

What effect has the Tax Cuts and Jobs Act of 2017 had on the federal debt of the United States of America?

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## Introduction

The Tax Cuts and Jobs Act of 2017, officially known as 'An act to provide for reconciliation pursuant to titles II and V of the concurrent resolution on the budget for fiscal year 2018', is a congressional revenue act which amended the Tax Reform Act of 1986, officially known as 'An act to reform the internal revenue laws of the United States' (Congress of the United States of America, 2017).

The act was introduced in the House of Representatives by the Republican party which controlled a majority of seats in both the House of Representatives and the Senate. The intended purpose of the act was to amend features of the United States internal revenue code which determines how and why each tax is collected, to reduce or eliminate taxes for individuals and corporations and to increase the size of tax deductions for various items.

The opposition Democratic party opposed the act and argued that it would increase the federal debt level, which would require a qualified majority to pass in the Senate due to the internal revenue code which requires that any acts which increase the federal debt level above a pre-determined limit must gain the consent of a qualified majority in the Senate. The act was then modified at the last minute so that the individual tax reductions became only temporary. However, the corporate tax reductions remained permanent.

The modifications allowed the Republican party to pass the legislation with a majority of one in the Senate.

One of the critics of the policy is the economist Paul Krugman. He argues in a New York Times column that the policy, in the wider context of the presidency of Donald Trump, amounts to foreign aid to overseas investors (Krugman, 2019).

The president of the United States Donald Trump has introduced tariffs on foreign products which increase prices for American consumers. The president claimed that the tax policy is more than enough to compensate the effect of the tariffs. However, Krugman claims that prices have increased much more than the savings from the tax cuts. He argues that the benefits of the taxes have gone to equity holders who have received increased dividends and realized capital gains as corporations buy back their own shares. Since a large proportion of American equity belongs to foreign investors, argues Krugman, a large proportion of the benefits of the tax cuts have gone to foreign investor while the cost has been paid by American consumers who buy foreign goods.

Alternatively, the benefits of the tax cut have been crowded out from American consumers to foreign investors and the net result is a higher debt-to-GDP ratio as the policy results in an inelastic response of GDP.

## Theory

The Blanchard-Amighini-Giavazzi debt dynamics model is a model of the public debt of a country as a first-order difference equation. The public deficit of an economy is defined as the sum of the primary government deficit, or the difference between public expenditure and taxation, and the interest on previously held public debt (Blanchard, 2017).

$d_t$  = Nominal deficit at time  $t = (G_t - T_t) + iD_{t-1}$  where  $G_t$  = Nominal public expenditure at time  $t$

$T_t$  = Nominal tax level at time  $t$

$i$  = Constant (or average) dollar interest rate

$D_{t-1}$  = Nominal public debt at time  $t - 1$

The change in the public debt between times  $t - 1$  and  $t$  is equal to the deficit.

$$D_t - D_{t-1} = d_t$$

Difference equation :  $\frac{D_t}{Y_t}$  = Debt-to-GDP ratio =  $\frac{G_t - T_t}{Y_t} + \frac{1+i}{1+g} \frac{D_{t-1}}{Y_{t-1}}$  where  $Y_t$  = Nominal GDP at time  $t$

$g$  = Constant (or average) nominal GDP  
growth rate

The general solution to the debt-to-GDP ratio difference equation can be used to model the evolution of the debt-to-GDP ratio, given that the interest rate and the growth rate are relatively small.

$$\frac{D_t}{Y_t} = \frac{G_t - T_t}{(g-i)Y_t} + (1+i-g)^t \left( \frac{D_0}{Y_0} - \frac{G_t - T_t}{(g-i)Y_t} \right) = \delta^* + (1+i-g)^t (\delta_0 - \delta^*)$$

where  $\delta^*$  = Equilibrium debt-to-GDP ratio =  $\frac{G_t - T_t}{(g-i)Y_t}$

$$\delta_0 = \text{Initial debt-to-GDP ratio} = \frac{D_0}{Y_0} > 0$$

The general solution may be used to justify the views of both the proponents and the opponents of a tax cut about the long-run effects of the tax cut. A tax cut is defined as a reduction in  $T_t$  while  $G_t$  stays constant and it increases the equilibrium debt-to-GDP ratio.

