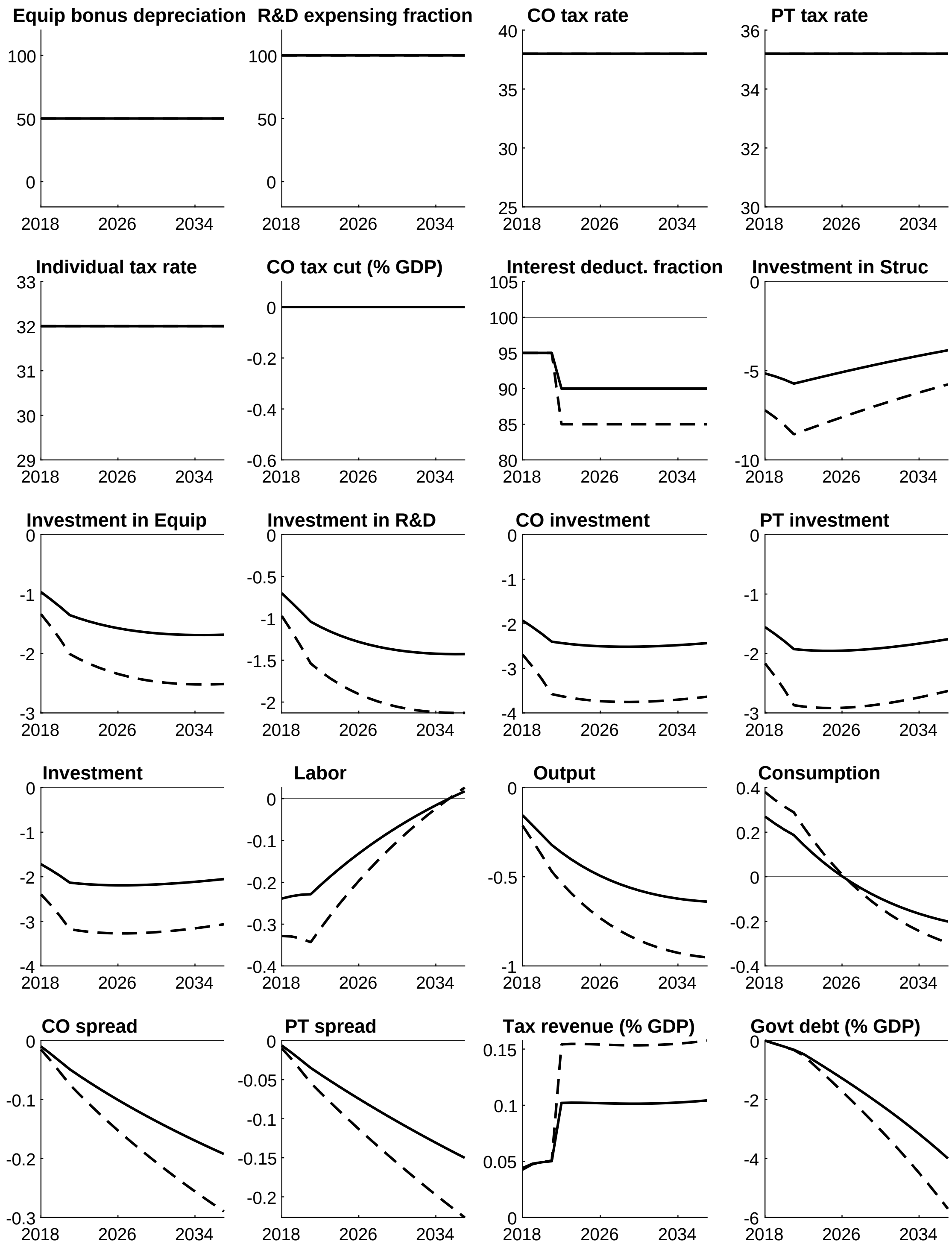

Figure 8: Effect of the limits on interest deductibility. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

