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Abstract. Since the mid-1980s, U.S. corporate tax cuts have become less expansionary and increasingly associated with rising share buybacks. Using dynamic general equilibrium models with corporate financial allocations, we show that buybacks render a corporate tax cut less expansionary. Simulations based on the Tax Cuts and Jobs Act have the optimal buyback response much smaller than that observed. This implies that restricting buybacks is likely to enhance the expansionary effects of a corporate tax cut. Both shareholders and non-shareholders enjoy higher income from a corporate tax cut, but most of the income increases accrue to shareholders. Whether non-shareholders enjoy higher consumption depends on the fiscal adjustment mechanism.

Keywords: corporate tax cuts, share buybacks, tax policy effects, fiscal policy effects, SVAR estimation

JEL Codes: E62, H25, H30, C32, D53

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1. Introduction

Share buybacks reached a historic high among S&P 500 companies in 2021. Amid rising energy prices and profits during the Russia-Ukraine war, major oil and gas companies' buybacks surged, but their capital expenditures remained mostly flat despite record second-quarter profits in 2022 (Kinery, 2022; Kimani, 2022). Rising buybacks have been blamed for reducing investment, jeopardizing innovation and long-term growth (Lazonick, 2014; Palladino, 2018; Lazonick et al., 2020; Nguyen et al., 2021). Some studies, however, highlight their merits in correcting for firm under-valuation (D'Mello and Shroff, 2000; Peyer and Vermaelen, 2009; Autore et al., 2019) and decreasing capital misallocation (De la O, 2020). Missing from these discussions is the influence of buybacks on the effects of corporate tax cuts.

We investigate whether buybacks undermine the macroeconomic effects of corporate tax cuts. Following the Tax Cuts and Jobs Act (the 2017 tax cut), which decreased the corporate tax rate from 35 to 21 percent, the investment response appears muted (see Figure 1). Meanwhile, buybacks in 2018 rose by 88 percent from the 2017 level (Standard & Poor's, 2022). Some argue that corporations spent the tax windfall on buying back shares rather than investing (Egan, 2018; Tung and Milani, 2018), although the literature has mixed evidence on whether buybacks decrease investment in general (Gruber and Kamin, 2017; Fried and Wang, 2018; Turco, 2018).

Over a longer horizon, U.S. corporat buybacks and investment present opposite trends (see Figure 2).[1] After the adoption of Rule 10b-18 in 1982, buybacks began to increase, as the rule provides share issuers a safe harbor from manipulation liability under the Securities and Exchange Act (the 1934 Act). The downward trend in business investment, on the other hand, has numerous explanations, such as increasing ownership concentration in certain

[1]Net share buybacks in Figure 2 are scaled by after-tax corporate profits. When they are scaled by total assets or EBITDA (earnings before interest, taxes, depreciation, and amortization), the upward trend remains.

industries and declining competitiveness and productivity in the U.S. traded goods sector (see, e.g., Stewart and Atkinson, 2013; International Monetary Fund, 2015; Gutiérrez and Philippon, 2017a,b; Alexander and Eberly, 2018; Covarrubias et al., 2019). One explanation for declining investment is related to corporate governance and agency issues in buyback decisions (Gutiérrez and Philippon, 2018). As buybacks often increase share prices, which can enrich corporate executives, Gutiérrez and Philippon (2018) find that buybacks crowd out investment in non-competitive sectors. Instead of buyback motivations, we focus on how buyback activity influences the macroeconomic effects of corporate tax cuts.

We first estimate U.S. federal corporate tax effects before and after the mid-1980s to see if share buybacks, GDP, and investment respond differently to a corporate tax shock. Structural vector auto-regression (SVAR) estimations indicate that the corporate tax cuts became less expansionary in GDP and investment, but more stimulative in buybacks in the latter sample. To explore how buybacks affect corporate tax effects, we then build a dynamic general equilibrium model with financial allocations. Simulations show that corporate tax cuts increase profits, and the optimal allocations raise both investment and buybacks. The optimal buyback response is nonetheless much smaller than the actual buyback response following the 2017 tax cut.

To mimic the scenario prior to the adoption of Rule 10b-18, we simulate an alternative model in which corporations cannot buy back shares with tax windfalls. Although the 1934 Act does not outlaw buybacks, it prohibits share price manipulation. Because buybacks often raise share prices, corporations were generally constrained in buyback activity. We find that corporate tax cuts produce stronger investment and output effects in the alternative model, relative to the baseline model with endogenous buybacks. For a permanent 5.2-percentage-point reduction in the corporate tax rate, approximately the size of the 2017 tax cut, the two- and ten-year cumulative output multipliers are -0.24 and -1.38 in the alternative model, compared to -0.15 and -0.87 in the baseline model. This suggests that buybacks render tax cuts less expansionary.

Since one criticism of share buybacks is that workers and non-shareholders are harmed, we also study the distributional effects of corporate tax cuts. The baseline model is extended to include non-shareholders, assumed to have only labor income and are liquidity constrained. Although both types of agents enjoy higher disposable income from the corporate tax cut, most of the income increases accrue to shareholders. Whether non-shareholders' consumption increases depends on the financing mechanism: when fiscal adjustments reduce transfers to both types of agents, non-shareholders' consumption falls below the path without the tax cut. When only transfers to shareholders are reduced, instead, non-shareholders' consumption increases immediately because the tax cut increases investment and capital, resulting in higher wage.

Our paper is one of the few that includes corporate finance decisions in a macroeconomic model. Among the few, Chen et al. (2017) focus on the evolution of corporate savings and investment in the global economy, and De la O (2020) studies how Rule 10b-18 affects financial and capital allocations.[2] Our paper is also related to the literature that emphasizes the supply-side effects of income taxes (e.g., Judd, 1985; Chamley, 1986; Judd, 1987; McGrattan, 1994; Leeper and Yang, 2008), but they ignore corporate finance decisions. Lastly, various papers study the weak investment effects of the 2017 tax cut, blaming economic uncertainty and rising market power (Krugman, 2018; Kopp et al., 2019), elevated government debt (Fotiou et al., 2020), and a reduced investment subsidy (Occhino, 2019, 2020). Our analysis suggests that buying back shares with the tax windfall weakened macroeconomic effects of the 2017 tax cut.

2. Corporate Tax Effects: Before and After the Mid-1980s

To see whether the U.S. macroeconomic effects of corporate tax changes evolved over time, we follow Mertens and Ravn (2013) to estimate the effects of federal corporate tax

[2]For the literature on the microeconomic effects of share buybacks, see York (2010) and Autore et al. (2019), or De la O (2020) for a review.

reductions in two subsamples: 1951Q4–1986Q4 and 1987Q1–2019Q4. This division is motivated by the observation that net share buybacks increased substantially after the mid-1980s (see Figure 2).

Mertens and Ravn (2013) combine Blanchard and Perotti's (2002) SVARs with Romer and Romer's (2010) narrative approach to estimate income tax effects. They focus on tax changes unrelated to the state of the economy—those driven by deficit and long-run growth considerations—to address endogeneity. Also, only corporate tax changes with implementation lags less than one quarter are included to address foresight issues in estimating fiscal policy effects (Yang, 2005; Mertens and Ravn, 2011; Leeper et al., 2013). They construct a narrative account from 1950 to 2006, extended to 2017 by Liu and Williams (2019). We further extend the series to include the permanent corporate tax cut from 35 to 21 percent in 2017. Appendix A describes this extension.

Our empirical model specification is similar to those in Mertens and Ravn (2013). We focus on the responses of share buybacks, GDP, and private investment. The SVAR system is

$$\mathbf{A}\mathbf{Y}_t = \mathbf{c} + \sum_{j=1}^{p} \alpha_j \mathbf{Y}_{t-j} + \varepsilon_t, \tag{1}$$

where $\mathbf{A}$ is a 8×8 matrix, $\mathbf{c}$ is a 8×1 vector of deterministic terms, the α_j's are 8×8 coefficient matrices, and ε_t is a 8×1 vector of structural shocks with $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_t') = \mathbf{I}$, $E(\varepsilon_t \varepsilon_s') = 0$ for $s \neq t$, and $\mathbf{I}$ is the identify matrix. The reduced-form representation is

$$\mathbf{Y}_t = \mathbf{B}\mathbf{c} + \sum_{j=1}^{p} \mathbf{B}\alpha_j \mathbf{Y}_{t-j} + \mathbf{u}_t, \tag{2}$$

where $\mathbf{B} = \mathbf{A}^{-1}$ and $\mathbf{u}_t = \mathbf{B}\varepsilon_t$ with $E(\mathbf{u}_t \mathbf{u}_t') = \mathbf{B}\mathbf{B}'$. $\mathbf{Y}_t$ consist of

(1) $APITR_t$, the average personal income tax rate,

(2) $ACITR_t$, the average corporate income tax rate,

(3) $\ln(G_t)$, government goods purchase per capita in logarithm,

(4) $\ln(GDP_t)$, gross domestic product per capita in logarithm,

(5) $\ln(DEBT_t)$, federal government debt per capita in logarithm,

(6) $\ln\left(B_t^{CI}\right)$, the corporate income tax base per capita in logarithm,

(7) $REPR_t$, the ratio of net share buybacks to after-tax corporate profits, and

(8) $\ln(I_t)$, private investment consisting of equipment and intellectual property products in logarithm.

Appendix B describes the data used in the SVAR estimation.

We use the narrative tax rate changes for personal and corporate income as proxy variables and impose two identification restrictions. First, these two narrative series are assumed to be related to the structural shocks of average personal and corporate income tax rates. Second, the narrative series are assumed to be orthogonal to other structural shocks. Mertens and Ravn (2013) show that these identification restrictions lead to estimable parameter restrictions on the impact matrix $\mathbf{B}$ of structural shocks. This method makes direct assumptions on matrix $\mathbf{B}$ unnecessary. Also, by treating the narrative series as proxy variables for the structural shocks, we mitigate the measurement errors when constructing the narrative series.

Figure 3 plots the responses of share buybacks, GDP, and private investment to a one-percentage-point reduction in the average corporate income tax rate. The left column presents the responses from the estimation using the entire sample: 1951Q4–2019Q4, and the middle and right columns are the responses using the two subsamples: 1951Q4–1986Q4 and 1987Q1–2019Q4.[3] The full sample estimation shows that corporate income tax changes are effective in raising GDP and private investment, but share buybacks are unresponsive to the tax changes. Our responses on GDP and private investment are similar to Mertens and Ravn (2013), which use the 1950Q1–2007Q4 sample.

[3]In all estimations, the VAR lag number is set to $p = 1$ according to the Akaike information criterion.

The two subsample estimations show noticeable differences in share buybacks and private investment responses. Buybacks turn positive in the 1987Q1–2019Q4 subsample. On the other hand, private investment becomes unresponsive—the 95-percent confidence bands encompass zero, although the point estimates are largely positive. Comparing the two subsample estimations suggests that corporate tax cuts in the U.S. became less expansionary but more instrumental in raising buybacks after the mid-1980s. We exclude 2020 and 2021 as they are unusual years, hit by a rare and huge health shock. When using the 1987Q1–2007Q4 subsample (excluding the Global Financial Crisis, not presented here), we find that private investment responds insignificantly to a corporate tax shock, similar to the response using the 1987Q1–2019Q4 sample.

3. The Baseline Model

We construct a dynamic general equilibrium model where corporations allocate after-tax profits among investment, share buybacks, and dividend payouts, similar to Gourio and Miao (2010, 2011) and Karabarbounis and Neiman (2012). The baseline model includes a representative agent, a representative corporation, and the government.[4] Online Appendix 1 describes the equilibrium system.

3.1. **Agents.**

The representative agent derives utility from effective consumption ($\tilde{c}_t$) and disutility from labor (l_t). Effective consumption is defined as $\tilde{c}_t = c_t - hC_{t-1}$, where c_t is consumption, $h \in [0, 1]$ is the habit parameter, and C_{t-1} is lagged aggregate consumption for capturing external habit formation. The representative agent chooses consumption, labor, government bonds (b_t), and corporate shares (s_t) each period to maximize the expected lifetime utility by solving

$$\max_{c_t, l_t, b_t, s_t} E_t \sum_{t=0}^{\infty} \beta^t \left[\frac{(\tilde{c}_t - \nu l_t^{\kappa} X_t)^{1-\gamma}}{1-\gamma} \right], \tag{3}$$

[4]Whether a corporation is financially constrained affects its investment with repatriated foreign earnings (Faulkender and Petersen, 2012). It is likely that financial constraints also affect profit allocation decisinos. We focus on aggregate investment dynamics and ignore financial constraints to simplify the model structure.

subject to

$$c_t + b_t + p_t s_t = b_{t-1} + (p_t + e_t)s_{t-1} + z_t + (1 - \tau_t^p) \underbrace{(w_t l_t + d_t s_{t-1} + r_{t-1} b_{t-1})}_{\text{income s.t. personal taxes}} - \tau_t^k \underbrace{(p_t + e_t - p_{t-1})\, s_{t-1}}_{\text{capital gain}}, \tag{4}$$

where $\beta \in (0, 1)$ is the discount factor, γ and κ are related to the elasticity of intertemporal substitution of consumption and the Frisch elasticity of labor supply, ν is the disutility weight on labor, w_t is the real wage rate, τ_t^p and τ_t^k are the tax rates on personal income and capital gain, r_{t-1} is the net real interest rate, and z_t is a lump-sum transfer from the government.[5] The preference index variable, X_t, evolves according to

$$X_t = (\tilde{c}_t)^\sigma X_{t-1}^{1-\sigma}. \tag{5}$$

We assume the Greenwood, Hercowtiz, and Huffman (GHH) preference (Greenwood et al., 1988) in the baseline model by setting $\sigma = 0$ and normalizing X_t to 1. The specification also accommodates the King, Plosser, and Rebelo (KPR) preference (King et al., 1988). We explore how the wealth effect on labor supply influences corporate tax effects in the sensitivity analysis.