Proponents of a tax cut may argue that the GDP growth rate will be higher than the interest rate, which stabilizes the debt-to-GDP ratio in the long-run. Opponents of a tax cut may argue that the GDP growth rate will be lower than the interest rate, which causes the debt-to-GDP ratio to spiral out of control unless the government runs a large primary surplus.

If  $g > i$  then :

$$\lim_{t \rightarrow \infty} \frac{D_t}{Y_t} = \lim_{t \rightarrow \infty} (\delta^* + (1+i-g)^t (\delta_0 - \delta^*)) = \delta^*$$

If  $g = i$  then :

$$\lim_{t \rightarrow \infty} \frac{D_t}{Y_t} = \lim_{t \rightarrow \infty} (\delta^* + (1+i-g)^t (\delta_0 - \delta^*)) = \lim_{t \rightarrow \infty} (\delta_0) = \delta_0$$

If  $g < i$  then :

Primary deficit : If  $G_t > T_t$  (and  $\delta_0 > 0 > \delta^*$ ) then  $\lim_{t \rightarrow \infty} \frac{D_t}{Y_t} = \lim_{t \rightarrow \infty} (\delta^* + (1+i-g)^t (\delta_0 - \delta^*)) = \infty$

Primary balance : If  $G_t = T_t$  (and  $\delta^* = 0$ ) then  $\lim_{t \rightarrow \infty} \frac{D_t}{Y_t} = \lim_{t \rightarrow \infty} ((1+i-g)^t \delta_0) = \infty$

Primary surplus : If  $G_t < T_t$  then

$$\text{If } \delta_0 > \delta^* \text{ then } \lim_{t \rightarrow \infty} \frac{D_t}{Y_t} = \lim_{t \rightarrow \infty} (\delta^* + (1 + i - g)^t (\delta_0 - \delta^*)) = \infty$$

$$\text{If } \delta_0 < \delta^* \text{ then } \lim_{t \rightarrow \infty} \frac{D_t}{Y_t} = \lim_{t \rightarrow \infty} (\delta^* + (1 + i - g)^t (\delta_0 - \delta^*)) = -\infty$$

## Evidence

A sample of 620 monthly observations of the debt-to-GDP ratio, the consumer price index, the effective federal fund rate and the trade weighted exchange rate in terms of foreign currency baskets beginning in January 1947 and ending in September 2019 was downloaded from the FRED database. The debt-to-GDP time-series was originally a quarterly time-series but was linearly interpolated to create a monthly series.

Linear interpolation :

$X_q$  = Value for the  $q^{\text{th}}$  quarter ( $q = 1, 2, \dots$ )  $\rightarrow x_{q,m}$  = Value for the  $m^{\text{th}}$  month ( $m = 1, 2, 3$ ) of the  $q^{\text{th}}$  quarter

$$= \left(1 - \frac{m-1}{3}\right) X_q + \frac{m-1}{3} X_{q+1}$$

The dataset was split into an in-sample dataset which was used to fit econometric models and an out-of-sample dataset which was used to compare predicted data series with observed data series. The in-sample dataset begins in January 1947 and ends in September 2017 when the Tax Cuts and Jobs Act was enacted. The out-of-sample dataset begins in October 2017 and ends in September 2019.

The Blanchard-Amighini-Giavazzi model is linear in parameters and can be estimated as an AR(1) autoregressive model using the ordinary least squares method with the debt-to-GDP ratio as the dependent variable and the lagged debt-to-GDP ratio as the independent variable.

$$\frac{D_t}{Y_t} = \beta_0 + \beta_1 \frac{D_{t-1}}{Y_{t-1}} + u_t \text{ such that } \beta_0 = \frac{G_t - T_t}{Y_t}, \beta_1 = \frac{1+i}{1+g} \text{ and } u_t = \text{Residual at time } t$$

$$\text{Linear approximation : } \frac{1+i}{1+g} \approx 1 + i - g \text{ if } i \text{ and } g \text{ are small} \rightarrow \beta_1 = 1 + i - g$$

A time trend and quarterly dummy variables are also included in the model to control for linear trends and seasonal effects. These coefficients are not reported but are included in the model.

The simple regression is highly significant with a joint f-test (null hypothesis that all coefficient are equal to zero) p-value equal to 0.0000 and an r-square equal to 0.9998. Robust standard errors are reported for the coefficients.

