Keynesian Fiscal Policy, Economic Growth, and Public Debt Dynamics

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Conventional macroeconomic policy analysis recommends expansionary fiscal policy to respond to transitory weakness in demand (especially when the "zero lower bound" constrains monetary policy). In contrast, a rapidly growing body of research grounded in "supermultiplier" demand-led growth models identifies the importance of the growth of government spending as a critical engine of growth over longer time horizons than the mainstream short run.

The model presented in this paper generates a growth path determined over longer horizons by the dynamics of autonomous demand. This approach, pioneered in its modern version by Serrano (1995), has been applied to fiscal policy in several recent papers.[1] While a variety of components of aggregate demand may be plausibly classified as autonomous, that is, independent of the current level of macroeconomic activity, the long-term trend of government spending is most easily justified as autonomous and is likely the quantitatively largest part of any empirical definition autonomous demand. Following the logic of supermultiplier models, therefore, it is sensible to focus on fiscal policy as an important source of demand growth.

To explore the relevance of fiscal policy as a long-term growth engine, it is essential to consider the connection between demand-led growth and supply. While it is widely recognized that resource constraints ultimately impose a limit on the growth demand can generate, most supermultiplier models do not analyze the dynamics of supply explicitly or simply assume supply constraints impose an upper bound on demand-led growth.[2] The model presented here, similar to Fiebiger (2021), follows Fazzari, et al. (2020, hereafter FFV) who incorporate endogenous supply. In this approach, hysteresis effects between the demand-determined state of the economy and both labor force and productivity growth create a range of growth rates over which supply accommodates the path of aggregate demand. There are no "natural" rates of

[1] These contributions include Allain (2015), Freitas and Christianes (2020),), Fiebiger (2021), and Hein and Woodgate (2021).
[2] Our own earlier work in this area, Fazzari et al. (2013) is one example in which supply constraints are exogenous.

growth or unemployment dictated by supply conditions alone. Instead, demand leads supply. Therefore, fiscal policy that stimulates demand and demand growth not only eliminates output or employment gaps but also expands the economy's potential output.

Conventional perspectives on fiscal policy almost always suggest a trade-off between the possible demand stimulus of higher government spending and greater burden of public debt if that spending is not accompanied by higher taxes. The actual social costs of public debt are controversial, especially when that debt is denominated in the a country's own sovereign currency.[3] That said, at a minimum, interest-bearing public debt generates transfer payments that lead to distributional effects. It is therefore important to analyze the implications of government spending growth on an economy's public debt-output ratio. We model taxes explicitly and track the dynamics of government debt and interest payments with stock-flow consistent accounting. Somewhat different from other related research, we account for taxes on interest payments in addition to labor income taxes. We also consider the possibility of consumption out government interest payments.

Results strongly support a heterodox view of fiscal policy. We show the growth rate of the economy depends positively on the growth rate of government spending. This result is standard in all supermultiplier models. Our results extend the standard findings, however, by identifying how hysteresis effects on supply accommodate fiscal expansion. Our model also delivers what recent research has called the "paradox of debt:" the steady-state debt-output ratio *necessarily declines* when government spending growth rises. As is the case in any analysis of steady-state debt sustainability, the debt-to-output converges to a ratio with the primary government deficit as a share of GDP in the numerator and the difference between the economy's growth rate and the tax-adjusted interest rate t in the denominator. When faster government spending growth raises economic growth, the denominator of the debt-output ratio rises, a fairly obvious effect. The supermultiplier approach also leads to a less obvious result that faster government spending, holding tax rates constant, *reduces* the primary deficit as a share of output. Both of these effects create the paradox of debt.

We also extend research on supermultiplier models and fiscal policy by calibrating the model with empirically grounded parameters for the current US economy. The calibration is based on empirical estimates from research by Fazzari and González (in progress) that estimates the full FFV model. Of particular importance, the estimates support the strong hysteresis effects studied theoretically in FFV. These effects imply that stimulative fiscal policy that improves the short-run state of the economy will spill over to raise labor productivity and labor supply so that the supply side accommodates faster growth of demand, a critical result for evaluating the long-term impact of fiscal policy. The model estimates are supplemented with a detailed analysis of the structure of US government spending that identifies autonomous components, including

[3] This point has been discussed extensively in debates surrounding the analysis known as Modern Monetary Theory.

government-financed demand that are treated as transfer payments in the national accounts (Medicare, for example).

