# Macroeconomic Effects of a Balanced Budget in the U.S.

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## 1. Introduction

Our project will investigate the impact that a balanced budget would have on the United States economy. A balanced budget is when government spending equals tax revenue. This topic is especially interesting since the government has been consistently running a deficit in recent years. Specifically, we will examine a two-part hypothesis: (1) a balanced budget has a positive impact on long-run economic growth, but (2) a strict balanced budget will reduce flexibility in handling short-run fluctuations in the business cycle (such as recessions). This hypothesis operates under the assumption that government spending is financed by lump-sum taxes. A lump-sum tax occurs when taxpayers' taxes all changed by the same quantity (Abel 125).

## 2. Literature Survey

### 2.1. Previous Findings

Opponents of a strict balanced budget argue that it would remove fiscal and monetary tools to fight short-run fluctuations in the business cycle such as recessions (Palley 8). This supports the second part of our hypothesis. The balanced budget would make fiscal policy much less flexible, putting most of the responsibility on the Federal Reserve. The central bank would have to further increase interest rates (specifically, the federal funds rate) in booms and further reduce them in recessions. Such volatile interest rates may discourage investment spending by firms and may even hinder long-run growth (Palley 8). The limited policy tools would also increase the magnitude of fluctuations in the business cycle.

These arguments have reason, but they are largely concerned with the logistics of maintaining a balanced budget. They will give us deep insights as we develop policy suggestions at the end of the paper. However, we will begin with a purely theoretical analysis of the balanced budget from an economic standpoint. There is a significant difference between increases in government spending financed by lump-sum taxes and

increases in government spending financed by distortionary taxes. A distortionary tax, such as a labor income tax, is one in which the amount of tax due from a taxpayer depends on his actions. Thus, a distortionary tax is so called since it distorts incentives and limits economic efficiency. These cases produce opposing effects on the long-run growth of the U.S. economy (Baxter 333). We have chosen to use lump-sum taxes as the method of financing spending to isolate the effects of a balanced budget on the economy, thus ignoring any deadweight loss (or economic inefficiency) that a distortionary tax may create.

The long-run effects of a permanent public investment shock are positive, even if this increase in government-financed investment is under the balanced budget constraint (Bom 352). Of course, investment is a key aspect of long-run economic growth as it increases the productive capacity of the economy (Abel et al. 237). This article, however, uses distortionary labor taxes to fund this government investment and consequently concludes that in the short run, the labor market distortions outweigh the benefits from increased investment (Bom 335). In the long run, the benefits surpass the costs. Our paper analyzes the effects of a balanced budget with non-distortionary taxes, this article generally supports the fact that increased government spending under a balanced budget has beneficial long-run impacts.

One article argues that regardless of the $MPC$, the short-run balanced budget multiplier is exactly 1 since the magnitude of the government expenditures multiplier on output is always 1 larger than the tax multiplier's magnitude (Haavelmo 315). This article operates under the assumption that investment is fixed; however, it ignores other factors such as crowding out which can hurt investment and reduce the output growth in the long run. Another article that examined empirical data from 1930 to 1985 and used a restricted neoclassical model concluded that a permanent government spending shock has a positive long-run output multiplier greater than 1, specifically when funded by lump-sum taxes. This is because the taxes create an income effect for workers, in which workers supply more labor in response to becoming less wealthy (Baxter 320-321). The rise in employment in turn increases $MPK^f$ since this shock is permanent. Thus, investment increases and long-run growth are stimulated, confirming our hypothesis.

Our final article examines an endogenous growth model with public capital and debt. It concludes that a balanced budget always leads to a higher growth rate in the long run compared to that where the public debt grows at the same rate as output in a deficit scenario. While a deficit-financed increase in public investment raises the short-run growth of the economy, it lowers long-run growth (Greiner 473). This is because any debt accrued by the government must eventually be serviced and requires resources. Therefore, this article supports our hypothesis and offers a counterargument to those who support a government deficit scenario where debt grows at the same rate as output.

## 2.2. Our Contribution

This project differs from existing literature in that (1) we analyze a balanced budget from a purely economic standpoint, hence our assumption regarding lump-sum taxes, (2) we consider a strictly balanced budget, ignoring policy suggestions such as tax-smoothing until the conclusion, (3) we look at government spending for any general purpose, rather than specific ones like war, (4) we draw a more direct comparison between the short- and long-run tradeoffs of a balanced budget, and (5) we perform a more dynamic analysis than some of these papers; for instance, we drop the assumption that investment is fixed during a government spending shock.