The representative agent saves through two financial assets—government bonds and corporate shares—and is the only shareholder. A government bond costs one unit of goods at $t - 1$ and pays $1 + r_{t-1}$ units of goods at t. A corporate share costs p_{t-1} units of goods at $t - 1$ and pays $(d_t + p_t + e_t)$ units of goods at t, where d_t is the dividend distributed per share, e_t is the buyback value per share, and p_t is the ex-dividend share price.

Without loss of generality, we assume that the agent only holds the share purchased for one period, and the market has one unit of perfectly divisible corporate share outstanding each period as in Chen et al. (2017). Then, the equity market clearing implies $s_t = 1$ for all

[5]We assume that dividend income and personal income are subject to the same tax rate. After the enactment of the Jobs and Growth Tax Relief Reconciliation Act in 2003, the two types of income are taxed differently in the U.S. We abstract from this fact for modeling simplicity.

t.[6] In practice, buybacks reduce share numbers in the equity market, driving up the share price. In the model, the agent's gain from share buybacks is captured by an increase in p_t and e_t as the share number is normalized to one. The capital gain at t (denoted by $\mathfrak{g}_t$) from share purchasing at $t-1$ is $(p_t + e_t - p_{t-1})\, s_{t-1}$, or simply $\mathfrak{g}_t \equiv (p_t + e_t - p_{t-1})$.

Denote net after-tax returns to government debt and to corporate shares at $t+1$ as

$$r^b_{t+1} \equiv \left(1 - \tau^p_{t+1}\right) r_t \tag{6}$$

and

$$r^s_{t+1} \equiv \frac{1}{p_t}\left[\left(1 - \tau^p_{t+1}\right) d_{t+1} + \left(1 - \tau^k_{t+1}\right) \mathfrak{g}_{t+1}\right]. \tag{7}$$

Combining the first order conditions with respect to government bonds and corporate shares yields the no-arbitrage condition between the two financial assets, $E_t r^b_{t+1} = E_t r^s_{t+1}$. The ex-dividend share price can be derived as

$$p_t = \frac{E_t\left[\left(1 - \tau^p_{t+1}\right) d_{t+1} + \left(1 - \tau^k_{t+1}\right) \mathfrak{g}_{t+1}\right]}{E_t r^b_{t+1}}. \tag{8}$$

Intuitively, equation (8) implies that the share price increases 1) when expected future dividend payouts or capital gain are higher, and 2) when the expected return to government bonds are lower, channeling savings from bonds toward corporate shares.

3.2. **Corporations.** The representative corporation operates in a perfectly competitive market and uses capital and hires labor to produce output, y_t, with Cobb-Douglas technology

$$y_t = k^{\alpha_k}_{t-1} l^{\alpha_l}_t, \tag{9}$$

where α_k and α_l are output elasticities with respect to capital and labor. We assume decreasing returns to scale ($\alpha_k + \alpha_l < 1$) as in Gourio and Miao (2010, 2011) to ensure positive profits.

[6]Our assumption that the number of shares is normalized to one is to simplify buyback modeling to only buyback value (e_t), similar to Gourio and Miao (2010, 2011).

Let i_t be net corporate investment (or investment) and δ be the capital depreciation rate. The law of motion for capital is

$$k_t = (1-\delta)k_{t-1} + i_t. \tag{10}$$

The corporation incurs a capital installation cost, à la Gould (1968) and Hayashi (1982). The total cost for investing i_t is

$$\tilde{i}_t = i_t + \frac{\phi}{2}\left(\frac{i_t}{k_{t-1}} - \delta\right)^2 k_{t-1}, \tag{11}$$

where $\phi \geq 0$ is the installation cost parameter, and $\tilde{i}_t$ is the gross investment expenditure.

The corporation uses its profits to invest in capital formation, pay out dividends, and buy back shares. The cash flow constraint is

$$\tilde{i}_t + e_t + d_t = (1-\tau_t^c)\left(y_t - w_t l_t\right) + \tau_t^c \delta k_{t-1}, \tag{12}$$

where τ_t^c is the corporate tax rate, and $\tau_t^c \delta k_{t-1}$ is the capital depreciation allowance. Plugging equation (11) in (12) yields

$$i_t + e_t + d_t = \underbrace{(1-\tau_t^c)\left(y_t - w_t l_t\right) + \tau_t^c \delta k_{t-1} - \frac{\phi}{2}\left(\frac{i_t}{k_{t-1}} - \delta\right)^2 k_{t-1}}_{\equiv \pi_t,\ \text{after-tax corporate profits}}. \tag{13}$$

The right hand side of equation (13) is the after-tax corporate profits (or "profits" for short), that is, the income earned from current production after deducting production costs (labor and capital installation costs) and taxes.

Corporate savings ($\mathfrak{s}_t$) are retained earnings from profits,

$$\mathfrak{s}_t \equiv \pi_t - d_t. \tag{14}$$

Combining equations (13) and (14) yields

$$\mathfrak{s}_t = i_t + e_t, \tag{15}$$

which says that corporate savings are allocated between investment and buybacks. As we are mainly interested in the allocation decisions between investment and buybacks, dividend

payouts are simplified as a constant share of profits,

$$d_t = \xi \pi_t, \tag{16}$$

where $0 < \xi < 1$.[7] Compared to share buybacks and investment, fluctuations in dividends are relatively small (see Figure 2). The coefficient of variation for share buybacks (as a fraction of after-tax corporate profits) is 10 times of that for dividend payments among the U.S. non-financial firms from 1950 to 2019.[8]

In a perfect foresight equilibrium, the representative corporation chooses l_t, i_t, k_t, and e_t to maximize corporate equity value

$$\max_{l_t, i_t, k_t, e_t} V_t = \sum_{j=0}^{\infty} \frac{1}{\Gamma_{t+j}} \left[\left(\frac{1 - \tau_{t+j}^p}{1 - \tau_{t+j}^k} \right) d_{t+j} + e_{t+j} \right], \tag{17}$$

subject to equations (10), (13), (16), and

$$\Gamma_{t+j} \equiv \prod_{s=0}^{j-1} \left[1 + r_{t+s} \left(\frac{1 - \tau_{t+s+1}^p}{1 - \tau_{t+s+1}^k} \right) \right] \text{ for } j \geq 0, \text{ and } \Gamma_t = 1, \tag{18}$$

where r_{t+s} is the net real interest rate. Karabarbounis and Neiman (2012) show that maximizing corporate value is equivalent to maximizing shareholders' wealth, as in Auerbach (1979) and Poterba and Summers (1985). See Online Appendix 2 for the equilibrium conditions for the corporation's optimization problem.

3.3. **Government.** The government issues debt, collects tax revenues, and pays for its goods purchases (g_t), transfers, and debt servicing costs each period. The government budget constraint is

$$\begin{aligned} & b_t + \underbrace{\tau_t^p (w_t l_t + r_{t-1} b_{t-1} + d_t)}_{\text{personal income taxes}} + \underbrace{\tau_t^k \left(p_t + e_t - p_{t-1} \right)}_{\text{capital gain taxes}} + \underbrace{\tau_t^c (y_t - w_t l_t) - \tau_t^c \delta k_{t-1}}_{\text{corporate taxes}} \\ & = g_t + z_t + (1 + r_{t-1}) \, b_{t-1}. \end{aligned} \tag{19}$$

[7]Technically, this class of models does not allow optimally chosen investment, share buybacks, and dividends, which can be seen from the first order conditions of the corporation's optimization problem with respect to e_t (buybacks) and d_t (dividends, if dividends were chosen optimally). In various simulated scenarios, Gourio and Miao (2011) also do not allow for simultaneous choices between buybacks and dividends (see their pp. 371-372).

[8]The coefficient of variation for the buybacks-to-profit ratio is 2.2, compared to 0.2 for the dividends-to-profit ratio. See Figure 2 for the data description related to this calculation.

Let a variable without a time subscript denote initial steady-state value. We simulate the effects to an unanticipated, permanent reduction in the corporate tax rate by the magnitude of ϵ,

$$\tau_t^c = \tau^c - \epsilon, \quad \forall t. \tag{20}$$

We assume that a lump-sum transfer adjusts to stabilize government debt,

$$\frac{z_t}{z} = \left(\frac{z_{t-1}}{z}\right)^{\rho} \left(\frac{s_{t-1}^b}{s^b}\right)^{-\omega_z}, \tag{21}$$

where $\rho < 1$, $s_{t-1}^b \equiv \frac{b_{t-1}}{4y_{t-1}}$ is the debt-to-annual output ratio, and $\omega_z > 0$ is the fiscal adjustment parameter.[9] Other fiscal variables are set to their steady-state values: $g_t = g$, $\tau_t^p = \tau^p$, and $\tau_t^k = \tau^k$ for all t.

Finally, the goods market clearing condition is

$$y_t = c_t + \tilde{i}_t + g_t, \tag{22}$$

where $\tilde{i}_t$ is gross investment expenditures as defined in (11).

4. Model Solution and Calibration

We calibrate the size of the tax cut to be the magnitude of the corporate tax rate reduction in the 2017 tax act. Based on Higgins (2018), the difference in the marginal effective tax rate before and after the 2017 tax cut is 5.2 percentage points—from 20.5 percent in 2017 to 15.3 percent in 2018; thus, we set the steady-state corporate tax rate $\tau^c = 0.205$ and $\epsilon = 0.052$ in equation (20). Because of the permanent nature of the tax cut, we solve for the fully nonlinear solution using `Dynare`'s (2011) perfect foresight solver and conduct deterministic simulations.[10]

[9]To focus on the first-order effect of a corporate tax cut, we assume lump-sum financing in the baseline model. Sensitivity analysis considers a distorting financing mechanism—cutting government consumption—to stabilized debt growth.

[10]It is arguable that agents may place some probability that the permanent tax cut would be reversed or revised in the future. Our analysis excludes this situation and does not study how policy change expectations affect the corporate tax cut effects, as studied in Davig (2004) and Fotiou et al. (2020).

The model is calibrated at the quarterly frequency for the U.S. economy. Table 1 summarizes the baseline calibration. We set $\beta = 0.993$, implying a 2.82 percent annualized real interest rate. The depreciation rate of capital is set to $\delta = 0.025$, implying a 10 percent annual depreciation rate. Following the GHH preference calibration in Bi et al. (2016), we assume a logarithmic preference for consumption, $\sigma = 1$, and a Frisch labor elasticity of 0.5, implying $\kappa = 3$. The investment adjustment cost is set to $\phi = 1.7$, as in Gourio (2012). The disutility weight on labor, ν is endogenously determined to target the share of time devoted to work, $l = 0.2$. The habit formation parameter is set to $h = 0.7$, based on the mean estimate using the U.S. data in Smets and Wouters (2007). Following Gourio and Miao (2011), output elasticities with respect to capital and labor are set to $\alpha_k = 0.31$ and $\alpha_l = 0.65$, implying a decreasing return to scale.

Given the real interest rate and the capital depreciation rate, the calibration implies the steady-state ratio of investment to after-tax profits, $\frac{i}{\pi} = 0.66$, close to 0.70—the average ratio of corporate investment to the after-tax corporate profit for U.S. non-financial corporate business from 2000 to 2019. Based on the 2000-2019 average ratio of buyback values to after-tax corporate profits, we set $\frac{e}{\pi} = 0.13$.With $\frac{i}{\pi} = 0.66$ and $\frac{e}{\pi} = 0.13$, equations (13), (14), and (15) imply $\xi = 0.21$—the average ratio of net dividends to after-tax corporate profits from 2000 to 2019.[11]

For fiscal values in the initial steady state, we use federal government data from 2000 to 2019. The ratio of government goods purchases as a share of output is set to $\frac{g}{y} = 0.072$, the average of the sum of government consumption expenditures and gross investment to GDP (NIPA Table 3.9.5, line 9 and Table 1.1.5, line 1). The personal income tax rate is $\tau^p = 0.22$, the average ratio of personal current taxes plus contributions for government social insurance to personal income. Based on the Congressional Budget Office (2014), we set the tax rate on capital gain to $\tau^k = 0.18$, the effective federal marginal tax rate on capital

[11]See Figure 2 for the data description of corporate investment, net buyback value, and dividends as fractions of profits, used in calibrating the initial steady state.

income in 2014. The debt-to-annual output ratio is $\frac{b}{4y} = 0.55$, the average ratio of federal government debt held by the public to GDP (Table 1a Congressional Budget Office, 2021). Given the calibrated fiscal values, the government budget constraint implies $\frac{z}{y} = 0.11$, close to the average of mandatory spending as a share of GDP—0.12 (Table 5a, Congressional Budget Office, 2021). The fiscal adjustment parameters in equation (21) are set to $\rho = 0.9$ and $\omega_z = 0.05$, producing a gradual adjustment path sufficient to ensure debt sustainability. Given the calibrated parameters and steady-state fiscal values, Online Appendix 1.2 describes how we solve for the endogenous variables in the initial steady state.