The calibrated model produces results that demonstrate the quantitative importance of the demand-led growth perspective for the analysis of practical fiscal policy. We show that a 0.5% permanent increase in real government spending growth raises the long-run growth rate by an equivalent amount. and can be accommodated by the supply side with just a modest reduction in the equilibrium unemployment rate. The additional demand stimulus raises labor productivity and labor supply growth so the supply side accommodates the stronger demand path, lowering the steady-state unemployment rate from 4.0% to 3.6%. Consistent with the paradox of this debt, this policy *reduces* the steady-state public debt-GDP ratio from approximately 1.4 to 0.9. We also consider the effects of a large one-time increase in the level of government spending such as proposed in the progressive "Green New Deal."

The conclusion from these results is that fiscal stimulus can lead to significant medium-run to long-run improvements in economic growth and unemployment, even when the economy begins in a reasonably strong position, without any increase long-run increase in the ratio of government debt to output and the associated interest transfer. The hysteresis effects in the model also imply that the scope for progressive policy to improve social welfare and address climate change can be much greater than implied by mainstream analysis in which the long-run path of the economy's supply side is independent of the dynamics of debt.

Demand and Supply in a Supermultiplier Model with Government Fiscal Variables

This section presents the model we use to explore the connection between government spending, demand dynamics, output growth, and tax revenues. The basic closed-economy model is based on the model in FFV augmented to include government fiscal variables. The model belongs to the "supermultiplier" class first identified by Hicks (1950) and pioneered in its modern form by Serrano (1995).

Output is determined at any point in time by aggregate demand, subject to the constraint that aggregate demand does not exceed aggregate supply. Demand consists of three components. Consumption (C_t) in the current period *t* is determined by expected after-tax labor income and interest income paid on the household sector's stock of government debt (rD_t):

$$C_t = (1 - s_Y)(1 - \tau_Y)(1 + Eg_t)Y_{t-1} + (1 - s_r)(1 - \tau_r)rD_t \quad (1)$$

where s_Y and s_r are saving rates out of labor and interest income, τ_Y and τ_r are tax rates on labor and interest income. To keep the model recursive, consumption depends on expected, rather than realized, labor income in period *t*. Interest income is known at the beginning of period *t* because the debt stock is measured at the beginning of the period.

Capital investment is set by firms to achieve a target capital output ratio ($\hat{v}_t$):

$$I_t = K_{t+1} - (1 - \delta)K_t = \hat{v}_t(1 + Eg_t)^2 Y_{t-1} - (1 - \delta)K_t \quad (2)$$

where δ is the geometric depreciation rate. The capital stock (K_t) is measured at the beginning of period *t*. New capital is productive with a one-period lag. Again, to maintain the recursive structure of the model, expected output in *t*+1 that determines capital accumulation in *t* depends on actual output in period *t*-1. Therefore, expected growth that determines investment is compounded over two periods. The target capital-output ratio at any point in time adjust toward a long-run value v^*:

$$\hat{v}_t = (1-\lambda)v_{t-1} + \lambda v^* \quad (3)$$

The value of v^* depends on technology as well as the long-run rate of capacity utilization chosen by firms.[4]

The third component of demand is autonomous in the sense that this part of spending does not depend on the current state of the economy. For our basic model we identify autonomous demand with government spending assumed to grow at a constant rate :.[5]

$$G_t = (1+g^*)G_{t-1}. \quad (4)$$

As in FFV and other demand-led growth models, growth expectations adjust adaptively:

$$g_t = (1-\alpha)g_{t-1} + \alpha E g_{t-1} \quad (5)$$

Equations 1 through 5 determine the demand side of the model and output is determined by aggregate demand (Y_t^D):

$$Y_t = Y_t^D = C_t + I_t + G_t \quad (5)$$

subject to the constraint that output not exceed a ceiling imposed by aggregate supply.

