Dynamic Analysis of Corporate Income Tax Rate Cut

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Abstract: *This Quantitative Note uses the OG-USA open source dynamic general equilibrium overlapping generations model to simulate the effect of cutting the U.S. corporate income tax rate from 35% to 20%. I simulate this rate cut under the assumptions of a closed economy and small open economy, respectively. In both cases, the corporate rate cut causes government revenues to decrease and the debt-to-GDP ratio to increase. In the small open economy scenario, GDP and wages increase by around 3.0%, and 2.5%, respectively. However, in the closed economy setting in which the increased debt service must be satisfied by domestic savings (crowding out), the GDP and wage gains are much smaller and short lived.*

Cutting the U.S. corporate income tax rate has been a central characteristic of business tax reform since the 1950s.[1] All versions of the current Tax Cuts and Jobs Act (TCJA) include a reduction in the corporate income tax rate from 35 percent to 20 percent.[2]

In anticipation of and in response to the TCJA, many recent articles have focused on the effect of a corporate income tax rate cut on wages.[3] In particular, one theoretical result is that every dollar cut to taxes on capital or corporate income can raise wages by more than a dollar. However, the size of this effect and even its sign depend critically on the underlying assumptions of the model. Furthermore, wages are one of many potential macroeconomic measures that influence household welfare and tax incidence, not to mention microeconomic measures.

In this *Quantitative Note*, I use use the OG-USA open source dynamic general equilibrium overlapping generations model of the U.S. economy to perform a dynamic simulation of the effects of a reduction in the corporate income tax rate from 35 percent to 20 percent.[4] I will describe the predicted effects on key macroeconomic variables, prices, government fiscal measures, as well as household responses by age and lifetime income.

A virtue of dynamic models that can sometimes be confusing is that an economy cannot run deficits that grow faster than GDP indefinitely. In other words, we cannot study the corporate income tax rate cut in pure isolation or else the debt levels of the economy would go to infinity and eventually consume all its resources. The closest we can come is to cut the corporate income tax rate and then impose a stabilizing adjustment to the government income statement years down the road. The default in OG-USA is a cut in government spending on public goods 20 years after the tax cut that gradually stabilizes the debt-to-GDP ratio at 1.0. This experiment is nice because the change in government spending is the least distortionary policy lever. Because of this internal consistency requirement of OG-USA, our results must be interpreted as the effect of permanently cutting the corporate income tax rate followed by a cut in government spending in 2038. All long-run results include the cut in spending, but short-run results over the next 20 years primarily reflect the effects of the tax cut.

As a final detail, it is important to note a key element that is not included in the OG-USA model. OG-USA does not currently

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[1] See Gravelle (2004, 2014) and Hungerford (2013).

[2] The Tax Cuts and Jobs Act (TCJA) was introduced in the U.S. House of Representatives on November 2, 2017, and is currently being revised by both the House and the Senate. Thorough summaries of the details of the TCJA can be found from the Tax Policy Center at http://www.taxpolicycenter.org/publications/preliminary-distributional-analysis-tax-cuts-and-jobs-act/full and from the Tax Foundation at https://taxfoundation.org/details-tax-cuts-jobs-act/.

[3] See Mankiw (October 18, 2017b), Mankiw (October 24, 2017a), Mulligan (October 18, 2017), Cochrane (October 21, 2017c), Cochrane (October 27, 2017a), Cochrane (October 27, 2017b), Summers (October 22, 2017), and Landsburg (October 22, 2017).

[4] OG-USA also makes use of the Tax-Calculator open source microsimulation model to incorporate the current U.S. tax code on households into the dynamic model.

have the ability to model profit shifting behavior of firms moving the accounting for business income across sovereign boundaries to take advantage of lower tax treatments. Recent work highlights the importance of this assumption in the predicted effects of a corporate income tax rate cut.[5] When profit shifting is highly responsive to changes in the corporate income tax rate, lost revenue from a rate cut could be offset by more corporate income entering the country. If firms' profit shifting is not responsive to the corporate income tax rate, a rate cut results in lost revenue. The degree to which profit shifting is responsive is still a matter of debate and is an open empirical question. Our results should be interpreted as what would likely happen if firms profit shifting does not significantly respond to the corporate income tax rate cut.