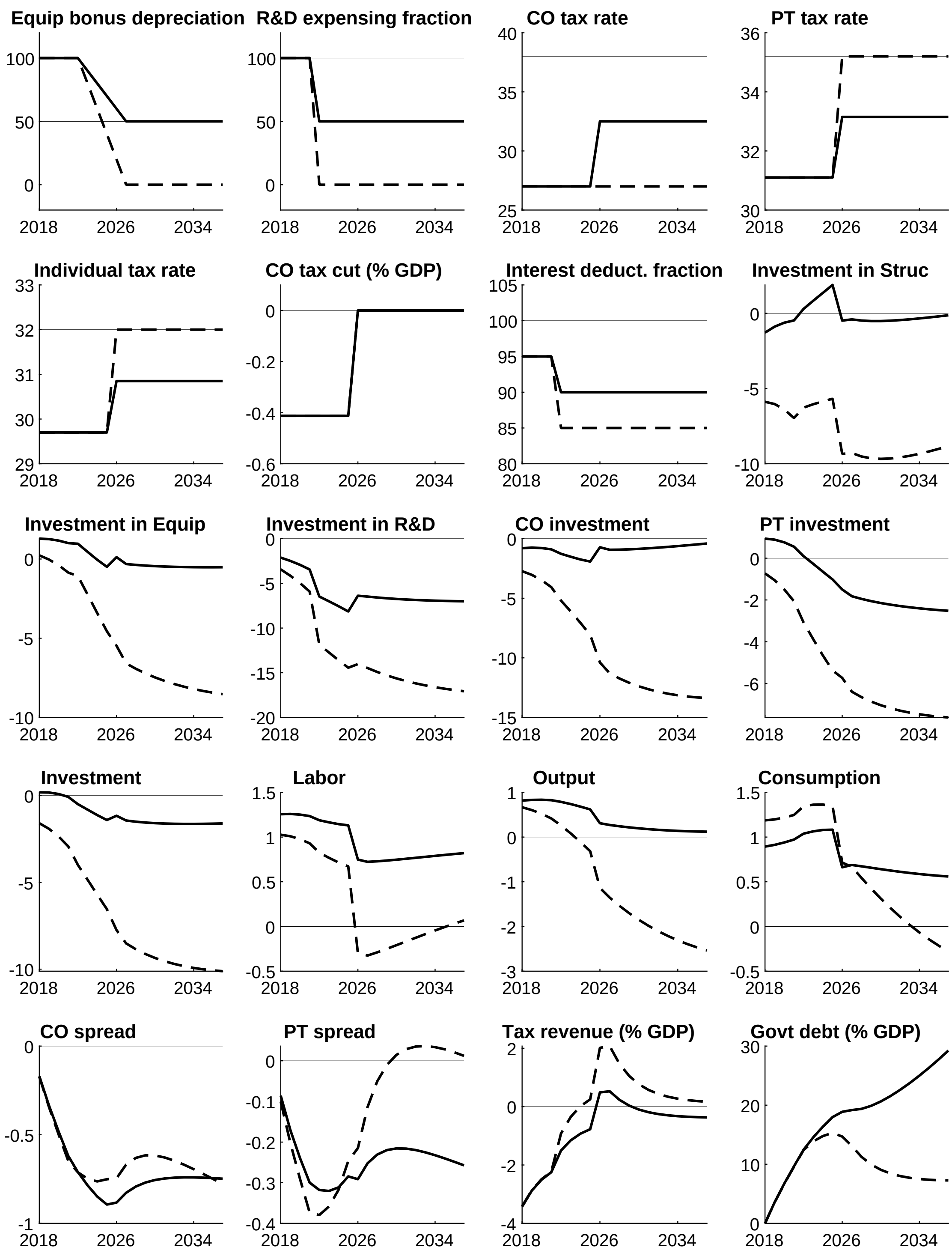

Figure 9: Cumulative effect of the seven TCJA provisions. *Note: The solid and dashed lines refer, respectively, to the plausible-expectations scenario and the current-legislation scenario.*