The key innovation in FFV is the introduction of an "accommodating" supply side. That is, we propose structural mechanisms that cause aggregate supply to converge to the demand-led growth path.[6] Supply is determined by available labor hours (L_t) and labor productivity (A_t):

$$Y_t^S = A_t L_t. \quad (6)$$

We assume a desired utilization rate low enough that capital, which is produced endogenously, is not a constraint on output for realistic levels of demand. The unemployment rate (u_t) is:

$$u_t = 1 - Y_t/Y_t^S. \quad (7)$$

To generate convergence of supply to demand, we specify both the growth of labor supply (g_t^L) and the growth of productivity (g_t^A) as negative functions of the lagged unemployment rate; a

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[4] This specification is based on a closely related approach in Freitas and Serrano (2015). The long-run target capital-output ratio v^*may incorporate firms' decisions to hold excess capacity on average as discussed in Ciccone (1986).
[5] To keep he model simple, we ignore non-autonomous government spending such as unemployment compensation. Some important components of government spending, such as government-financed health care in the US, clearly have a non-autonomous component, but also have a large autonomous piece.
[6] Girardi, et al. (2020) provides empirical support for this implication and label it "reverse" hysteresis; "reverse" in the sense that demand leads supply, rather than the traditional mainstream proposition that supply dynamics determine demand in the long run.

stronger economy stimulates supply growth (see FFV for further discussions and extensive reference to research that supports these structural assumptions). In addition to the unemployment effect, we also include a term that captures the effect on productivity growth of the rate of capital turnover (the growth rate of the capital stock plus the depreciation rate). These assumptions lead to the key supply-side equations:

$$g_t^L = \theta_0 - \theta_1 u_{t-1} \tag{8}$$

$$g_t^A = \rho_0 - \rho_1 u_{t-1} + \rho_2 (g_{t-1}^K + \delta). \tag{9}$$

In FFV, we show that if the dynamics of the demand side (equations 1 through 5) converge to a steady-state path, the supply side will also converge to the demand-led growth path if $\theta_1 + \rho_1 > 0$.[7] The intuition for this result is straightforward. Suppose the growth of demand rises permanently. Initially, the unemployment rate declines due to the demand stimulus. Because θ_1 and ρ_1 in equations 8 and 9 are positive, the lower unemployment rate stimulates the growth rate of labor supply and productivity. This effect continues until supply growth catches up with demand growth (otherwise the unemployment rate would continue to fall boosting supply growth even further).

This result has important implications for fiscal policy. If the source of higher demand growth is a rise in the rate of growth of government spending, the model predicts supply will accommodate the higher demand path, a strong form of "crowding in." There are limits to how far this expansion can go, however, as discussed in the next section.

Steady-State Results for Growth and Unemployment

As with all basic supermultiplier models, the steady-state growth rate of output equals the growth rate of autonomous demand (g^*). Of course, real-world economies are buffeted by many shocks and structural changes so that the economy is never in steady state. But if the dynamics are stable, the steady state identifies a center of gravity for economic growth.[8] In the simple form of our model with government spending as the only source of autonomous demand, this result implies fiscal policy is the engine of economic growth.

Combining the demand-side equations 1, 2, 4, and 5 and dividing through by lagged output leads to this law of motion for the actual growth rate (g_t) of the economy:

$$1 + g_t = (1 - s_Y)(1 - \tau_Y)(1 + E g_t) + (1 - s_r)(1 - \tau_r) r \frac{D_t}{Y_{t-1}}$$

[7] FFV cite many empirical studies, and present some original empirical work, that support positive effects of the level of economic activity, proxied by the unemployment rate, on the growth of both labor supply and labor productivity. In work in progress, Fazzari and González estimate the model presented here and find economically and statistically significant hysteresis effects.

[8] FFV discuss dynamic stability of the demand side of the model in some detail. The model can be stable or unstable theoretically although FFV provide calibration results that imply stability is the most likely case empirically.

$$+\hat{v}_t(1+Eg_t)^2-(1-\delta)\frac{K_t}{Y_{t-1}}+\frac{(1+g^*)G_{t-1}}{Y_{t-1}} \quad (10)$$

In steady state, $g_t = Eg_t = g^*$ and $\hat{v}_t = v^*$. Let us also assume, for expositional clarity, that there is no consumption out of interest income on government debt (we consider the effect of consumption out of interest later). Imposing these conditions generates the following equation for steady-state growth:

$$g^* = \frac{(1-\tau_Y)s_Y + (\tau_Y - \gamma^*)}{v^*} - \delta \quad (11)$$

where γ^* is the steady-state share of government spending in output. Note that the numerator of the ratio in equation 11 is the sum of private and government saving per unit of output. Thus, this equation appears equivalent to a generalized version of Harrod's "warranted rate of growth" concept. But this interpretation is somewhat misleading. The steady-state growth rate is determined entirely by the growth rate of autonomous spending. In steady state, the right-hand side of equation 11 adjusts to equate to g^*. This adjustment takes place through the government spending share γ^*, or, more generally, the share of autonomous demand in output. Any change in g^* or other structural parameters in equations 11 will cause an endogenous change in γ^*. For this reason, a more useful form of equation 11 solves for the share of autonomous demand in output:

$$\gamma^* = (1-\tau_Y)s_Y + \tau_Y - v^*(g^* + \delta) \quad (12)$$

Any structural change that increases "leakages" from demand (higher saving or higher taxes) requires a higher autonomous demand share to balance output with demand and structural "injections" (higher investment due to technological changes or faster growth).

Equation 12 leads to a key result for fiscal policy. A *higher growth rate of government spending reduces the steady-state share of government spending in output*. This outcome is generic for supermultiplier models and has also been emphasized by Freitas and Christianes (2020),), Fiebiger (2021), and Hein and Woodgate (2021).While this result may seem counterintuitive, the economic logic behind it in this model is straightforward. Along the steady-state path, output is determined by the supermultiplier equation:

$$Y_t = \frac{G_t}{(1-\tau_Y)s_Y + \tau_Y - v^*(g^* + \delta)} = \frac{G_t}{\gamma^*} \quad (13)$$

The supermultiplier is just the inverse of the share of autonomous demand in output. A higher growth rate of autonomous demand requires a larger share of investment in output to maintain a the steady-state capital-output ratio. This effect induces a rise in the investment accelerator term in the supermultiplier, that is, $v^*(g^* + \delta)$ increases and the autonomous demand share (γ^*) declines. [9]

[9] See Girardi and Pariboni (2020) and Haluska et al. (2019) for further analysis of this point and extensive empirical evidence supporting this implication of the supermultiplier models.

These results are generated entirely from the demand side of the economy. For these outcomes to occur in reality, however, the economy must be capable of producing what is demanded. That is, the resource constraint from the supply side must not bind. The general conditions required for the supply side to accommodate a demand-led growth path is the focus of FFV which carries over to the fiscal policy analysis here. Through equations 8 and 9, when demand growth accelerates, the unemployment rate declines and stimulates growth in labor supply and labor productivity. These hysteresis effects can generate steady-state convergence of the supply path to demand if the sum of the coefficients that connect the unemployment rate to supply growth in equations 8 and 9 is positive ($\theta_1 + \rho_1 > 0$).

Adjustment of supply to demand creates another steady-state condition. Solving equations 8 and 9 to equate supply growth to g^* implies a steady-state unemployment rate of:

$$u^* = \frac{\theta_0 + \rho_0 - g^*(1 - \rho_2) + \rho_2 \delta}{\theta_1 + \rho_1}. \tag{14}$$

Faster growth of government spending *lowers the long-run unemployment rate*. It is this lower unemployment rate that boosts the steady-state growth rate of supply to match faster demand growth.

While $\theta_1 + \rho_1 > 0$ is necessary for supply to converge to demand, it is not sufficient in the case of an acceleration in government spending growth. As equation 14 shows, a higher g^* requires a lower unemployment rate. Because the unemployment rate is bounded below, g^* is bounded above. Therefore, the potential for higher demand-led growth of the overall economy caused by faster growth in government spending has limits imposed by labor resources. In a fundamental sense, then, supply imposes limits to how much influence aggregate demand can have on the rate of growth. Feedback between the labor market and the goods market determine this ceiling.[10] But acceleration of government spending growth can generate faster steady-state output growth if the economy begins with an unemployment rate above its lower bound. Furthermore, a reduction in government spending growth always increases the steady-state unemployment rate.

In this sense, as discussed in FFV, there is no "natural" rate of either economic growth or unemployment in this model. The equilibrium center of gravity for unemployment depends on the dynamics of autonomous demand and those dynamics depend on fiscal policy.

[10] Therefore, our model acknowledges a key result from Skott (2019) that the supply side imposes limits to demand-led growth

Steady-State Effects of Fiscal Policy on the Government Debt-Output Ratio

Much attention in fiscal policy discussions center on the "sustainability" of government debt dynamics usually focused on the ratio of government debt to the size of the economy (see Blanchard, 2022 for extensive discussion and numerous references). While it again may seem counter-intuitive, the supermultiplier model generates a straightforward result that faster growth of government spending reduces the debt-output ratio.