Tables 1 and 2 show the percent change from the baseline to the reform in macroeconomic variables, prices, and fiscal variables over the first 10 years, the 10-year average, and long-run values (steady-state) under a closed economy assumption versus a small open economy assumption, respectively. Figure 1 shows the same percent changes over a 60-year time path, after which point the economy is close to its long-run steady state. The respective vertical black lines at $t = 2038$ in each panel of Figure 1 represent the period in which government spending adjusts in order to begin stabilizing the debt-to-GDP ratio to return to $D_t/Y_t = 1.0$.

1. Closed vs. Open Economy

Although OG-USA does not model profit shifting by firms, we capture two extremes in terms of capital's ability to move across borders. In the closed economy version of OG-USA, capital demand by firms K_t^D plus the government debt D_t (lending to firms and lending to government) must equal capital supplied by household savings K_t^S.

$$\text{(closed economy)} \qquad K_t^D + D_t = K_t^S \quad \forall t \tag{1}$$

If something causes firms' demand for capital or government debt to increase, the interest rate will likely rise, mitigating the degree to which capital supplied must rise. In a closed economy setting, government debt has the maximum potential to crowd out investment because the increased deficits divert household savings and thereby reduce investment.

At the other extreme is the assumption of a small open economy. In this case, the interest rate is assumed to be the world interest rate r^* and capital supply is perfectly elastic. Foreign capital K^F can freely flow into and out of the country to make up for any deficits or surpluses in net domestic capital supply.

$$\text{(small open economy)} \quad K_t^D + D_t = K_t^S + K_t^F \quad \forall t \tag{2}$$

[5] See Pomerleau (June 7, 2017) and Benzell et al. (2017).

In a small open economy setting, government debt has the minimum potential to crowd out investment because the supply of capital is perfectly elastic. Any increase in the demand for capital—either from domestic firms or from new government debt—can be met by the free inflow of capital from abroad K_t^F.

By comparing the simulated effect of a cut in the corporate income tax rate from 35 percent to 20 percent using OG-USA with a closed economy assumption versus a small open economy assumption, I capture the two extremes of how much such a policy can stimulate the U.S. economy.

2. Government Revenue, Debt, and Spending

Under both the closed economy and small open economy assumptions, the corporate income tax rate cut causes revenue to fall by between 6 percent and 9 percent each year, and the debt-to-GDP ratio rises over 30 percentage points in 20 years. Government spending as a percent of GDP must be cut by 5 percentage points in 2038 in order to stabilize the debt-to-GDP ratio at 1.0 in the long run.[6]

The loss in revenue from the corporate income tax cut is smaller in the closed economy case (-7% per year versus -9% per year) because household savings and, therefore, taxable capital income rise by more in the closed economy case. In the closed economy, it is the domestic households who must supply all the capital for the increased capital demand by firms and the increased government debt burden.

3. Capital, Investment, Output

In the closed economy scenario, the rate cut causes an immediate increase in the demand for capital, both from firms and from government debt. However, a large increase in the interest rate of 12% in 2018 (from 6.5% to 7.25%) reduces firm demand but increases the debt service over time. Figure 1a shows that the crowding out of the increased debt burden starts to cause investment to decline and the capital stock to peak about 10 years after the tax cut, between 2026 and 2028. It takes closer to 20 years before the crowding out of the debt service actually reduces GDP. But the average annual increase in GDP in the reform over the baseline over the 10-year budget window is a modest 1.2%.

Under the small open economy assumption the capital, investment, and output gains are understandably more pronounced. With interest rates fixed, the cut in the corporate income tax

[6] Some adjustment in government spending, taxes, or transfers is necessary to stabilize the model so that government debt does not go off to infinity and eventually consume all the resources of the economy. This is called a budget closure rule. I chose a decrease in government spending 20 years after the tax cut because it is the least distortionary policy change.

rate immediately increases capital demand. The increased government debt burden is satisfied by an inflow of foreign capital. Household savings is not crowded out, investment rises, capital stock rises, and output rises. The increases in the capital stock and output are most pronounced in the first period in this case, with the capital stock rising 9% above the baseline and GDP rising 4% above the baseline. But the long-run increases are notable. If foreign capital will flow freely into the U.S., a corporate rate cut can have tremendous benefits.

4. Wages and Employment

Figures 1c and 1d show the simulated effects of the corporate income tax rate cut on interest rates and average wages under the closed economy and open economy assumptions, respectively. In both cases, the corporate rate cut increases capital demand by domestic firms. As was previously noted in the closed economy case, the corporate rate cut causes a large initial rise in the interest rate, mitigating the increase in captial demand by firms. The large rise in interest rates causes many households to increase labor supply in the early periods, which results in a capital labor ratio that is declining initially. For this reason, we see average wages initially decline. But by 2020, the increase in the capital stock outstrips the increases in labor and average wages begin to rise. We see this upward trend in wages start to reverse in the closed economy around 2030 as a result of the crowding out of investment. And the effect on wages would be slightly negative after 2038 were it not for the large cut in government spending to stabilize the debt-to-GDP ratio.