Coefficient	Estimate	Std. Error	T-ratio	P-value
$\hat{\beta}_0$	-0.00278285	0.000751242	-3.704	0.0002
$\hat{\beta}_1$	0.997640	0.00255329	390.7	0.0000

$$\hat{\beta}_1 = 0.997640 \rightarrow 1 + \hat{i} - \hat{g} = 0.997640$$

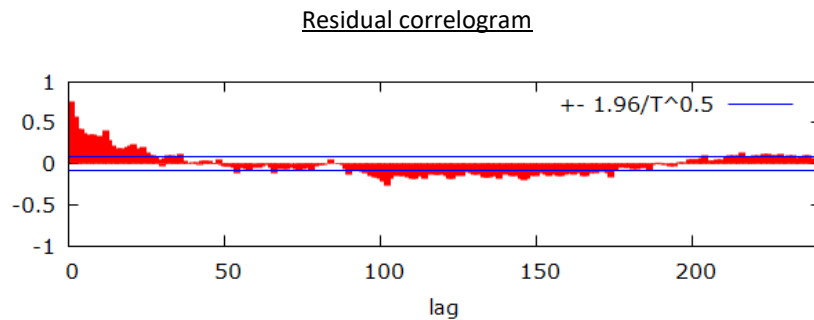
$$\hat{g} - \hat{i} = 1 - 0.997640$$

$$\hat{g} - \hat{i} = 0.00236 \rightarrow \hat{g} > \hat{i} \rightarrow \lim_{t \rightarrow \infty} \frac{D_t}{Y_t} = \delta^* = \frac{G_t - T_t}{(g - i)Y_t}$$

$$\hat{\beta}_0 = -0.00278285 \rightarrow \hat{G}_t - \hat{T}_t = -0.00278285Y_t \rightarrow \hat{G}_t < \hat{T}_t \rightarrow \frac{G_t - T_t}{(g - i)Y_t} < 0$$

$$\therefore \lim_{t \rightarrow \infty} \frac{D_t}{Y_t} < 0$$

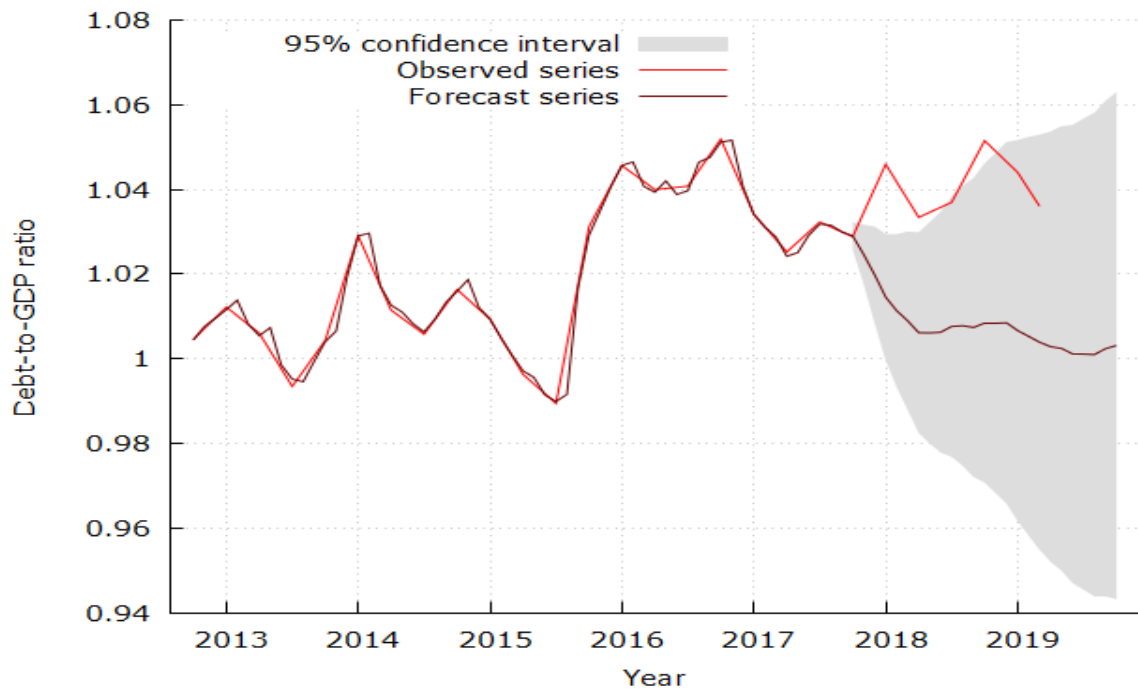
The evidence suggests that the Tax Cuts and Jobs Act will reduce the federal debt in the long-run because the growth rate tends to be higher than the interest rate and because the government tends to run a small primary surplus. However, the estimates may be biased due to endogeneity reflecting the real business cycle which causes positive serial correlation in the residuals. The debt-to-GDP ratio is a highly persistent ratio which reflects the business cycle and the state of public finances. Alternatively, knowing one residual will be useful in predicting subsequent residuals. Therefore, there must be other variables (for example higher-order lags of the debt-to-GDP ratio) which can be used to better predict the debt-to-GDP ratio.