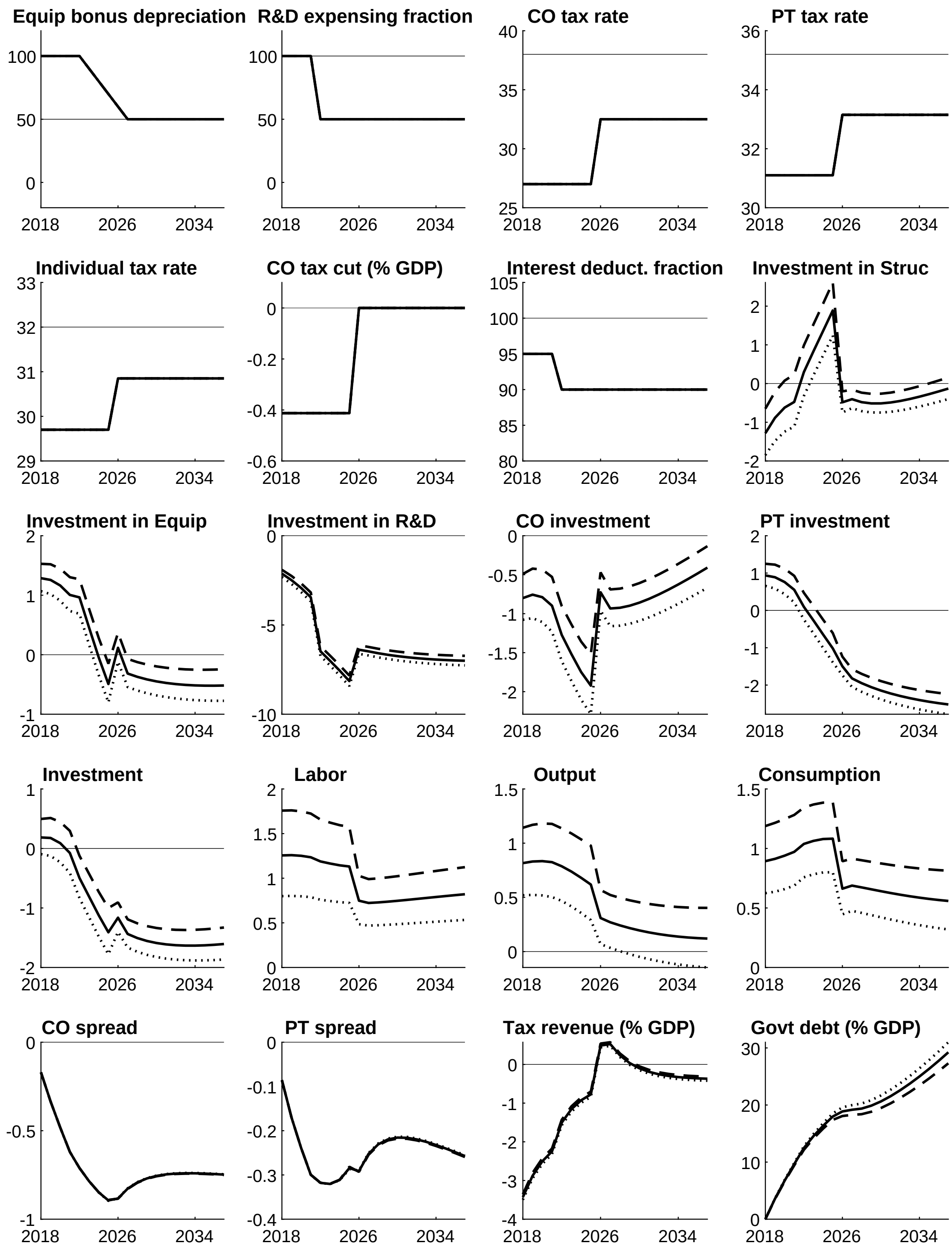

Figure 10: Cumulative effect of the seven TCJA provisions. *Note: The dotted, solid, and dashed lines refer, respectively, to values of the Frisch elasticity of labor supply equal to* $\varphi = 0.25$*,* $\varphi = 0.5$*, and* $\varphi = 1$*. All lines refer to the plausible-expectations scenario.*

Parameter	Description	Value	Targeted moments and notes
	length of one period	1 year	
β^H	HH preferences discount factor	0.96	
β^P	PT preferences discount factor	0.9533	implied by spreads and tax rates
β^C	CO preferences discount factor	0.9617	implied by spreads and tax rates
γ	relative risk aversion	2	
φ	Frisch elasticity of labor supply	0.5	
Φ	labor disutility parameter	0.08	$n = 1/3$
δ^S	depreciation rate for Struc	0.04	average duration of 27 years
δ^E	depreciation rate for Equip	0.16	average duration of 6 years
δ^R	depreciation rate for R&D	0.2	average duration of 5 years
α^S	production function exponent for Struc	0.11	$MPK^S \propto MCK^S$
α^E	production function exponent for Equip	0.19	$MPK^E \propto MCK^E$
α^R	production function exponent for R&D	0.05	$MPK^R \propto MCK^R$
α	sum of α^is	0.35	
ψ^i	investment adjustment costs	10	
ω^C	CO measure	0.43	ratio of CO output to business output
A^C	production function scale	36.95	$y^C = 75$
A^P	production function scale	37.12	$y^P = 75$, $y^B = 75$
y^H	HH's endowment	25	$y^H = 0.25\, GDP$, $y^B = 0.75\, GDP$
b^C	CO debt	12.85	3.7 ratio of EBIT to interest expenses
b^P	PT debt	17.38	3.7 ratio of EBIT to interest expenses
$\tilde{A}^C$	wedge function scale	0.1317	credit spread equal to 1 percent
$\tilde{A}^P$	wedge function scale	0.2138	credit spread equal to 1 percent
ρ	wedge function exponent	1.81	semi-elasticity of spread to leverage
G	government spending	18	$G = 0.18\, GDP$
D	government debt	76	$D = 0.76\, GDP$
π	inflation rate	0.02	
τ^H	individual tax rate	0.32	
τ^P	pass-through tax rate	0.352	
τ^C	corporate tax rate	0.38	
τ^d	dividend tax rate	0.15	
χ^S	fraction of Struc immediately expensed	0	
χ^E	fraction of Equip immediately expensed	0.5	
χ^R	fraction of R&D immediately expensed	1	
$\tilde{\delta}^S$	accounting depreciation rate for Struc	0.08	accelerated depreciation
$\tilde{\delta}^E$	accounting depreciation rate for Equip	0.32	accelerated depreciation
$\tilde{\delta}^R$	accounting depreciation rate for R&D	0.2	5-year amortization of R&D expenses
ζ	interest deductibility fraction	1	

Table 1: Parameters and steady-state values.