The wage in the small open economy scenario is much more simple and mechanical, as shown in Figure 1d. The corporate rate cut increases capital demand by firms. Because the interest rate is fixed at the world rate, the capital-labor ratio rises, and the wage rises by 2.5%.

5. Concluding Remarks

In both the closed economy and small open economy simulations, output and wages experience short-term gains. And those gains are more pronounced in the first 20 years in the small open economy case. The gains are much larger in the long-run in the closed economy case because all the efficiency gains from the rate cut are entirely captured by the domestic economy, as opposed to some of the gains being exported to foreign investors in the small open economy case.

It is likely that the true nature of the U.S. economy lies somewhere between the two extremes presented here of the closed economy and small open economy assumptions. The question is how freely does capital flow into and out of the United States? If one believes that capital frictions are minimal, then the optimistic results of the small open economy analysis are the most likely. If one believes that capital supply is much less elastic, then there is a chance for significant crowding out in the medium term of investment and output from the reduction in the corporate income tax rate.

Even in the small open economy case, the increase in the debt-to-GDP ratio and the required 5-percentage-point cut in 2038 in government spending on public goods as a percent of GDP to stabilize the economy begs the question of how disruptive that might be.

Modeling Notes

OG-USA

OG-USA is an open source dynamic general equilibrium overlapping generations model of the U.S. economy. The OG-USA model is written in Python and includes realistic demographics, productivity growth, household response to consumption, labor supply, and savings, intended and unintended bequests, realistic household taxes, government ability to run deficits and surpluses, and a closed economy or small open economy option. All documentation and code are available in the OG-USA GitHub repository (https://github.com/open-source-economics/OG-USA).

Tax-Calculator

Tax-Calculator (release 0.13.2) is an open source microsimulation model that is able to simulate a rich set of policy changes to the U.S. federal individual income tax system. In conjunction with micro data that represent the U.S. population and a set of behavioral assumptions, Tax-Calculator can be used to conduct static revenue scoring and distributional analyses of tax policies. Tax-Calculator is written in Python, an interpreted language that can execute on Windows, Mac, or Linux. Tax-Calculator can be run using the Public Use File (PUF) from the IRS Statistics of Income Group or using a Current Population Survey matched dataset. All documentation and code are available in the Tax-Calculator GitHub repository (https://github.com/open-source-economics/Tax-Calculator).

Modeling Assumptions

The simulations from Tax-Calculator include assumptions about tax filer behavioral responses to policy changes as well as an assumption about the growth in the Consumer Price Index (CPI) chained measure of inflation.

Table 1. Time path and steady-state percent changes for macroeconomic variables from corporate income tax rate cut, closed economy

Macro	Year										Avg.	Steady
var.[a]	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	10-yr	state
Y_t	1.12%	1.20%	1.26%	1.28%	1.29%	1.27%	1.23%	1.17%	1.09%	0.96%	1.19%	3.28%
C_t	-2.01%	-1.43%	-0.95%	-0.55%	-0.22%	0.05%	0.28%	0.47%	0.62%	0.78%	-0.30%	3.10%
I_t	9.31%	7.98%	6.91%	6.04%	5.22%	4.44%	3.74%	3.03%	2.30%	1.45%	5.04%	10.56%
K_t	-0.24%	0.65%	1.34%	1.87%	2.25%	2.53%	2.71%	2.80%	2.83%	2.79%	1.95%	10.48%
L_t	1.86%	1.49%	1.21%	0.96%	0.78%	0.61%	0.45%	0.31%	0.16%	-0.01%	0.78%	-0.39%
w_t	-0.73%	-0.29%	0.05%	0.31%	0.51%	0.66%	0.78%	0.86%	0.92%	0.97%	0.40%	3.69%
r_t	12.58%	11.11%	9.98%	9.09%	8.42%	7.89%	7.49%	7.21%	7.00%	6.83%	8.76%	-2.03%
Rev_t	-7.73%	-7.21%	-7.03%	-7.02%	-7.09%	-7.07%	-7.01%	-6.83%	-6.66%	-6.11%	-6.98%	-7.52%
D_t/Y_t[b]	0.00%	1.85%	3.59%	5.30%	7.01%	8.75%	10.50%	12.27%	14.03%	15.80%	7.91%	-0.00%
G_t/Y_t[b]	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-1.48%