5. The Effects of a Permanent Corporate Tax Cut

We use the baseline model (with endogenous buybacks) to simulate the effects of an unanticipated, permanent reduction in the corporate tax rate (τ_t^c) from 0.205 to 0.153. The results are compared to those from the simulations using the alternative model (without endogenous buybacks), in which the corporation cannot use tax windfalls to buy back shares. The alternative model is meant to capture the situation before the adoption of Rule 10b-18 in 1982. The differences in the investment responses between the baseline and alternative models can be interpreted as the effects of restricting corporations from buying back shares with tax windfalls.[12] Figure 4 presents the impulse responses to a permanent reduction of the corporate tax rate by 5.2 percentage points.

5.1. **Simulations with the Baseline Model.**

Our model produces the standard results that a permanent corporate tax cut increases investment and output (solid lines in Figure 4). Higher capital accumulation raises the marginal product of labor and, hence, the wage rate. An increase in goods demand from more investment drives up the real interest rate and labor demand. More capital and labor inputs then expand output. Consumption decreases in the

[12]Another way to construct the alternative model is to remove buybacks from the baseline model altogether. This would yield a different steady state from the baseline model and makes impulse responses in percent deviation from a steady state incomparable.

first few years. As the tax cut increases the share return, the agent decreases consumption to accommodate more savings through corporate shares. Consumption gradually rises and reaches a permanent higher level, 0.8 percent above the initial steady-state level, consistent with higher income in the new steady state.

We compute the present-value, cumulative multipliers for output k quarters after the initial corporate tax cut as

$$\frac{\sum_{j=0}^{k}\prod_{i=0}^{j}(1+r_{t+i})^{-1}\Delta y_{t+j}}{\sum_{j=0}^{k}\prod_{i=0}^{j}(1+r_{t+i})^{-1}\Delta tax^{c}_{t+j}}, \tag{23}$$

where Δy and Δtax^c denote the level differences in output and corporate tax revenues from the initial steady-state levels. The corresponding investment and consumption multipliers are computed by replacing Δy_{t+j} with Δi_{t+j} and Δc_{t+j}. The top panel of Table 2 shows that the two-year (ten-year) cumulative output multiplier for the corporate tax cut is -0.15 (-0.87), and the investment multipliers are -0.70 (-0.83). A positive consumption multiplier means a negative consumption response to the corporate tax cut. The two-year (ten-year) consumption multiplier is 0.55 (-0.04), consistent with the changing sign of consumption response over time (see Figure 4).

Higher production and a smaller tax burden from the corporate tax cut increase profits, as seen from equation (13). Conditional on the dividend rule, equation (16), the optimal allocation implies more investment and buybacks, driving up buyback value. Combined with higher dividend payouts, the share price increases accordingly. Because the tax cut is unanticipated, a relatively low share price at $t = -1$ pushes up capital gain at $t = 0$: the share return and capital gain jump immediately. Once the permanent corporate tax cut becomes known, the persistent increase in the share price decreases the share return and capital gain.

Our analysis shows that rising buybacks need not contradict corporate value maximization, but the observed buyback magnitude following the 2017 tax cut appears excessive. For a permanent rate reduction of 5.2 percentage points, buybacks are about 10 percent of the

pre-tax cut level on impact (Figure 4). This magnitude is dwarfed by an 88 percent increase in net buybacks in 2018 from the 2017 level for U.S. corporations (Standard & Poor's, 2022). In reality, corporations can issue debt to buy back shares, which is not accounted for in our model. The substantial buyback increase in 2018 is nonetheless unlikely to be financed by rising debt issuance. The net issuance of long-term corporate debt for U.S. corporations in 2018 decreased by 26 percent from the 2017 level.[13]

Tax revenues in the baseline model fall permanently, except for the initial increase. Because of an initial jump in capital gain, higher capital gain taxes offset the decline in corporate tax revenues. The initial higher tax revenue lowers the debt-to-annual output ratio briefly before it climbs steadily over time. Although higher output exerts downward pressure on the debt-to-annual output ratio, permanent lower tax revenues increase borrowing needs and result in more debt accumulation. Hence, the corporate tax cut is not self-financing, consistent with Mankiw and Weinzierl (2006) and Fotiou et al. (2020). In the new steady state, the debt ratio is 0.63, 8 percentage points higher than the pre-tax cut level of 0.55.

5.2. **Simulations with the Alternative Model.** We modify the baseline model such that $e_t = e$ for all t. The representative corporation now chooses l_t, i_t, and k_t to maximize

$$V_t = \sum_{j=0}^{\infty} \frac{1}{\Gamma_{t+j}} \left[\left(\frac{1 - \tau^p_{t+j}}{1 - \tau^k_{t+j}} \right) d_{t+j} + e \right], \tag{24}$$

subject to equations (10) and (13). The calibration of the alternative model ensures the same initial steady state as the baseline model. Unlike the baseline model, dividend payouts do not follow equation (16) and are endogenously determined by the cash flow constraint, equation (12), in the alternative model. When the corporation cannot use tax windfalls to buy back shares, investment increases more than if they can (dotted-dashed lines in Figure 4). Because of the quadratic investment installation costs, the initial investment difference

[13]We abstract from corporate borrowing for modeling simplicity. In a low interest rate environment, corporate borrowing can be important in financing share buybacks (The Economist, 2014). Chang et al. (2020) account for corporate borrowing and find that the optimal buyback increase is greater relative to the case without corporate borrowing.

is small as an immediate big adjustment is costly. As a result, dividend payouts increase during the first few years but then decline temporarily to accommodate higher investment. In the new steady state, investment ultimately increases by 5.2 percent, versus 3.2 percent in the baseline model.

In the longer run, more capital accumulation increases profits, and dividend payouts eventually rise above the initial steady-state level. With higher investment and capital, the marginal product of labor and the wage rate also rise, increasing labor inputs. Higher investment and labor make corporate tax cuts more expansionary without endogenous buybacks. The bottom panel of Table 2 shows that the two-year (ten-year) cumulative output multiplier is -0.24 (-1.38) in the alternative model, versus -0.15 (-0.87) in the baseline model. This is mainly driven by much more negative investment multipliers throughout the simulation horizon.

As the corporate tax cut is more expansionary without endogenous buybacks, the alternative model generates more profits than the baseline. Note that the share return, capital gain, and tax revenues all have opposite movements on impact between the two models. Two main factors influence the ex-dividend share price: 1) the expected future dividend payouts and 2) the return to government bonds.

In the baseline model, higher profits imply a higher dividend stream under a rule of constant dividend payouts-to-profit ratio. In the alternative model, dividends are not restricted to a constant proportion of profits and can fall to support higher investment. Furthermore, the higher real interest rate from stronger goods demand encourages the agent to save through government bonds—the competing financial asset, lowering corporate share demand. Both factors work to lower the initial share price, which decreases capital gain on impact and, hence, the taxes levied on capital gain in the alternative model.

With lower tax revenues, the tax-to-output ratio declines substantially from 0.19 to 0.16 on impact. A bigger revenue decline drives the government debt ratio higher relative to the

baseline. The debt ratio in the alternative model initially falls below the initial steady-state level because of a more positive effect of the corporate tax cut on output without endogenous buybacks. In the longer run, the debt ratio gradually increases in both the baseline and alternative model; the new steady-state debt ratio is 0.62 in the alternative model, close to 0.63 in the baseline. The result of a higher debt ratio higher during the transition path and in the new steady state than the initial level of 0.55 implies that corporate tax cuts are not self-financing. More aggressive fiscal adjustments than what are assumed in our simulations are required to lower the debt ratio in the new steady state.

Overall, simulations of the baseline and alternative models show that rising buybacks siphon profits from productive investments toward redistributive financial activities and, hence, dampen the macroeconomic effects of corporate tax cuts. The 1934 Act did not prohibit buybacks per se, but it prevented corporations from manipulating stock prices. Since share buybacks raised suspicion or accusations of stock price manipulation, corporations were generally reluctant to buy back shares before the adoption of Rule 10b-18 in November 1982. We do not argue that policymakers should return to the pre-1983 period to strictly limit buyback activity. Our analysis, however, suggests that restricting buybacks can enhance the macroeconomic effects of corporate tax cuts.[14]

5.3. **Sensitivity Analysis.** The baseline model assumes non-distorting fiscal adjustments through a lump-sum transfer reduction. In the sensitivity analysis, we explore government consumption as an adjustment instrument. Also, the baseline model features the GHH preference. In this section, we simulate under another commonly used preference—the KPR preference (King et al., 1988).

[14]One implication of our simulations is that investment should be more correlated with the after-tax corporate profits before 1983 than after. The calculation using the data in the earlier sample (1950Q1–1982Q4) has a higher correlation than the one in the latter sample (1983Q1–2019Q4), whether the series are detrended by the Hodrick-Prescott filter or a linear trend: 0.15 vs. 0.26 and 0.18 vs. 0.38, respectively. Corporate investment is scaled by the GDP deflator (NIPA Table 1.1.9, line 1 Bureau of Economic Analysis, 2022). See Figure 2 for the data description.

5.3.1. *Fiscal Adjustment via Government Consumption.* We replace the transfer rule in the baseline model, equation (21), with $z_t = z$, and have government consumption respond to debt as

$$\frac{g_t}{g} = \left(\frac{g_{t-1}}{g}\right)^{\rho_g} \left(\frac{s^b_{t-1}}{s^b}\right)^{-\omega_g}, \tag{25}$$

where $0 < \rho_g < 1$, and $\omega_g > 0$ is the fiscal adjustment parameter. We calibrate $\rho_g = \rho_z = 0.9$ and $\omega_g = 0.082$, yielding a debt-to-annual output path similar to that in the baseline model. Figure 5 compares the impulse responses to the corporate tax cut: the dotted-dashed lines are those under government consumption adjustments, and the solids lines are those under lump-sum transfer adjustments in the baseline model.

Government consumption reductions lower goods demand and, hence, labor demand. In equilibrium, labor and the wage rate do not increase as much, and a smaller labor increase results in a smaller increase in the marginal product of capital. Thus, the optimal profit allocation has a smaller investment increase, which leads to more buybacks as dividend payouts are proportional to profits. Together with a less positive labor response, the corporate tax cut becomes less expansionary under government consumption than transfer reductions. The top panel of Table 3 shows that the two-year output multiplier is almost zero, and the two-year (ten-year) multiplier is -0.02 (-0.26), compared to -0.15 (-0.87) under transfer adjustments in the baseline model (see Table 2).[15]

5.3.2. *KPR Preference.* The KPR preference has $\sigma = 1$ and $X_t = \tilde{c}_t$. In this specification, the marginal utility for consumption now affects the labor supply decision.

Figure 6 compares the impulse responses for the corporate tax cut under the two preferences. The biggest difference is the labor response. During the first five years, the KPR preference generates a bigger labor increase than does the GHH preference. The initial negative consumption response increases the marginal benefit of working, inducing the agent

[15]Aside from government consumption, other instruments to finance corporate tax cuts have been considered, such as labor income taxes in Domeij and Heathcote (2004) and dividends and capital gain taxes in Anagnostopoulos et al. (2022).

to supply more labor. Conversely, after consumption turns positive, higher consumption brings a negative wealth effect on labor supply, suppressing the labor response relative to that under the GHH preference. The higher labor response increases the marginal product of capital, inducing the corporation to allocate more profits to investment than under the GHH preference. With higher labor and capital, output responds more positively to the corporate tax cut. The bottom panel of Table 3 shows that the two-year (ten-year) output multiplier is -0.35 (-0.95), compared to -0.15 (-0.87) under the GHH preference in the baseline model (see Table 2). Also, the two-year (ten-year) investment multiplier under the KPR preference is -1.03 (-0.83), compared to -0.70 (-0.91) under the GHH preference.

Buybacks under the KPR preference fall below the initial steady-state level for an extended period during the first 10 years. To take advantage of high labor inputs in the short run, optimal allocations have the corporation cut buybacks to support higher investment. As profits rise over time, buybacks under the KPR preference eventually rise above the initial steady-state level. Except for buybacks, other impulse responses under the KPR preference are qualitatively the same as those under the GHH preference.

To see whether our main conclusion—endogenous buybacks weaken the positive investment and output responses to a corporate tax cut—holds in the sensitivity analysis, we simulate the alternative model (without endogenous buybacks) under either government consumption adjustments or the KPR preference. Figure 7 shows when the corporation cannot buy back shares with the tax windfall, output and investment increase much more for a corporate tax cut than otherwise.

6. Distributional Effects of a Corporate Tax Cut

Our baseline model has only one type of agents, precluding analysis of distributional effects. In this section, we modify the baseline model to add non-shareholders, similar to Bilbiie (2008).