# 3. Macroeconomic Shock and Microfoundations

## 3.1. Defining the Shock

Our shocks will be real, demand shocks in which the economy experiences an increase in government spending financed entirely by lump-sum taxes. We will analyze both a temporary and a permanent shock under a balanced budget, as well as the short-run and long-run impacts in each case.

## 3.2. Temporary Shock

The first shock we will consider is temporary. For example, the U.S. may increase government spending and lump-sum taxes by the same amount for military production during a war.

### 3.2.1. Labor Market

To determine the effect on how much labor the individual supplies, we turn to the income-leisure tradeoff. Like the intertemporal choice model, $BL$ represents the feasible combinations of consumption and leisure, while $IC$ represents all combinations of consumption and leisure which yield the same level of utility (Abel et al., 81). The equation of $BL$ relates the sum of leisure $L$ and consumption $C$ in a day to the number of available hours in a day $N_{max}$, the real wage $w$, the number of hours worked $N$, and initial wealth. This relationship is shown in Equation (1).

$$C + L = w\,N + a \tag{1}$$

Notice that $L = N_{max} - C$ since the time not spent working is considered leisure. The slope of $BL$ is $-w$ as the real wage represents the tradeoff between consumption and leisure. The optimal combination occurs where the slopes of $BL$ and $IC$ are equal, as seen in Figure 1.

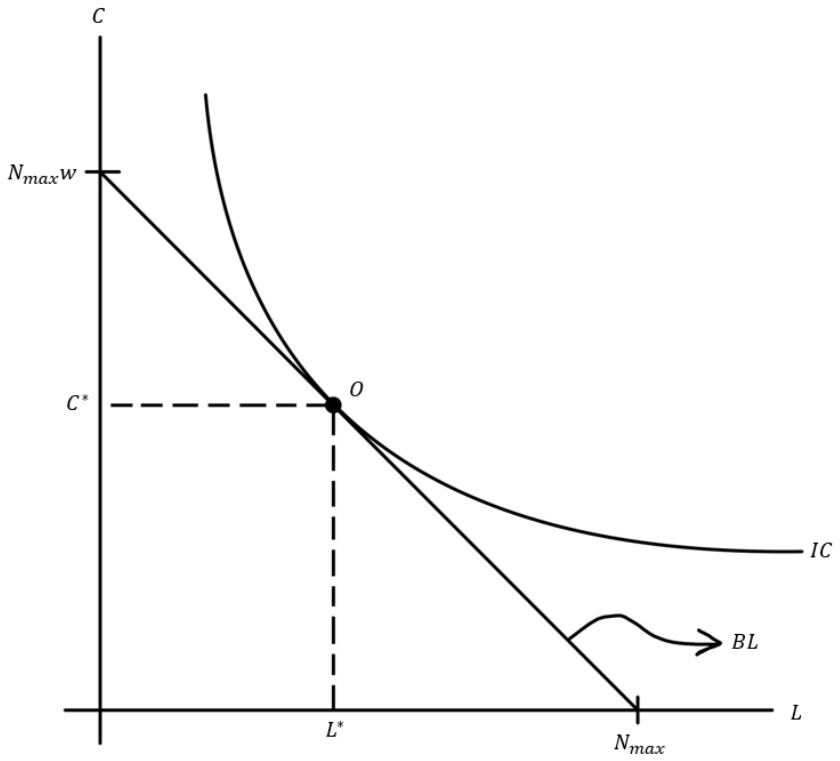


Figure 1. Income-Leisure Tradeoff

The increase in lump-sum tax on $w$ reduces the amount of consumption and leisure that a worker can afford since the maximum after-tax earnings fall from $N_{max}\, w\, (1 - t_1)$ to $N_{max}\, w\, (1 - t_2)$, where $t_2 > t_1$.