[a] The macroeconomic variables in the table are GDP (Y_t), aggregate consumption (C_t), aggregate investment (I_t), aggregate capital stock (K_t), aggregate labor (L_t), average wage (w_t), interest rate or rate of return on savings (r_t), government revenue (Rev_t), government debt (D_t), government spending on public goods (G_t), debt-to-GDP ratio (D_t/Y_t), and government spending as a percent of GDP (G_t/Y_t).

[b] The changes in debt-to-GDP ratio (D_t/Y_t) and government spending as a percent of GDP (G_t/Y_t) are reported as percentage point differences (simple differences) rather than percent changes to avoid zeros in the denominator.

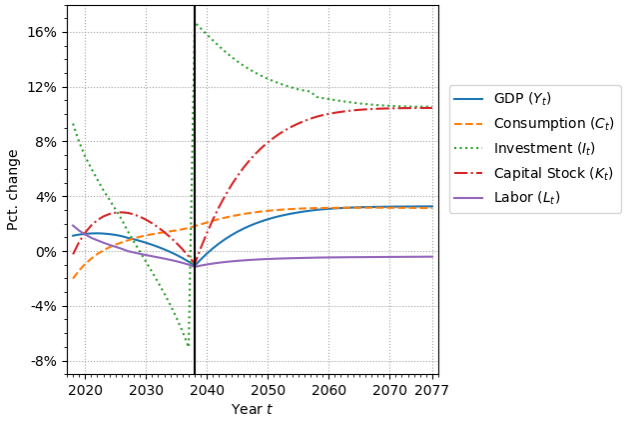
Table 2. Time path and steady-state percent changes for macroeconomic variables from corporate income tax rate cut, small open economy

Macro	Year										Avg.	Steady
var.[a]	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	10-yr	state
Y_t	4.04%	3.70%	3.47%	3.27%	3.14%	3.02%	2.91%	2.83%	2.73%	2.61%	3.17%	2.23%
C_t	0.55%	0.82%	1.02%	1.18%	1.30%	1.40%	1.48%	1.54%	1.59%	1.64%	1.25%	2.20%
I_t	4.86%	5.72%	5.97%	6.63%	6.56%	6.62%	6.71%	6.54%	6.10%	7.01%	6.27%	7.14%
K_t	9.03%	8.68%	8.43%	8.22%	8.09%	7.96%	7.85%	7.76%	7.66%	7.53%	8.12%	7.14%
L_t	1.45%	1.12%	0.89%	0.70%	0.57%	0.45%	0.35%	0.26%	0.17%	0.05%	0.60%	-0.31%
w_t	2.55%	2.55%	2.55%	2.55%	2.55%	2.55%	2.55%	2.55%	2.55%	2.55%	2.55%	2.55%
r_t	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rev_t	-9.36%	-8.92%	-8.80%	-8.86%	-8.99%	-9.02%	-9.01%	-8.88%	-8.75%	-8.23%	-8.88%	-8.54%
D_t/Y_t[b]	0.00%	1.98%	3.80%	5.54%	7.22%	8.91%	10.57%	12.22%	13.84%	15.46%	7.95%	0.00%
G_t/Y_t[b]	0.00%	0.00%	0.00%	-0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-1.38%

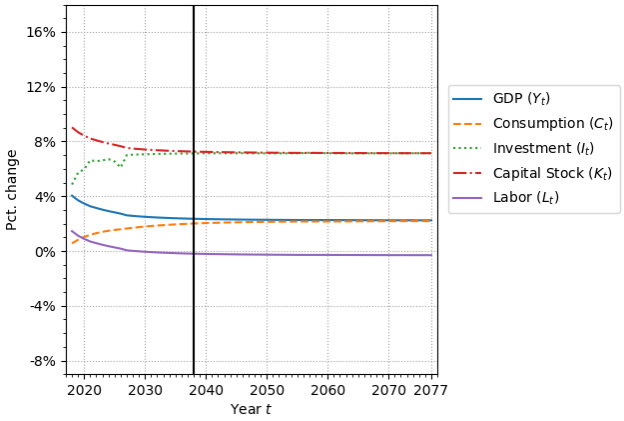
[a] The macroeconomic variables in the table are GDP (Y_t), aggregate consumption (C_t), aggregate investment (I_t), aggregate capital stock (K_t), aggregate labor (L_t), average wage (w_t), interest rate or rate of return on savings (r_t), government revenue (Rev_t), government debt (D_t), government spending on public goods (G_t), debt-to-GDP ratio (D_t/Y_t), and government spending as a percent of GDP (G_t/Y_t).