6.1. **An Extended Model with Shareholders and Non-shareholders.** We assume that a fraction of agents, $1-\mu$, are shareholders and μ are non-shareholders. Shareholders are like the representative agent in the baseline model. Non-shareholders are like hand-to-mouth consumers in typical DSGE models (e.g., Mankiw, 2000; Forni et al., 2009; Traum and Yang, 2015): they cannot accumulate wealth and consume all the disposable income each period.

Let the superscript "s" ("n") indicate variables associated with shareholders (non-shareholders). The representative shareholder's utility is the same as the representative agent's in the baseline model, and his/her consumption and labor are denoted by $\tilde{c}_t^{\mathrm{s}}$ and l_t^{s}. The representative non-shareholder solves a static optimization problem by choosing consumption (c_t^{n}) and labor (l_t^{n}) to maximize utility each period

$$\frac{\left[\tilde{c}_t^{\mathrm{n}} - \nu \left(l_t^{\mathrm{n}}\right)^{\kappa}\right]^{1-\gamma}}{1-\gamma}, \tag{26}$$

where $\tilde{c}_t^{\mathrm{n}} = c_t^{\mathrm{n}} - hC_{t-1}^{\mathrm{n}}$ is effective consumption, and C_{t-1}^{n} is the lagged aggregate consumption of non-shareholders. The non-shareholder's budget constraint is

$$c_t^{\mathrm{n}} = \left(1-\tau_t^{p}\right) w_t l_t^{\mathrm{n}} + z_t^{\mathrm{n}}, \tag{27}$$

where z_t^{n} is a lump-sum transfer to non-shareholders. We assume that the labor decision of non-shareholders is determined by the first order condition with respect to labor, as in Yang (2007) and Forni et al. (2009). The labor supplied by the two types of agents is homogeneous, so there is only one market wage rate, w_t.

We consider two financing mechanisms: one has transfers to shareholders adjust to stabilize debt growth as in the baseline model, and the other has transfers to both types of agents adjust. In the first scenario, transfers for non-shareholders do not respond to debt, so $z_t^{\mathrm{n}} = z^{\mathrm{n}}$ for all t, and transfers to shareholders respond to government debt as in (21). The coefficient of transfer response to the lagged debt ratio, ω_z, is set to 0.05 as in the baseline model. In the second scenario, z_t^{n} follows the same process as z_t^{s} in (21).

In aggregation,

$$x_t = (1-\mu)x_t^{\mathrm{s}} + \mu x_t^{\mathrm{n}}, \qquad x \in \{c, l, z\}. \tag{28}$$

The aggregate consumption of non-shareholders is $C_t^{\mathrm{n}} \equiv \mu c_t^{\mathrm{n}}$, and the aggregate bond holding is

$$b_t = (1-\mu)b_t^{\mathrm{s}}. \tag{29}$$

We calibrate $\mu = 0.49$, based on data for the average share of families with direct and indirect stock holdings in the Survey of Consumer Finance in 2007, 2010, 2013, 2016, and 2019 (Board of Governors of the Federal Reserve System, 2012, 2014, 2017, 2020). Since both types of agents have the same preference parameters, $l^{\mathrm{n}} = l^{\mathrm{s}} = 0.2$. We also assume $z^{\mathrm{s}} = z^{\mathrm{n}} = z$ in the steady state. The baseline and the extended models have the same values for common variables, such as output, aggregate consumption, and investment.

Figure 8 presents the impulse responses to a 5.2-percentage-point reduction in the corporate tax rate using the extended model. The solid lines repeat the responses from the baseline model (with only shareholders) for reference. The dotted-dashed and dashed lines are the responses from the extended model with reductions in transfers to shareholders only and to both shareholders and non-shareholders, respectively.

6.2. **Fiscal Adjustment via Reducing Transfer to Shareholders.** Relative to the baseline model, the aggregate variables (output, consumption, investment, capital, and wage) have similar responses in the extended model with reduced transfers to shareholders for fiscal adjustments.

Despite an initial decline in aggregate consumption, non-shareholders' consumption responds positively to the tax cut from the beginning. Higher wage (from more investment and labor productivity) increases the opportunity cost of leisure, increasing their labor supply and income. Since non-shareholders consume all disposable income each period, their consumption rises, opposite of shareholders' consumption response. Table 4 shows that the

extended model produces similar output and investment multipliers as the baseline model (compared to the top panel in Table 2), but consumption multipliers have the opposite signs for the different types of agents: the two-year (ten-year) cumulative consumption multiplier is -0.03 (-0.20) for non-shareholders versus 0.52 (0.18) for shareholders; see rows (4) and (5) of Table 4. The short-run decline in shareholders' consumption is driven by an increase in the higher after-tax return to investment. As the after-tax income (the sum of labor and financial income) increases substantially for shareholders, their consumption eventually turns positive and is permanently higher in the longer run, as shown by the dotted-dashed line in Figure 8.

The permanent corporate tax cut also produces higher after-tax income for non-shareholders because of higher wage. As the government does not adjust their transfers to pay for the corporate tax cut, a higher income supports more consumption. Although non-shareholders see increased consumption, most of the income increase from the corporate tax cut accrues to shareholders. Figure 8 shows that shareholders' after-tax income rises much more than non-shareholders', mainly because of more financial income from a higher real interest rate and capital gain.

6.3. **Fiscal Adjustments via Reducing Transfers to Both Types of Agents.** The above simulation shows that non-shareholders enjoy higher consumption and income from a permanent corporate tax cut than shareholders. To see if this result is robust, we simulate another scenario that fiscal adjustments involve reducing transfers to both shareholders and non-shareholders.

Although most responses are qualitatively the same as the previous simulation with reduced transfers to shareholders (comparing dashed lines and dotted-dashed lines in Figure 8), non-shareholders' consumption now falls below the pre-tax cut level because their government transfers are reduced. Since they cannot borrow to smooth consumption, their

consumption takes a direct hit from the corporate tax cut. The 10-year cumulative consumption multiplier for non-shareholders is 0.10, compared -0.20 when only transfers to shareholder are reduced (see rows (10) and (5) in Table 4). Non-shareholders now experience a consumption decline from the corporate tax cut in the long run (see the middle plot of row 3 in Figure 8).

Our simulation results imply that the benefits of the corporate tax cut mostly fall on shareholders, leading to income redistribution (see after-tax income in Figure 8). When non-shareholders bear some of the fiscal burden of a corporate tax cut, non-shareholders can be worse off in terms of a permanently lower consumption.[16] This is similar to the capital tax cut analyzed in Domeij and Heathcote (2004), which is paid by an increase in labor income taxes, affecting all workers. Lastly, the literature shows that how a permanent tax cut is financed matters a great deal for the tax cut effect (see, e.g., Leeper and Yang, 2008; Barro and Furman, 2018; Bhattarai et al., 2022). Our analysis supports this conclusion.

7. Concluding Remarks

U.S. corporate tax cuts have become less expansionary and more associated with rising share buybacks since the mid-1980s. More recently, the sizable corporate tax cut contained in the Tax Cuts and Jobs Act of 2017 was followed by a buyback surge and produced weak investment responses. While other plausible explanations exist for this muted investment response, our theoretical investigation finds that buybacks diminish the expansionary effects of corporate tax cuts. This implies rising share buybacks can contribute to the reduced tax cut effects after the mid-1980s.

Optimal allocations from model simulations suggest that both share buybacks and investment rise in response to corporate tax cuts. The implied buyback increase, however,

[16]Section 3 of the Online Appendix presents the simulation result under the KPR preference for the extended model. It shows that the results are qualitatively the same as those presented here. First, shareholders' income increases much more than non-shareholders'. Second, non-shareholders' consumption can fall permanently when their transfers are decreased to pay for part of a corporate tax cut.

is much smaller than what we observe following the 2017 tax cut. This suggests that the substantial buyback increase is likely to be excessive from the perspective of corporate value maximization. Our analysis suggests that policymakers should consider reining in share buybacks in the U.S. to avoid crowding out productive uses of corporate profits, hurting long-run economic growth.

To our knowledge, this paper is the first to study the macroeconomic effects of corporate tax cuts in the face of rising share buybacks. The topic lies in the intersection of macroeconomics, public finance, and corporate finance. Future research can explore firm heterogeneity in affecting profit allocation decisions, as Gourio and Miao (2010, 2011) find that heterogeneous firms with different productivity and capital stocks respond differently to dividend and capital gain tax changes. Also, we focus on allocation tradeoffs between investment and share buybacks. A natural extension is corporate borrowing, which would relax the modeling constraint on dividend payouts. Finally, the theoretical implications of our paper are based on a calibrated model. An estimated dynamics stochastic general equilibrium model can provide counterfactual analyses for the historical macroeconomic responses or tax policy effects of rising share buybacks in the U.S.

Appendix A. Extending the Narrative Account

This appendix documents how we extend the narrative account of unanticipated corporate tax reductions in Mertens and Ravn (2013) for 1950-2006 and Liu and Williams (2019) for 2007-2017.

Mertens and Ravn (2013) define unanticipated tax changes as those with lags between the enactment and implementation dates not longer than 90 days. The 2017 tax cut was enacted in December 2017 and implemented in January 2018. Since this tax cut is not driven by countercyclical or spending reasons, it falls into the "exogenous" category of tax changes by Romer and Romer's (2010) classification. The Congressional Budget Office (2017) estimates that the budgetary cost of the business-related tax changes of the 2017 Tax Act is $127.1 billion for the FY2018. We scale this estimated revenue loss by the corporate income tax base, which is calculated as NIPA corporate profits with adjustment for inventory valuation and capital consumption (NIPA Table 1.12 line 13) less Federal Reserve Bank Profits (NIPA Table 6.16D line 11). The estimated tax change of FY2018 is attributed to the first quarter of 2018. We exclude revenue loss in later years, as those changes are anticipated. Following Mertens and Ravn (2013), we demean the narrative account of corporate tax changes by the mean of nonzero observations.

Appendix B. Data Description: the SVAR Estimation

This section provides the data description for the time series used in the SVAR estimation in Section 2. In addition to the narrative account of unanticipated corporate tax changes, the estimation of the SVAR, (1), uses the following data.

- Population (POP_t): U.S. civilian non-institutional population for persons 16 years and older (CNP16OV, Bureau of Labor Statistics (2021)), quarterly frequency with values taken at the end of each quarter.

- GDP (GDP_t): Real GDP, Quantity Index (NIPA Table 1.1.3 line 1), divided by POP_t.

- Government purchase (G_t): Real federal government consumption expenditures and gross investment (NIPA Table 1.1.3 line 22), divided by POP_t.

- Personal income tax base (B_t^{PI}): Personal income (NIPA Table 2.1 line 1) less government transfers (NIPA Table 2.1 line 17) plus contributions for government social insurance (NIPA Table 3.2 line 11), deflated by the GDP deflator (NIPA Table 1.1.9 line 1) and POP_t.

- Corporate income tax base (B_t^{CI}): Corporate profits (NIPA Table 1.12 line 13) less Federal Reserve Bank profits (NIPA Tables 6.16 B-C-D), deflated by the GDP deflator (NIPA Table 1.1.9 line 1) and POP_t.

- Average personal income tax rate ($APITR_t$): The sum of federal personal current taxes (NIPA Table 3.2 line 3) and contributions for government social insurance (NIPA Table 3.2 line), divided by the personal income tax base.

- Average corporate income tax rate ($ACITR_t$): Federal taxes on corporate income excluding Federal Reserve banks (NIPA Table 3.2 line 9) divided by the corporate income tax base.

- Debt ($DEBT_t$): The market value of privately held gross federal debt (Federal Reserve Bank of Dallas, 2021), quarterly frequency with values taken at the end of each quarter.

- Private fixed investment on equipment and IPP (I_t): The sum of real private fixed investment on equipment (NIPA Table 1.1.3 line 11) and intellectual property products (NIPA Table 1.1.3 line 12), divided by POP_t.

- Net income after taxes (INC_t): Net income after tax is calculated as net income, before extraordinary items and taxes minus taxes on corporate income for non-financial

corporate business (X.9, series FA106110305.Q) from Financial Accounts of the Federal Reserve Board.

- Net share repurchases (REP_t): Net share repurchases are calculated as the negative of net corporate equity issuances by non-financial corporate business (Table F.101, series FA103164103.Q) from Financial Accounts of the Federal Reserve Board .

- Net Repurchase Ratio ($REPR_t$): The ratio of net share repurchases (REP_t) to net income after taxes (INC_t).