To derive this result, start with the law of motion for the beginning-of-period level of government debt (D_t):

$$D_{t+1} = (1+r)D_t + G_t - \tau_Y Y_t - \tau_r r D_t \qquad (15)$$

Divide equation 15 by output and define the debt ratio as $d_t = D_t/Y_t$:

$$\frac{D_{t+1}}{Y_t} = \frac{D_{t+1}}{Y_{t+1}}\frac{Y_{t+1}}{Y_t} = (1+r)\frac{D_t}{Y_t} + \frac{G_t}{Y_t} - \tau_Y - \tau_r r\frac{D_t}{Y_t}$$

$$d_{t+1}(1+g_{t+1}) = (1+r)d_t + \gamma_t - \tau_Y - \tau_r r d_t \qquad (16)$$

To solve for steady-state d^*, set $d_{t+1} = d_t, g_{t+1} = g^*,$ and $\gamma_t = \gamma^*$:

$$d^* = \frac{\gamma^* - \tau_Y}{g^* - (1-\tau_r)r} \qquad (17)$$

Equation 17 has a familiar form: the steady-state debt-output ratio is the primary deficit (relative to output) divided by the difference between the economy's growth rate and the tax-adjusted interest rate.[11] As is well known, any primary deficit is sustainable, in the sense the debt ratio does not explode, if the economy's growth rate exceeds the appropriate measure of the interest rate. The supermultiplier model extends this basic result in two ways. First, and most important, the growth rate depends fundamentally on demand. Second, we explicitly recognize that interest is taxable.[12]

Consider the important policy implications of equation 17 combined with equation 12. There are two effects of faster government spending growth on the steady-state public debt ratio. First, a higher growth rate of autonomous demand, that is, faster growth of government spending, lowers d^* because faster demand growth raises the economy's growth rate (Domar, 1944). Second, from equation 12, faster government spending growth also reduces the endogenous steady-state share of government spending in output, so γ^* declines when g^* increases. Both effects go in the same direction to demonstrate the paradox of debt: *faster growth of government spending lowers the debt-output ratio.*[13] More formally:

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[11] See Domar (1944) and Blanchard (2022).

[12] While our analysis abstracts from inflation, equation 17 could be expressed in nominal terms. In this case, a given rate of inflation added to both the growth rate and the interest reduces the steady-state debt ratio if nominal interest income is taxable.

[13] Again, this result is identified in Freitas and Christianes (2020),and Hein and Woodgate (2021). Fiebiger (2021, page 9) writes "the government has—through the principle of effective demand and the capital stock adjustment

$$\frac{d(d^*)}{dg^*} = -\frac{(v^* + d^*)}{g^* - (1 - \tau_r)r} < 0$$

Also consider a one-time permanent change in the level of government spending without raising taxes or changing the long-run growth of government spending. Initially, a higher level of government spending will raise the debt ratio, but in steady state there is no effect on d^* as long as the economy is not constrained by the supply side. (That is, as long as supply accommodates demand and labor supply does not constrain the ability of production to meet demand, or, equivalently in this model, the lower bound on the unemployment rate is not binding.) The long-run independence of d^* from a higher level of government spending occurs because, after the level shock, faster output growth along the transition path raises the level of the output path permanently to restore γ^* to its steady-state level determined by equation 12. This effect is symmetric. A one-time permanent reduction in the level of government spending will leave long-run d^* unaffected. In this case, however, there is no qualification imposed by supply-side constraints. Fiscal austerity in this model always fails to lower the government share of output in the absence of structural changes in other parameters in equation 12. Instead, permanent austerity, puts the economy on a permanently lower output path (also see Freitas and Christianes, 2021).[14] Furthermore, fiscal austerity reduces supply through hysteresis effects which constrains the extent to which the economy can accommodate demand stimulus.