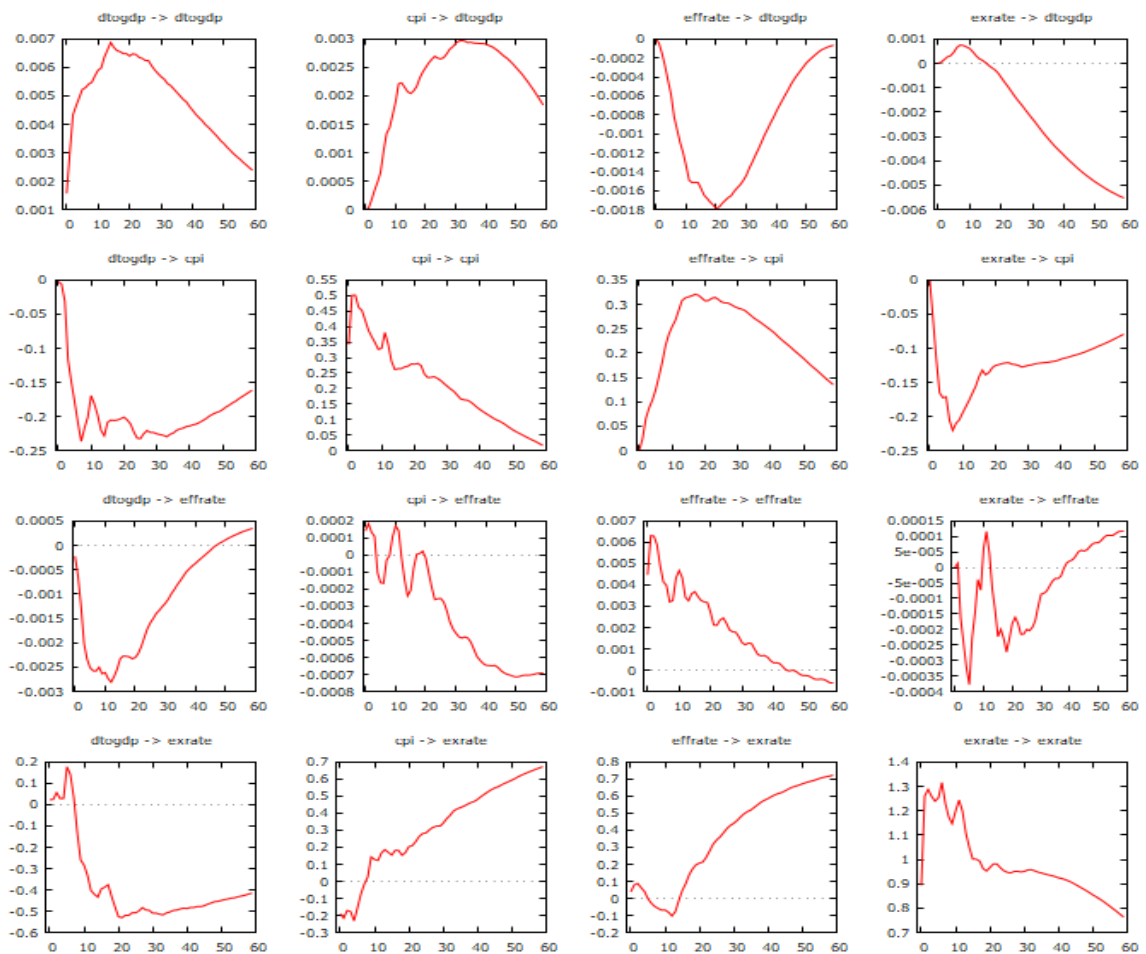
A Ljung-Box Q test with the null hypothesis that the residuals are independently distributed up to the 12<sup>th</sup> lag has a p-value of 0.000. The estimates are biased since the residuals could be explained by at least one of 12 lagged values of the residuals. This kind of time-series regression is known as a spurious regression since it has a very high r-square but only represents a correlation and not a causal relationship.