Table 1: **Calibration and Some Steady-State Values: the Baseline Model**

Parameters	**Values**
β, quarterly discount factor	0.993
α_k, elasticity of output with respect to capital	0.31
α_l, elasticity of output with respect to labor	0.65
δ, depreciation rate for capital	0.025
γ, inverse of intertemporal elasticity of substitution	1
κ, corresponding to a Frisch labor elasticity of 0.5	3
σ, GHH preference parameter	0
h, external habit formation parameter	0.7
l, steady-state fraction of time worked	0.2
ν, disutility weight on labor	12.17
ϕ, investment adjustment costs	1.7
ξ, dividend-to-profit ratio	0.21
$\frac{e}{\pi}$, share buyback-to-profit ratio	0.13
$\frac{i}{\pi}$, investment-to-profit ratio	0.66
τ^c, corporate tax rate	0.205
ϵ, the magnitude of the permanent corporate tax cut	0.052
τ^p, tax rate on personal income	0.22
τ^k, tax rate on capital gain	0.18
$\frac{g}{y}$, government goods purchase-to-output ratio	0.072
$\frac{b}{4y}$, government debt-to-annual output ratio	0.55
$\frac{z}{y}$, transfer-to-output ratio	0.11
ω_z, transfers response to debt	0.05
ρ, autocorrelation coefficient in the lump-sum transfer rule	0.9

Variables	2-Year	5-Year	10-Year
Baseline Model: With Endogenous Buybacks			
Output	−0.15	−0.48	−0.87
Investment	−0.70	−0.79	−0.83
Consumption	0.55	0.31	−0.04
Alternative Model: Without Endogenous Buybacks			
Output	−0.24	−0.76	−1.38
Investment	−1.12	−1.26	−1.32
Consumption	0.88	0.50	−0.06

Table 2: **Cumulative multipliers for a permanent corporate tax cut.** See equation (23) for multiplier calculation.

Variables	2-Year	5-Year	10-Year
Government Consumption Adjustment			
Output	−0.02	−0.07	−0.26
Investment	−0.08	−0.17	−0.42
Consumption	0.05	−0.08	−0.37
KPR Preference			
Output	−0.35	−0.65	−0.95
Investment	−1.03	−0.99	−0.91
Consumption	0.68	0.34	−0.04

Table 3: **Cumulative multipliers for a permanent corporate tax cut: sensitivity analysis.** See equation (23) for multiplier calculation.

Variables	2-Year	5-Year	10-Year
Transfer Reduction for Shareholders Only			
(1) Output	−0.14	−0.43	−0.80
(2) Investment	−0.63	−0.71	−0.78
(3) Consumption	0.49	0.29	−0.02
(4) Consumption, *shareholders*	0.52	0.39	0.18
(5) Consumption, *non-shareholders*	−0.03	−0.11	−0.20
Transfer Reduction for Shareholders and Non-shareholders			
(6) Output	−0.07	−0.23	−0.48
(7) Investment	−0.33	−0.40	−0.54
(8) Consumption	0.25	0.18	0.06
(9) Consumption, *shareholders*	0.27	0.16	−0.05
(10)Consumption, *non-shareholders*	−0.02	0.02	0.10

Table 4: **Cumulative multipliers for a permanent corporate tax cut: distributional effects.** See equation (23) for multiplier calculation.

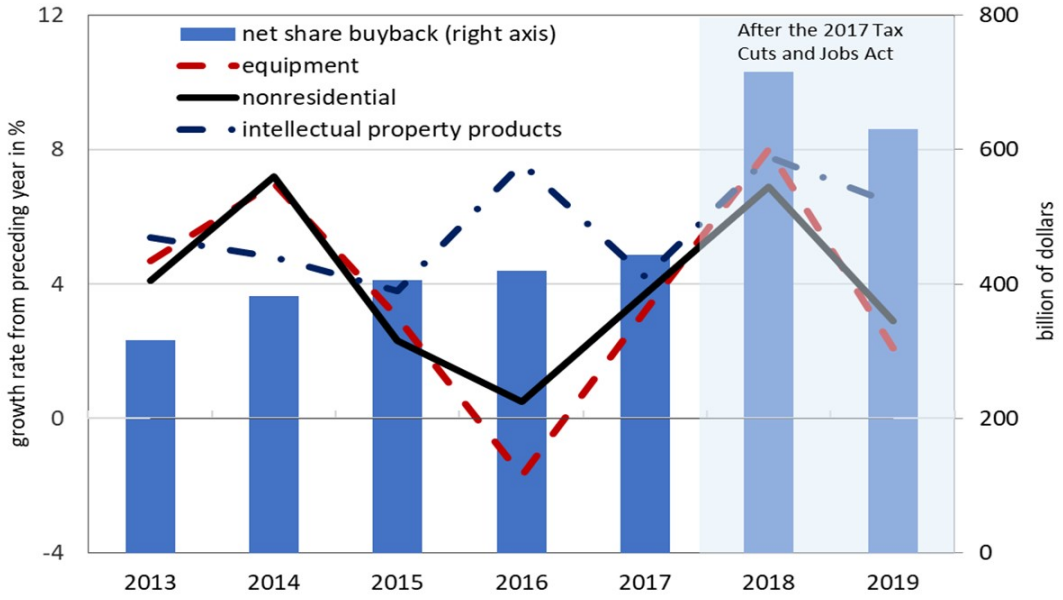

Figure 1: **Annual growth rates of business investment.** All three series are taken from gross private domestic investment in NIPA Table 1.1.1 Bureau of Economic Analysis (2021). Business investment is non-residential investment in gross private domestic investment (line 9). Investment in equipment and intellectual property are subcomponents of business investment (lines 11 and 12).

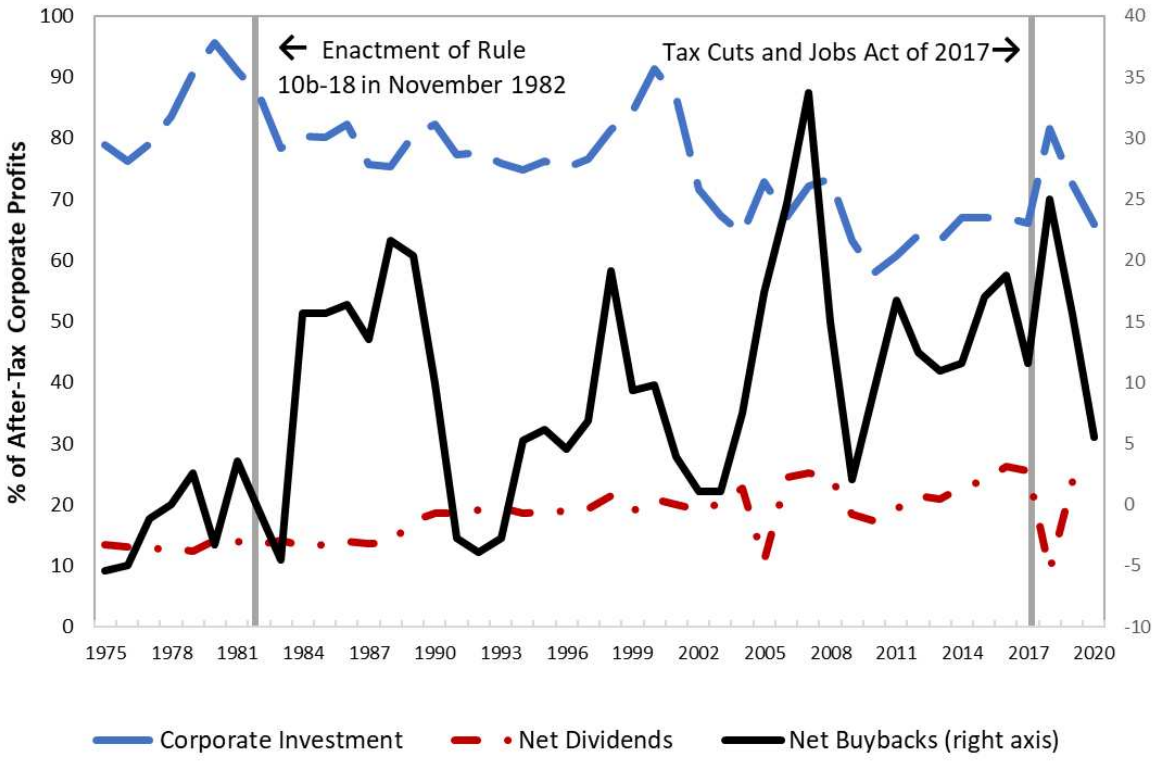

Figure 2: **Share buybacks, corporate investment, and dividends in the U.S.** Buybacks are calculated as the negative net corporate equity issuance. Corporate investment is gross capital formation of non-financial corporations . All three series come from Table F.103 of the Financial Accounts of the United State (Federal Reserve System, 2021). The after-tax corporate profits follow the definition used in De la O (2020).

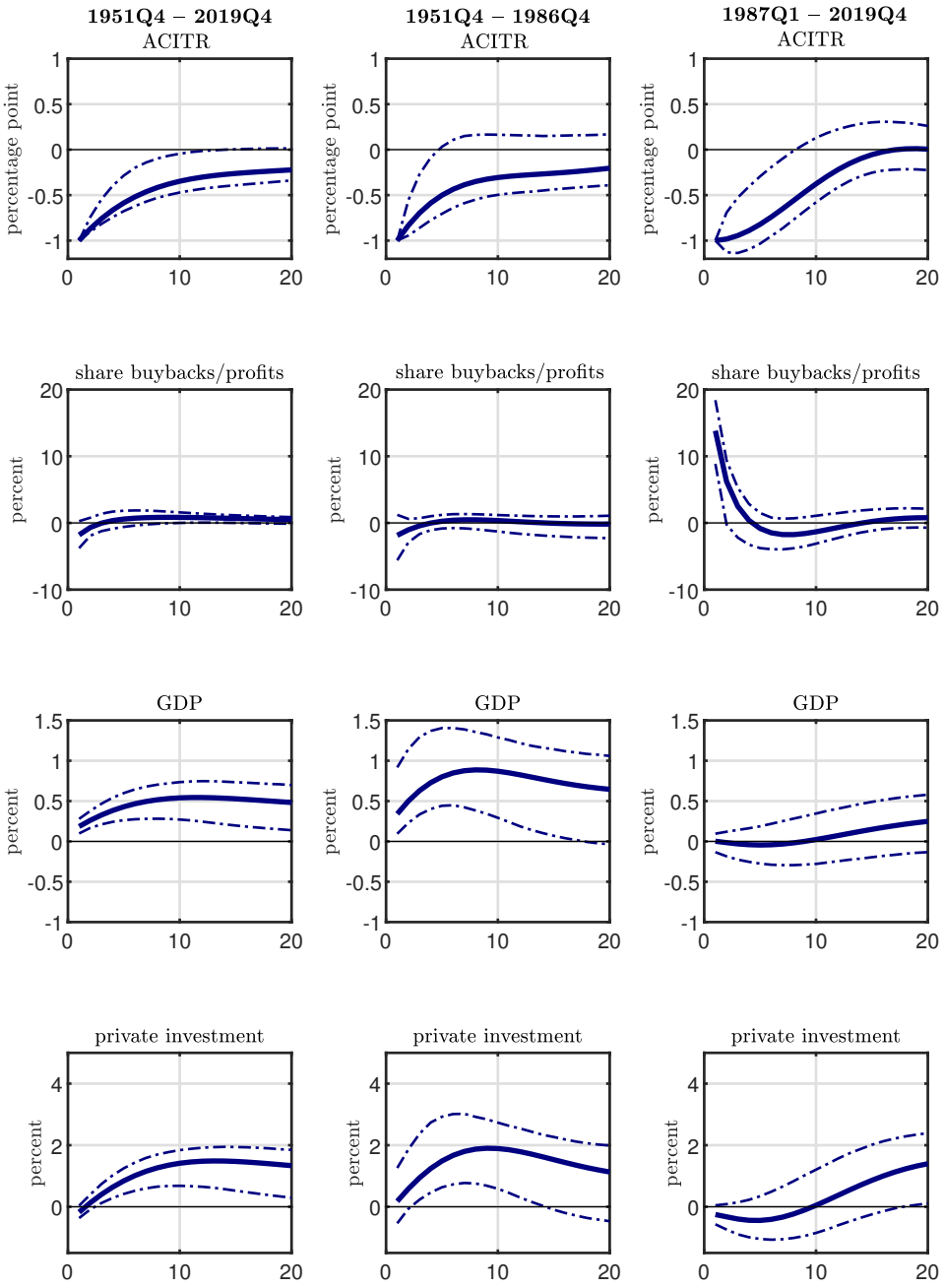

Figure 3: **Responses to an initial corporate tax cut of 1 percentage point.** "ACITR" is the average corporate income tax rate. "Share buybacks" are net share repurchases, and "profits" are the after-tax corporate profits. "Private investment" is the sum of private fixed investment on equipment and intellectual property products. See Appendix B for further details. The dotted-dashed lines are the 95 percent confidence bands. X-axes are in quarters.