General Model with Consumption out of Government Interest Payments

If there is some consumption out of interest income ($s_r < 1$), the steady-state growth rate becomes:

$$g^* = \frac{(1 - \tau_Y)s_Y + \tau_Y - (1 - s_r)(1 - \tau_r)rd^* - \gamma^*}{v^*} - \delta \qquad (11')$$

As this equation shows, when $s_r < 1$, the steady-state solution for γ^* is no longer independent of the debt-output d^* which complicates the analysis. A simple graphical framework helps illuminate key results. Begin by solving for the steady-state share of government spending in GDP:

$$\gamma^* = (1 - \tau_Y)s_Y + \tau_Y - (1 - s_r)(1 - \tau_r)rd^* - v^*(g^* + \delta). \qquad (ADS)$$

This equation can be depicted as a locus in (γ^*, d^*) space that we label ADS for "autonomous demand share." The steady-state debt ratio (equation 17) can also be solved for γ^*:

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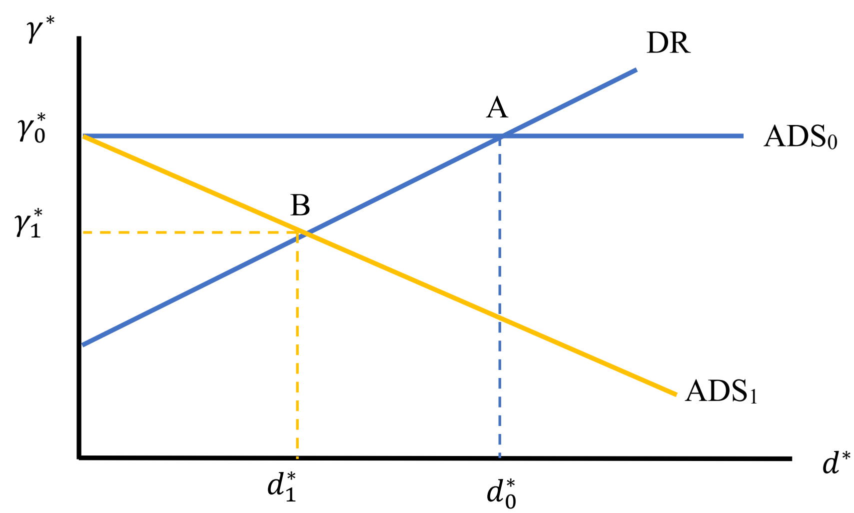
principle—crowded in economy activity to such an extent there is a paradoxical long-run improvement in fiscal metrics."

[14] Perhaps the most obvious source of a response to fiscal austerity that could affect the long-run share of government spending in output and the debt-GDP ratio would be a drop in the real interest rate. If a lower interest rate is possible (that is, if the lower bound on interest rates is not binding) and there is interest elasticity of the saving rate and the capital-output ratio to interest rates there could be indirect effects of austerity on γ^* and d^* in equations 12 and 17. Whether these effects are empirically significant is an interesting issue, but one outside the scope of this paper. See Fazzari, et al. (1998) and Fazzari (2020) for some further discussion.

$$\gamma^* = d^*[g^* - (1-\tau_r)r\,] + \tau_Y. \qquad (DR)$$

We label this relation in (γ^*, d^*) as the DR locus for "debt ratio." If $s_r = 1$ (or $\tau_r = 1$ or $r = 0$) the DR locus is flat, as shown by ADS_0 in Figure 1 and the steady-state debt ratio and autonomous demand share are determined by the intersection of the DR and ADS_0 loci at point A.

Figure 1: Steady-State Effect of Saving Out of Interest Income



If there is some saving out of interest, the ADS locus rotates clockwise (the intercept on the vertical axis is unchanged because there would be no saving out of interest if $d^* = 0$. Steady-state values of both the autonomous demand share and the debt ratio decline. Other things equal, saving out of interest income reduces the gap between the total saving share and the investment share reducing the share of autonomous demand necessary for goods market equilibrium. Because the autonomous demand share is the share of government spending, the primary government deficit declines relative to output, reducing the debt ratio.

How does saving out of interest affect the implications of a change in g^*, the steady-state growth rate of government spending? As Figure 2 shows, a faster growth rate shifts the ADS locus down. This is the basic supermultiplier result that faster growth requires a larger investment share in output, reducing the autonomous demand share by a constant amount at any debt-output ratio. The DR locus rotates counterclockwise: faster growth lowers the debt ratio by an amount by an amount that is greater the higher the debt ratio.