[b] The changes in debt-to-GDP ratio (D_t/Y_t) and government spending as a percent of GDP (G_t/Y_t) are reported as percentage point differences (simple differences) rather than percent changes to avoid zeros in the denominator.

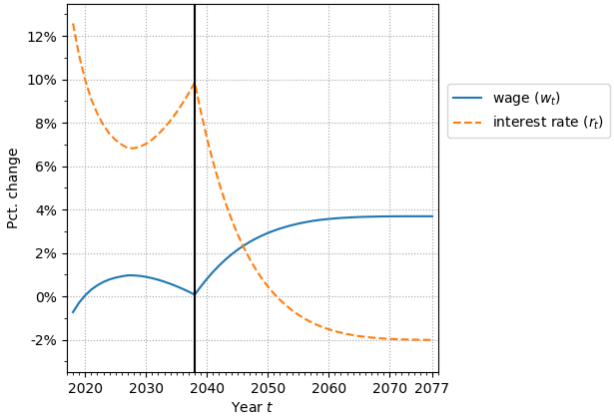
Figure 1. Time path percent changes of aggregate macroeconomic variables, prices, and fiscal variables: closed economy vs. small open economy



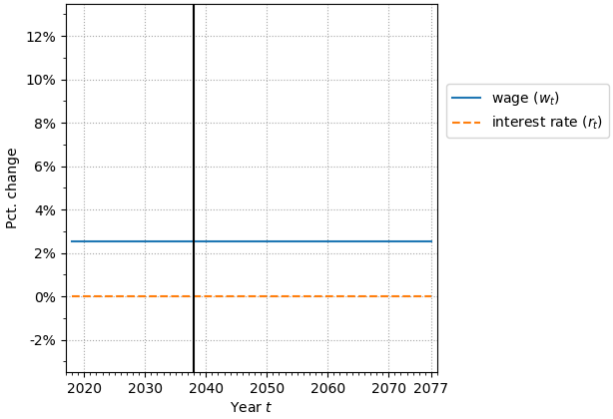
(a) Macro aggregates, closed economy



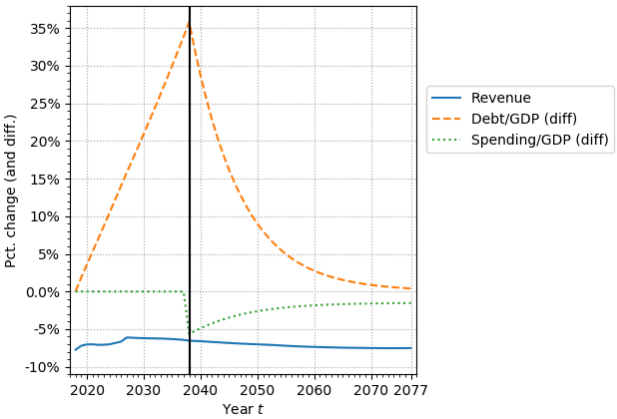
(b) Macro aggregates, open economy, $r^* = 0.04$



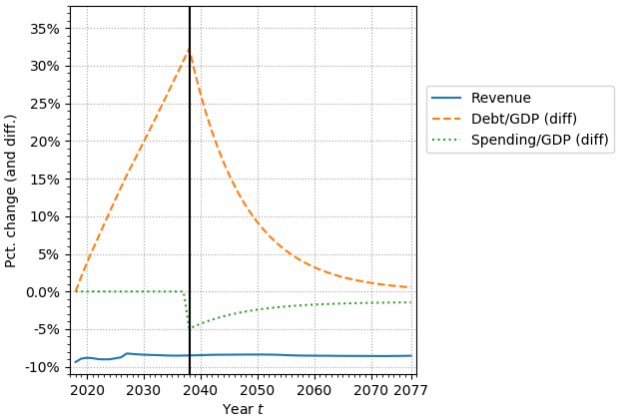
(c) Prices, closed economy



(d) Prices, open economy, $r^* = 0.04$



(e) Fiscal variables, closed economy



(f) Fiscal variables, open economy, $r^* = 0.04$

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