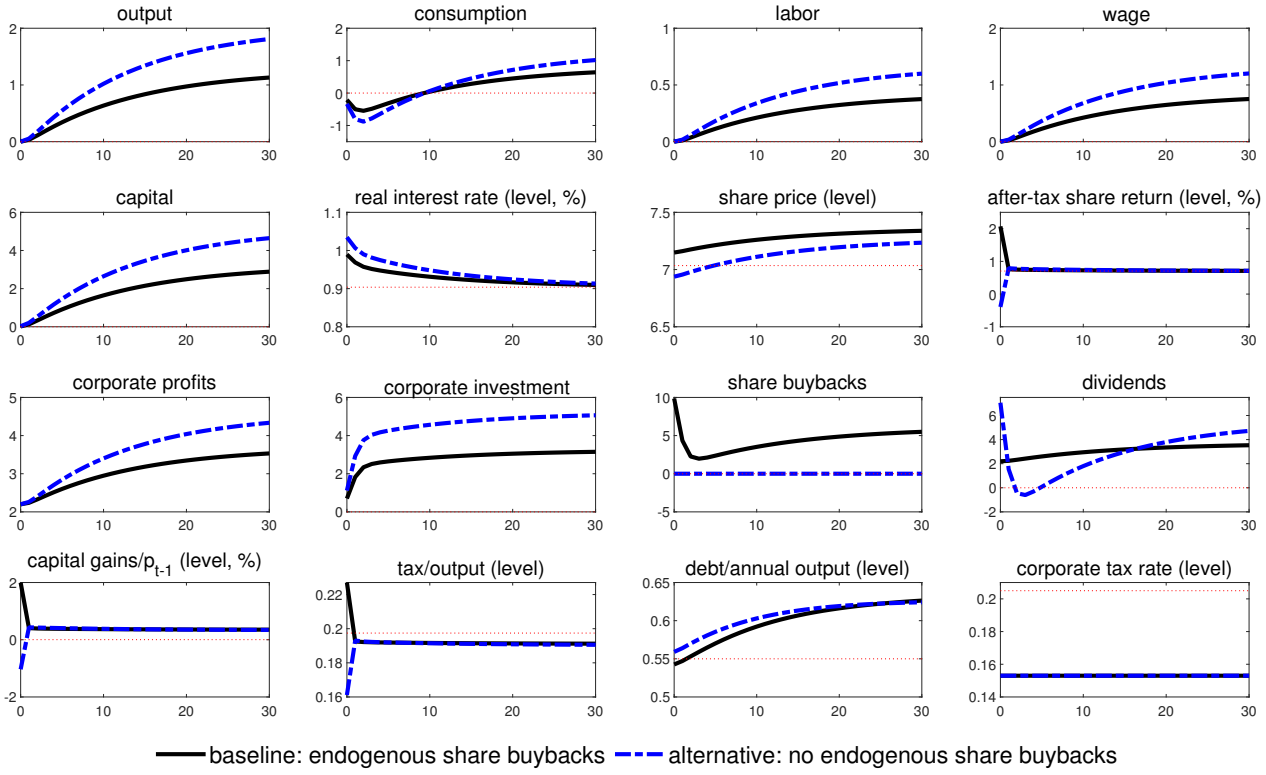

Figure 4: **Impulse responses to a permanent reduction in the corporate tax rate.** The corporate tax rate falls from 0.205 in the initial steady state to 0.153 starting at $t = 0$. The y-axes are in percent deviation from the initial steady state unless specified in parentheses. The x-axes are in years.

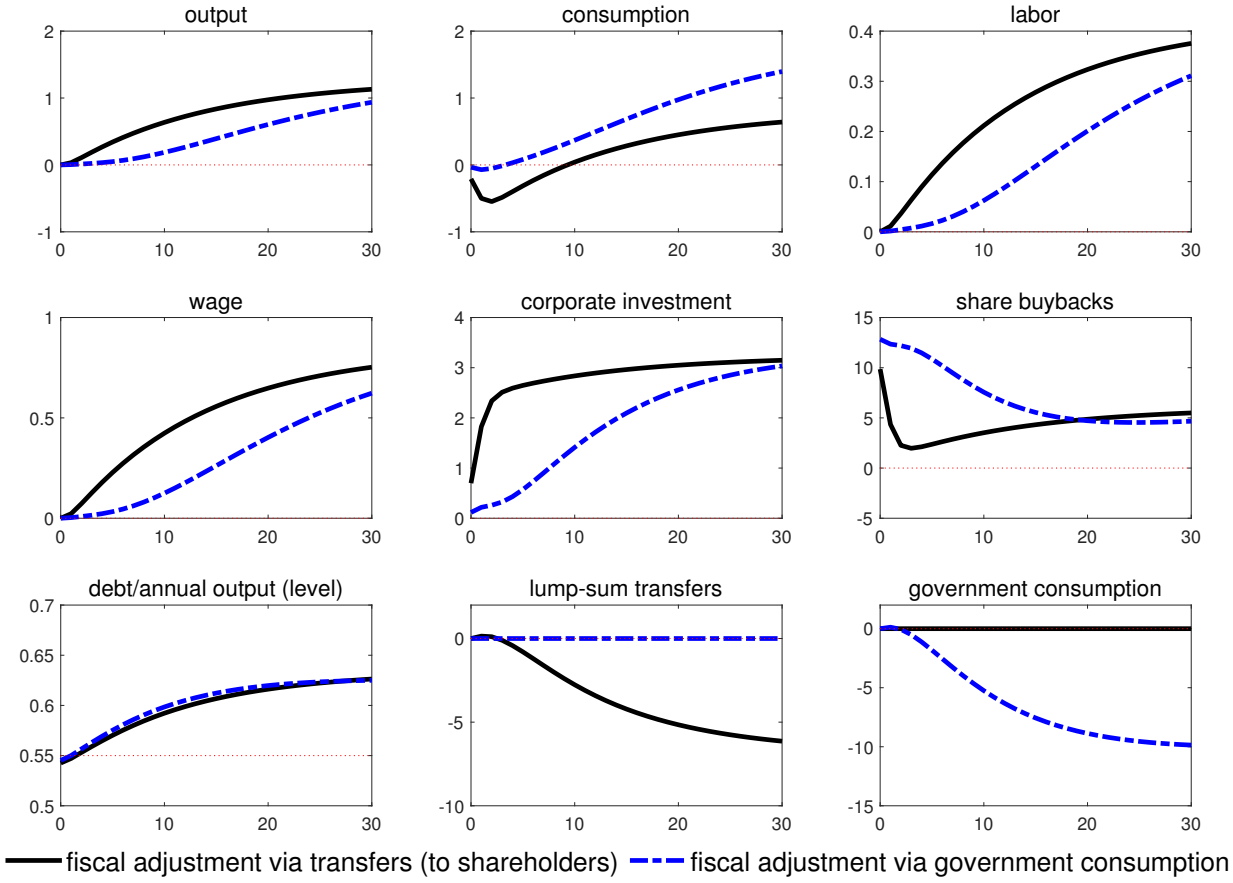

Figure 5: **Sensitivity analysis: government consumption adjustment.** See Figure 4 for the unit and axis description.

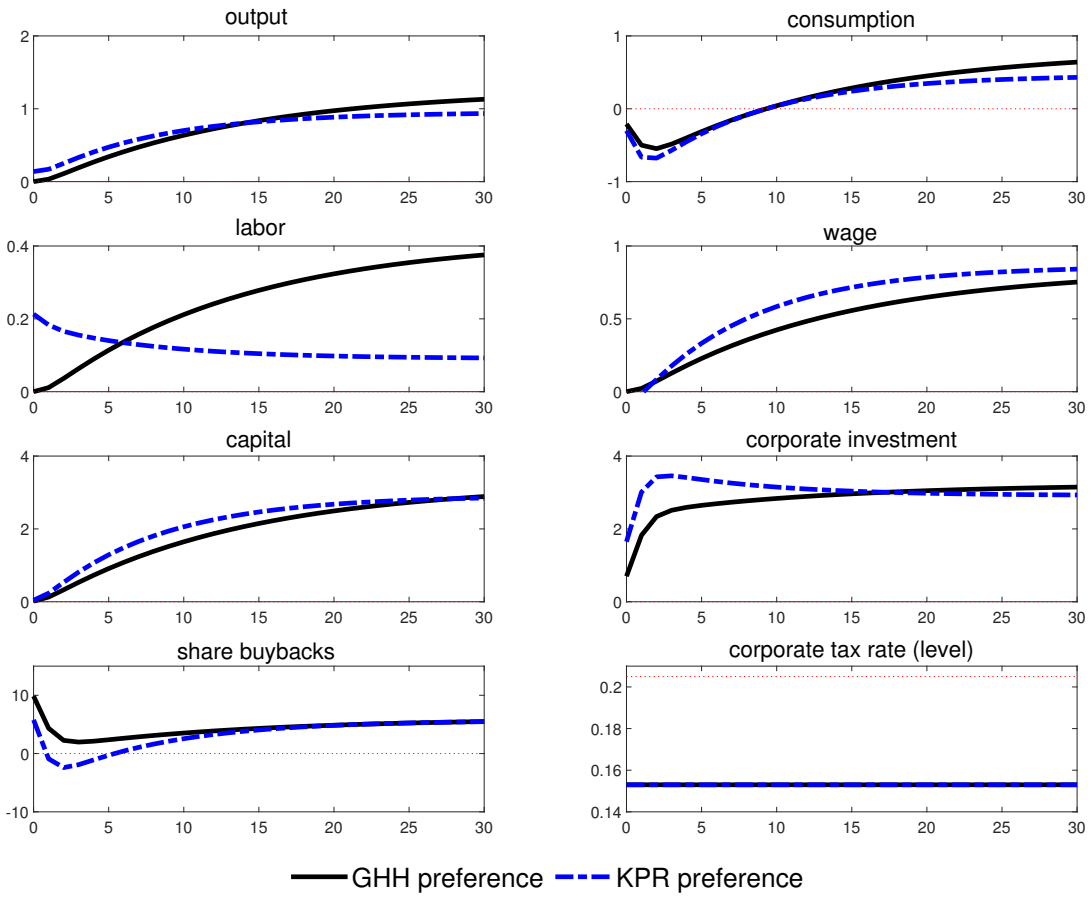

Figure 6: **Sensitivity analysis: KPR preference.** See Figure 4 for the unit and axis description.

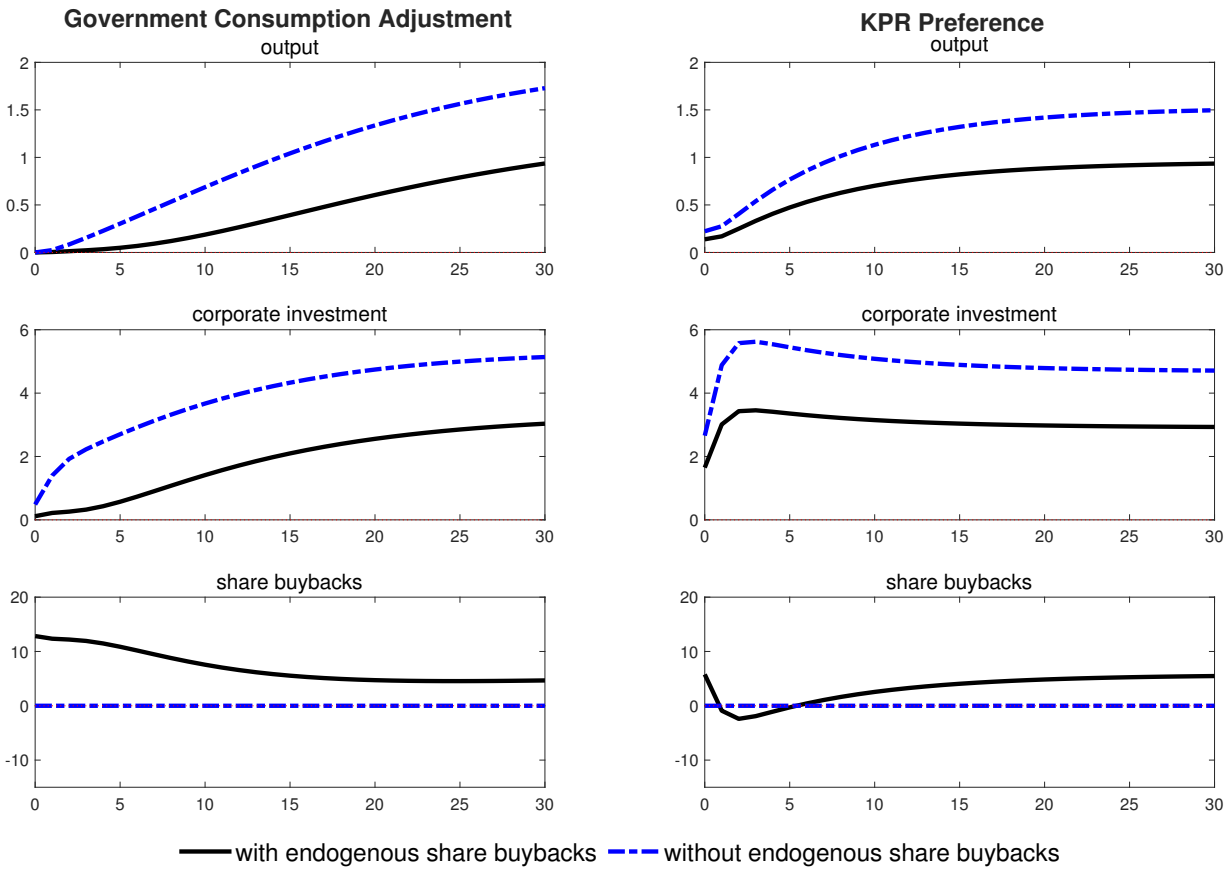

Figure 7: **Sensitivity analysis: the responses of a corporate tax cut with and without endogenous buybacks.** The left (right) column is the responses under government consumption adjustments (the KPR preference). See Figure 4 for the unit and axis description.