Figure 2: Steady-State Effect of Faster Government Spending Growth (with $s_r < 1$)

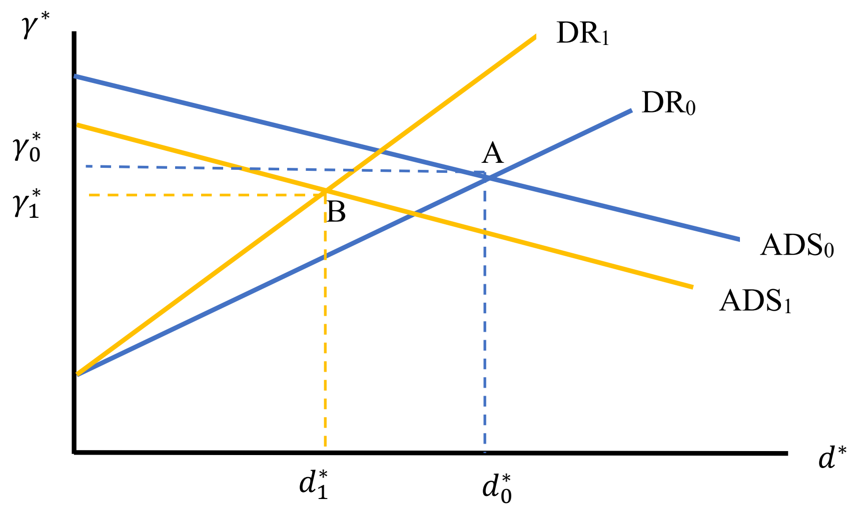


Figure 2 shows that faster growth unambiguously reduces the steady-state debt ratio, confirming the result we obtained when there is no saving out of interest. However, the effect on the autonomous demand share is ambiguous.[15] The downward shift of the ADS locus tends to reduce γ^* because the rising investment share reduces the autonomous demand share. But the negative slope of the ADS curve reflects the fact that consumption out of interest falls as the debt ratio declines. This effect tends to increase γ^*. Note that if $s_r = 1$, the horizontal downward shift in the ADS locus is the same as in figure 2, but the ADS loci are flat and the steady-state debt ratio would fall by more than in the case when $s_r < 1$. The main point is that consumption out of interest income can reduce the size of the steady-state debt ratio decline caused by higher growth of government spending. But the paradox of debt still holds.

While one may expect the saving propensity out of interest to be small, the steady-state effects of consumption out of interest could be non-trivial empirically. Some government interest payments go to small savers. For various plausible combinations of other parameter values, reducing s_r from 1.0 to 0.8 lowers the steady-state debt ratio from between 6 and 28 basis points.

Tax Rates and the Steady-State Government Debt Ratio (text incomplete)

Policy commentators often define "fiscal responsibility" as a rule that assures government spending be "paid for" by equivalent tax revenue. For example, the debate around the U.S. "Build Back Better" package of government actions proposed early in the Biden administration was animated to a large extent by discussions of "pay-fors."

[15] This ambiguity is confirmed by computing derivatives in the general case with $s_r < 1$.

A simplistic view of the steady-state debt ratio in equation 17 suggests that raising the tax rate reduces the d^* ratio. But most conventional discussion of tax policy does not take into account the long-run implications of taxes on demand.

In our model, the effect of the (labor) income tax rate on d^* with $s_r = 1$ is:

$$\frac{\partial d^*}{\partial \tau_Y} = \left[\frac{1}{g^* - r(1-\tau_r)}\right]\left(\frac{\partial \gamma^*}{\partial \tau_Y} - 1\right) = \frac{-s_Y}{g^* - r(1-\tau_r)} < 0. \quad (18)$$

Raising the tax rate will lower the long-run debt-GDP ratio, a conventional result. However, the endogeneity of γ^* in our demand-led model makes tax increases less effective at reducing d^*, perhaps much less effective, because s_Y is much less than one, at least in the aggregate. Consumption out of interest, which leads to $\phi > 0$, reduces the effect of a tax increase on γ^* even more. If $s_r < 1$, the effect of a labor income tax cut becomes even smaller than the result from equation 18.

Additional results to be included: effects of changing the tax rate on interest income and changing the interest rate itself.

Policy Experiments with a Calibrated Model (text to come)

We have calibrated the model with estimates from empirical work in progress to estimate the parameters of an extended FFV model. We also calibrated fiscal parameters such as the primary government deficit and average tax rates to US data at the end of 2019. The analysis will include steady-state results and simulated transitional dynamics.

Empirical Tests (text to come)

This section will present evidence that share in US GDP of different measures of government spending (and broader measures of autonomous demand) are in fact negatively correlated with the growth rate of autonomous demand. The negative correlations become much stronger at lower frequencies (using the Baxter-King filter)

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