To obtain a better prediction, a VAR(14) vector autoregressive model of order 14 is used. It is a system of AR(14) models of the debt-to-GDP ratio, the consumer price index, the the effective federal funds rate and the exchange rate. It also includes a time trend and quarterly dummy variables. The order is chosen according to the Akaike information criterion. The model is used to forecast the debt-to-GDP ratio in the out-of-sample period after the Tax Cuts and Jobs Act was implemented and to compute orthogonal impulse response functions. The orthogonal impulse responses are somehow distributed such that the confidence intervals can't be bootstrapped. The VAR(3) model, suggested by the Hannan-Quinn criterion, impulse response confidence intervals could be bootstrapped but the model displays autocorrelation. The VAR(14) model displays no autocorrelation.

# VAR(14) model forecast of the evolution of the debt-to-GDP ratio of the United States



## VAR(14) model orthogonalized impulse response functions

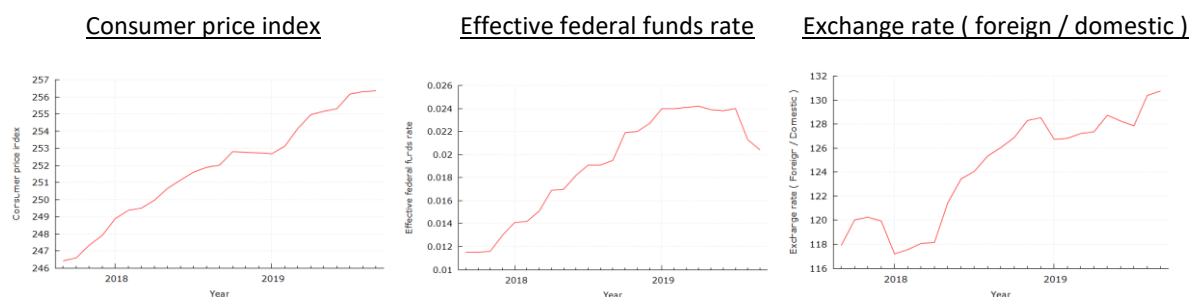


## Discussion

The forecast predicts that the debt-to-GDP ratio will fall. However, the observed series is much higher. The difference can be explained as the effect of the Tax Cuts and Jobs act unless there were major shocks in other relevant variables which were not included in the model. If there were no other relevant major shocks, it is likely that the difference between the two series was caused by the enactment of the Tax Cuts and Jobs Act. Alternatively, the legislation increased the debt-to-GDP ratio relative to the previous trend of the debt-to-GDP ratio while the trend was a decreasing trend.

Therefore logically, given the current economic environment, the causal effect of a 'Tax Cuts and Jobs Act' (if such a policy exists) is an increase in the debt-to-GDP ratio.

The observed increase in the price level, the interest rate and the exchange rate in the period following the enactment of the Tax Cuts and Jobs Act may be explained in the context of an IS-LM model of an open economy.



The multiplier effect of an increase in disposable income is reduced because the increase in disposable income increases demand in the dollar market which increases the equilibrium dollar interest rate. As the interest rate rises it becomes more difficult to borrow, which reduces consumption and investment. Furthermore, as the tax cuts increase the profitability of American corporations, they increase demand for dollars in the foreign exchange market which increases the equilibrium exchange rate and causes domestic prices to become relatively expensive compared to foreign prices. This, given that there are no barriers to trade, causes a decrease in exports and an increase in imports. This in turn reduces the trade balance and GDP.

The net effect is an increase in GDP which may or may not be higher than the size of the tax cut which means that the cut may result in a higher or lower equilibrium debt-to-GDP ratio.

## Conclusion

In conclusion, the effect of the tax cut is hidden unless it is extracted from the data using a VAR(14) model. The data suggests that the Tax Cuts and Jobs Act has caused upwards pressure on the debt-to-GDP ratio.

# References

Blanchard, O., Amighini, A. and Giavazzi, F. (2017). **Macroeconomics: A European Perspective**. 3rd ed. Pearson, pp.437-454.

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