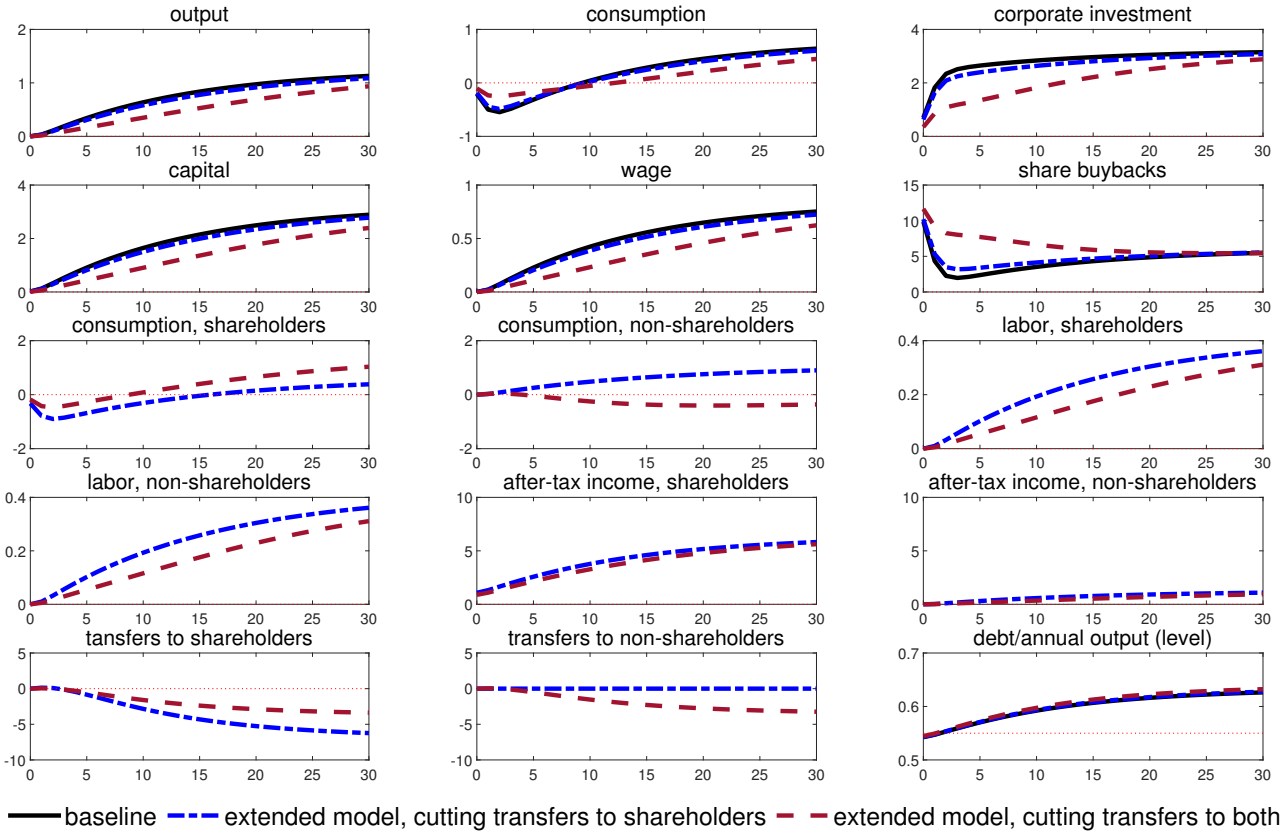

Figure 8: **Distributional effects of a corporate tax cut.** The baseline model has shareholders only, and the extended model has both shareholders and non-shareholders. See Figure 4 for the unit and axis description.

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Online Appendix
"Share Buybacks and Corporate Tax Cuts"

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The online appendix includes the equilibrium system of the baseline model, corporations' optimization problem, and the distributional effects under the KPR preference.

1 The Equilibrium System

This appendix describes the nonlinear equilibrium system and how we solve for the steady state in the baseline model.

1.1 The Nonlinear Equilibrium System

The equilibrium system of the baseline model consists of the following equations.

- Effective consumption:

$$\tilde{c}_t = c_t - hC_{t-1} \tag{1}$$

- Agent's first order condition for consumption:

$$\lambda_t = \left(\tilde{c}_t - \nu l_t^{\kappa}\right)^{-\gamma}, \tag{2}$$

  where λ_t is the Lagrange multiplier for the agent's budget constraint.

- Agent's first order condition for labor supply:

$$\nu\kappa l_t^{\kappa-1} = \left(1-\tau_t^p\right) w_t \tag{3}$$

- Agent's first order condition for government bonds:

$$\lambda_t = \beta E_t \lambda_{t+1} \left(1 + r_{t+1}^b\right), \tag{4}$$

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where $r^b_{t+1} \equiv \left(1-\tau^p_{t+1}\right) r_t$.

- Agent's first order condition for corporate shares:

$$\lambda_t = \beta E_t \lambda_{t+1} \left(1 + r^s_{t+1}\right), \tag{5}$$

where $r^s_{t+1} \equiv \frac{1}{p_t}\left[\left(1-\tau^p_{t+1}\right) d_{t+1} + \left(1-\tau^k_{t+1}\right)\left(p_{t+1}+e_{t+1}-p_t\right)\right]$.

- Corporation's first order condition for labor:

$$w_t = \alpha_l k^{\alpha_k}_{t-1} l^{\alpha_l - 1}_t \tag{6}$$

- Definition of Γ_{t+1}:

$$\Gamma_{t+1} = \left[1 + \frac{\left(1-\tau^p_{t+1}\right) r_t}{\left(1-\tau^k_{t+1}\right)}\right] \tag{7}$$

- The law of motion for capital:

$$k_t = (1-\delta) k_{t-1} + i_t \tag{8}$$

- Corporation's first order condition for capital in the perfect foresight equilibrium:

$$\begin{aligned} q_t = & \\ & \frac{1}{\Gamma_{t+1}} \left\{ \left(\frac{1-\tau^p_{t+1}}{1-\tau^k_{t+1}} - 1 \right) \frac{d_{t+1}}{\pi_{t+1}} \left[\frac{\left(1-\tau^c_{t+1}\right) \alpha_k y_{t+1}}{k_t} + \tau^c_{t+1}\delta + \phi \left(\frac{i_{t+1}}{k_t} - \delta \right) \frac{i_{t+1}}{k_t} \right] \right\} \\ & - \frac{1}{\Gamma_{t+1}} \left(\frac{1-\tau^p_{t+1}}{1-\tau^k_{t+1}} - 1 \right) \frac{d_{t+1}}{\pi_{t+1}} \left[\frac{\phi}{2} \left(\frac{i_{t+1}}{k_t} - \delta \right)^2 \right] + \frac{1}{\Gamma_{t+1}} \left[\frac{\left(1-\tau^c_{t+1}\right) \alpha_k y_{t+1}}{k_t} \right] \\ & + \frac{1}{\Gamma_{t+1}} \left\{ q_{t+1}(1-\delta) + \tau^c_{t+1}\delta + \phi \left(\frac{i_{t+1}}{k_t} - \delta \right) \frac{i_{t+1}}{k_t} - \frac{\phi}{2} \left(\frac{i_{t+1}}{k_t} - \delta \right)^2 \right\}, \end{aligned} \tag{9}$$

where q_t is the Lagrange multiplier for the law of motion for capital, or the shadow price of investment.

- Corporation's first order condition for investment:

$$q_t = 1 + \phi \left(\frac{i_t}{k_{t-1}} - \delta \right) \tag{10}$$

- The production function:

$$y_t = \left(k_{t-1}\right)^{\alpha_k} \left(l_t\right)^{\alpha_l} \tag{11}$$

- Ex-dividend value of corporate shares:

$$p_t = \frac{E_t\left[\left(1-\tau_{t+1}^p\right)d_{t+1} + \left(1-\tau_{t+1}^k\right)\left(p_{t+1}+e_{t+1}-p_t\right)\right]}{E_t\left[1+r_t\left(1-\tau_{t+1}^p\right)\right]} \tag{12}$$

- Corporate profits:

$$\pi_t = \left(1-\tau_t^c\right)\left(y_t - w_t l_t\right) + \tau_t^c \delta k_{t-1} - \frac{\phi}{2}\left(\frac{i_t}{k_{t-1}} - \delta\right)^2 k_{t-1} \tag{13}$$

- Corporate savings:

$$\mathfrak{s}_t = \pi_t - d_t \tag{14}$$

- Funds for investment:

$$i_t = \mathfrak{s}_t - e_t \tag{15}$$

- Corporation's cash flow constraint:

$$e_t + i_t + d_t + \frac{\phi}{2}\left(\frac{i_t}{k_{t-1}} - \delta\right)^2 k_{t-1} = \left(1-\tau_t^c\right)\left(y_t - w_t l_t\right) + \tau_t^c \delta k_{t-1} \tag{16}$$

- Dividend payout:

$$d_t = \xi \pi_t \tag{17}$$

- Government's flow budget constraint:

$$\begin{aligned} & b_t + \tau_t^p(w_t l_t + r_{t-1} b_{t-1} + d_t) + \tau_t^k\left(p_t + e_t - p_{t-1}\right) + \tau_t^c(y_t - w_t l_t) - \tau_t^c \delta k_{t-1} \\ =& g_t + z_t + \left(1+r_{t-1}\right) b_{t-1} \end{aligned} \tag{18}$$

- corporate tax rule:

$$\tau_t^c = \tau^c - \epsilon \tag{19}$$

- Transfer rule:

$$\frac{z_t}{z} = \left(\frac{z_{t-1}}{z}\right)^{\rho}\left(\frac{s_{t-1}^b}{s^b}\right)^{-\omega_z}, \tag{20}$$

  where $s_{t-1}^b = \frac{b_{t-1}}{y_{t-1}}$.

- Goods market clearing condition:

$$y_t = c_t + g_t + i_t + \frac{\phi}{2}\left(\frac{i_t}{k_{t-1}} - \delta\right)^2 k_{t-1} \tag{21}$$

1.2 Steady State

We denote steady-state values by variables without a time subscript. In the model with the representative agent, we have $c = C$. Given the calibrated values in Table 1 in the paper and for an initial guess of $\frac{k}{y}$ and π, we first compute the following steady-state values:

$$r = \frac{1-\beta}{\beta\left(1-\tau^{p}\right)} \tag{22}$$

$$\Gamma = 1 + r\left(\frac{1-\tau^{p}}{1-\tau^{k}}\right) \tag{23}$$

$$\frac{i}{y} = \delta\frac{k}{y} \tag{24}$$

$$\frac{c}{y} = 1 - \frac{i}{y} - \frac{g}{y} \tag{25}$$

$$y = \left[\left(\frac{k}{y}\right)^{\alpha_k}(l)^{\alpha_l}\right]^{\frac{1}{1-\alpha_k}} \tag{26}$$

$$k = y \times \frac{k}{y}; \qquad i = y \times \frac{i}{y}; \qquad c = y \times \frac{c}{y} \tag{27}$$

$$w = \alpha_l\left(k^{\alpha_k}\right)\left(l^{\alpha_l - 1}\right) \tag{28}$$

$$\nu = \left[\frac{w\left(1-\tau^{p}\right)}{\kappa l^{\kappa-1}}\right] \tag{29}$$

$$q = 1 \tag{30}$$

$$\lambda = \left[(1-h)\,c - \nu l^{\kappa}\right]^{-\gamma} \tag{31}$$

$$e = \pi \times \frac{e}{\pi} \tag{32}$$

$$d = (1-\tau^{c})(y - wl) - e + \tau^{c}\delta k - i \tag{33}$$

$$\xi = \frac{d}{\pi} \tag{34}$$

$$\frac{i}{\pi} = 1 - \xi - \frac{e}{\pi} \tag{35}$$

$$p = \frac{\left(\frac{1-\tau^{p}}{1-\tau^{k}}\right)d + e}{\Gamma - 1} \tag{36}$$

$$\mathfrak{s} = e + i \tag{37}$$

$$\frac{z}{y} = s^{b} + \tau^{p}\left(w\frac{l}{y} + rs^{b} + \frac{d}{y}\right) + \tau^{k}\frac{e}{y} + \tau^{c}\left(\frac{y - wl}{y}\right) - \tau^{c}\delta\frac{k}{y} - \frac{g}{y} - (1+r)\,s^{b} \tag{38}$$

The following two equations are used to solve for $\frac{k}{y}$ and π:

$$\pi = \mathfrak{s} + d \tag{39}$$

and

$$\frac{k}{y} = \frac{(1-\tau^c)\,\alpha_k \left[\left(\frac{1-\tau^p}{1-\tau^k}-1\right)\frac{d}{\pi}+1\right]}{q\Gamma - \left(\frac{1-\tau^p}{1-\tau^k}-1\right)\frac{d}{\pi}\tau^c\delta - q\,(1-\delta) - \tau^c\delta}. \tag{40}$$

2 The Corporation's Optimization Problem

This section drives the Tobin's q and the user cost of investment for the baseline and alternative models.

2.1 The Baseline Model

The Lagrangian for the corporation's optimization problem is rewritten as

$$\mathcal{L} = \sum_{j=0}^{\infty} \times$$
$$E_t \frac{1}{\Gamma_{t+j}} \left\{ \begin{array}{l} \left(\frac{1-\tau^p_{t+j}}{1-\tau^k_{t+j}}\right) d_{t+j} + e_{t+j} + \\ q_{t+j}\left[(1-\delta)k_{t+j-1} + i_{t+j} - k_{t+j}\right] + \\ \chi_{t+j}\left[\left(1-\tau^c_{t+j}\right)\left(k^{\alpha_k}_{t+j-1} l^{\alpha_l}_{t+j} - w_{t+j} l_{t+j}\right) + \tau^c_{t+j}\delta k_{t+j-1} - \frac{\phi}{2}\left(\frac{i_{t+j}}{k_{t+j-1}} - \delta\right)^2 k_{t+j-1} - i_{t+j} - e_{t+j} - d_{t+j}\right] \end{array} \right\},$$

where q_{t+j} and χ_{t+j} are the Lagrangian multipliers associated with the law of motion for capital and the cash flow constraint, and

$$\Gamma_{t+j} \equiv \prod_{s=0}^{j-1}\left[1 + r_{t+s}\left(\frac{1-\tau^p_{t+s+1}}{1-\tau^k_{t+s+1}}\right)\right] \text{ for } j \geq 0, \text{ and } \Gamma_t = 1. \tag{41}$$

The first order conditions with respect to k_t, i_t, and e_t can be combined as follows

$$\begin{aligned} q_t =& E_t \frac{1}{\Gamma_{t+1}} \left\{ \left(\frac{1-\tau^p_{t+1}}{1-\tau^k_{t+1}} - 1\right) \frac{d_{t+1}}{\pi_{t+1}} \left[\frac{\left(1-\tau^c_{t+1}\right)\alpha_k y_{t+1}}{k_t} + \tau^c_{t+1}\delta + \phi\left(\frac{i_{t+1}}{k_t} - \delta\right)\frac{i_{t+1}}{k_t}\right] \right\} \\ & - E_t \frac{1}{\Gamma_{t+1}} \left(\frac{1-\tau^p_{t+1}}{1-\tau^k_{t+1}} - 1\right) \frac{d_{t+1}}{\pi_{t+1}} \left[\frac{\phi}{2}\left(\frac{i_{t+1}}{k_t} - \delta\right)^2\right] + E_t \frac{1}{\Gamma_{t+1}} \left[\frac{\left(1-\tau^c_{t+1}\right)\alpha_k y_{t+1}}{k_t}\right] \\ & + E_t \frac{1}{\Gamma_{t+1}} \left\{ q_{t+1}(1-\delta) + \tau^c_{t+1}\delta + \phi\left(\frac{i_{t+1}}{k_t} - \delta\right)\frac{i_{t+1}}{k_t} - \frac{\phi}{2}\left(\frac{i_{t+1}}{k_t} - \delta\right)^2 \right\}; \end{aligned} \tag{42}$$

$$q_t = 1 + \left[1 + \frac{1-\tau^p_t}{1-\tau^k_t}\xi\right]\phi\left(\frac{i_t}{k_{t-1}} - \delta\right). \tag{43}$$

2.2 The Alternative Model

In the alternative model without additional share buybacks ($e_t = e \; \forall \; t$), equations (42) and (43) are modified as

$$q_t = E_t \frac{1}{\Gamma_{t+1}} \left\{ \left(\frac{1-\tau^p_{t+1}}{1-\tau^k_{t+1}} \right) \left[\frac{\left(1-\tau^c_{t+1}\right) \alpha_k y_{t+1}}{k_t} + \tau^c_{t+1} \delta + \phi \left(\frac{i_{t+1}}{k_t} - \delta \right) \frac{i_{t+1}}{k_t} - \frac{\phi}{2} \left(\frac{i_{t+1}}{k_t} - \delta \right)^2 \right] \right\} + E_t \frac{1}{\Gamma_{t+1}} q_{t+1} \left(1-\delta\right); \tag{44}$$

$$q_t = \left(\frac{1-\tau^p_t}{1-\tau^k_t} \right) \left[1 + \phi \left(\frac{i_t}{k_{t-1}} - \delta \right) \right]. \tag{45}$$

3 Distributional Effects under the KPR Preference

To see whether the wealth effect on labor supply can change the distributional effects of the tax cut, we simulate the extended model under the KPR preference with transfer adjustments for shareholders alone and for both shareholders and non-shareholders. We follow the specification in Section 5.3.2 and the same calibration as in the extended model under the GHH preference ($\mu = 0.49$ and $l^{\mathrm{n}} = l^{\mathrm{s}} = 0.2$). Figures 1 and 2 in this Online Appendix compare consumption, labor, and after-tax income under two fiscal adjustment mechanisms.

Under the KPR preference with transfer adjustments for shareholders, non-shareholders' labor response (the dashed line) changes little relative to the much positive response under the GHH preference (the solid line). This is due to rising consumption under the KPR preference, which induces a negative wealth effect on labor supply. Despite little labor response, the increase magnitudes in non-shareholders' after-tax income are similar. As the overall aggregate labor supply does not increase as much under the KPR preference for most periods, the wage rate increases more than under the GHH preference. Since the after-tax income increases by about the same magnitudes, non-shareholders' consumption has similar positive responses between the two preference.

When transfer adjustments for both types of agents, the KPR preference yields negative consumption response for the non-shareholders, as under the GHH preference. In summary, whether a permanent corporate tax cut can improve non-shareholders' consumption depends crucially on the financing mechanisms, as found in the paper.

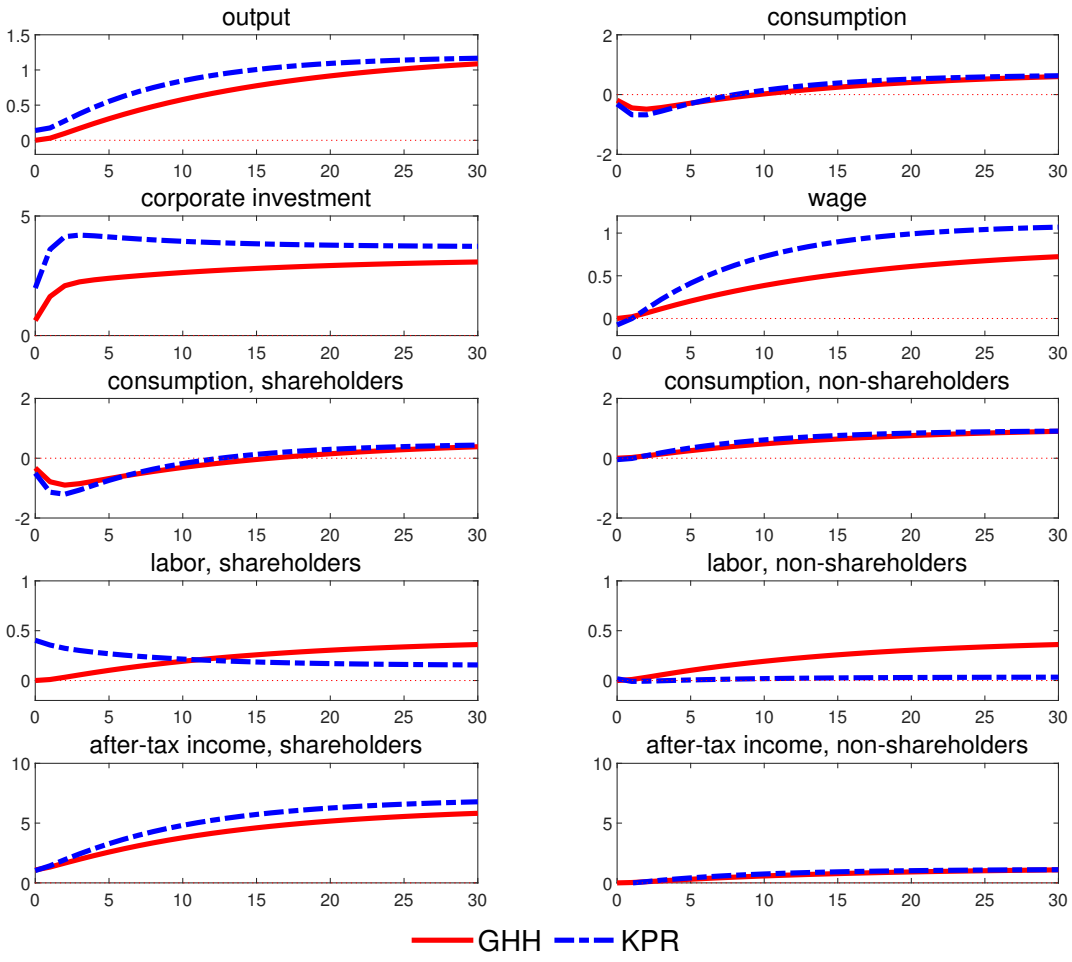

Figure 1: **The effects of a corporate tax cut: the extended model with a reduction in transfers to shareholders.** The magnitude of the tax cut is 5.2 percentage points. The y-axes are in percent deviation from the initial steady state. The x-axes are in years.

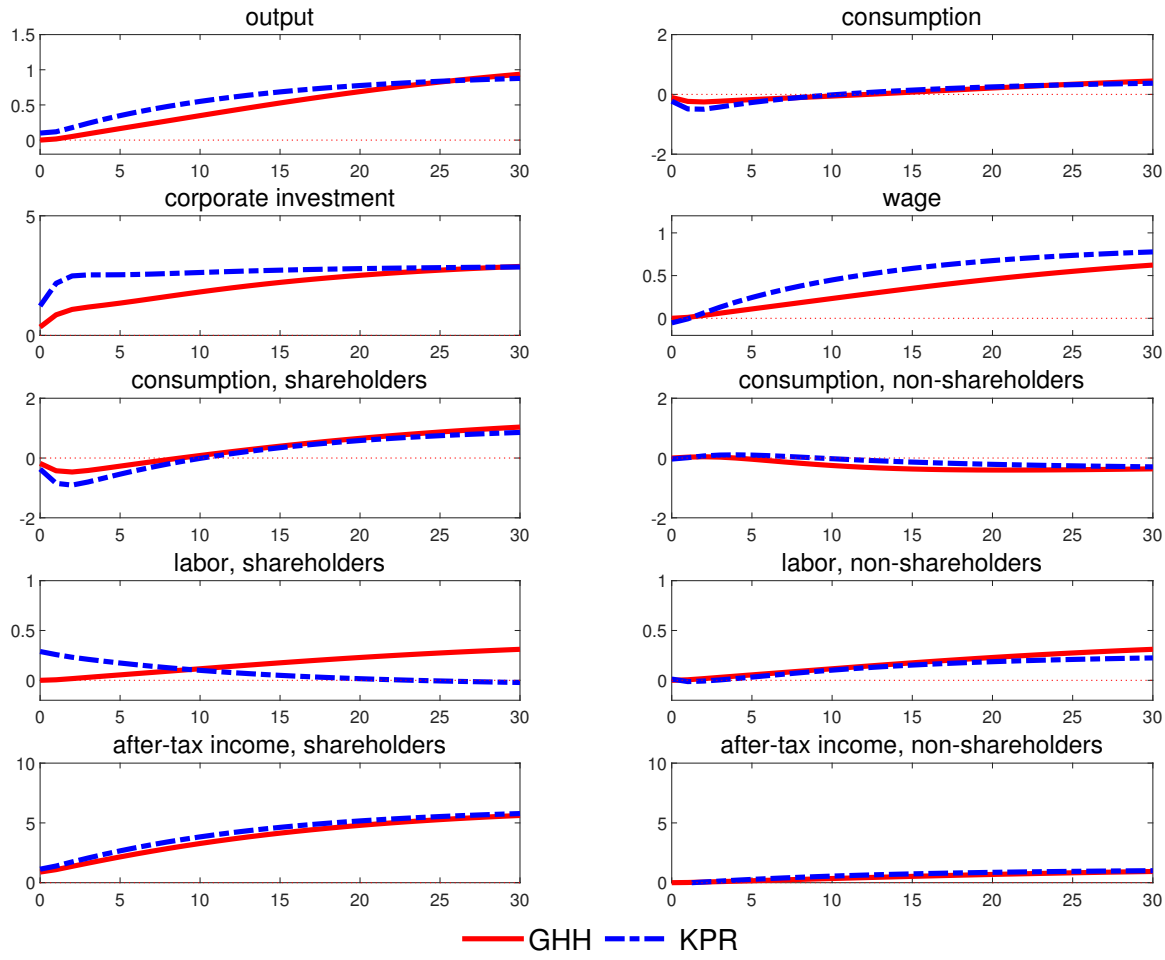

Figure 2: **The effects of a corporate tax cut: the extended model with a reduction in transfers to both shareholders and non-shareholders.** The magnitude of the tax cut is 5.2 percentage points. The y-axes are in percent deviation from the initial steady state. The x-axes are in years.

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