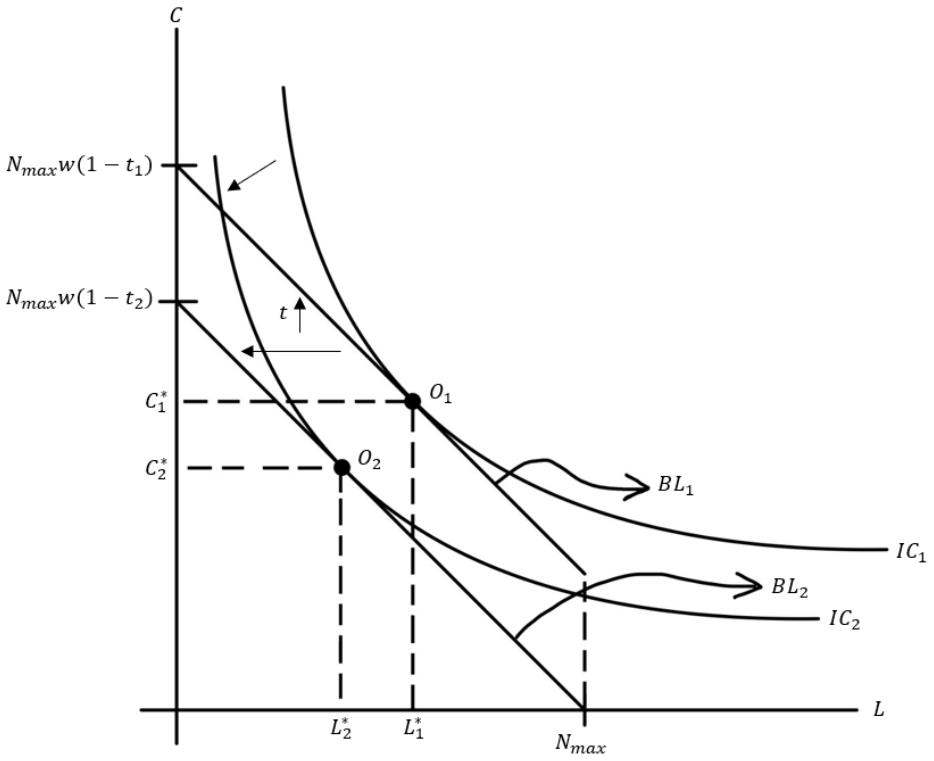


Figure 2. Effect of Lump-Sum Tax Increase on Income-Leisure Tradeoff

Thus, because of this pure income effect, the worker chooses to reduce $C$, which is consistent with our results from the intertemporal choice model. The worker also reduces $L$, and as a direct result, increases labor supplied $N$ since $N = N_{max} - L$. Implications of these decisions will be discussed in the partial equilibrium analysis.

### 3.2.2. Goods Market

The underlying foundations of the goods market equilibrium lie in the two-period intertemporal choice model, in which a consumer faces the tradeoff between current and future consumption. People's desire to maintain a stable pattern of consumption over the present and future is known as the consumption-smoothing motive (Abel et al., 115). To determine the optimal combination of consumption, we use a graph with future consumption $c^f$ on the vertical axis and current consumption $c$ on the horizontal axis. Another assumption is that consumers spend all their income over their lifetime (Abel et al., 161). We begin with a budget line that depicts the possible

consumption combinations for the consumer. This line, then, is defined by equating the present value of lifetime resources ($PVLR$) with the present value of lifetime consumption ($PVLC$).

$$PVLC = PVLR \tag{2}$$

$$c + \frac{c^f}{1+r} = a + y + \frac{y^f}{1+r} \tag{3}$$

In Equation (3), $a$ is wealth at the start of the current period and $r$ is the real interest rate, which determines the present value of $y^f$ and $c^f$. Solving Equation (3) for $c^f$ in terms of $c$, we obtain the equation for the budget line $BL$ whose slope is $-(1+r)$. The vertical intercept is given by the future value of lifetime resources ($FVLR$), while the horizontal intercept is given by $PVLR$. These intercepts represent the extremes of spending all money on future consumption, or current consumption, respectively. The endowment point $E$ is where the consumer neither saves nor borrows; that is, where $c = y + a$ and $c^f = y^f$.

We must also introduce an indifference curve $IC$ which depicts the combinations of $c$ and $c^f$ which gives the consumer a given amount of utility $U$. It slopes downward as giving up $c$ would necessitate a higher level of $c^f$ as a tradeoff. Specifically, the slope's magnitude equals the marginal rate of substitution between $c$ and $c^f$. Indifference curves farther from the origin yield more utility since they allow for more consumption in both the present and future. It is also bowed toward the origin because of the consumption-smoothing motive (Abel et al., 162).

Combining the budget line constraint with the indifference curve, we can determine the optimal level of consumption with point $O$ in Figure 3, which is where the slopes of $IC$ and $BL$ are the same.

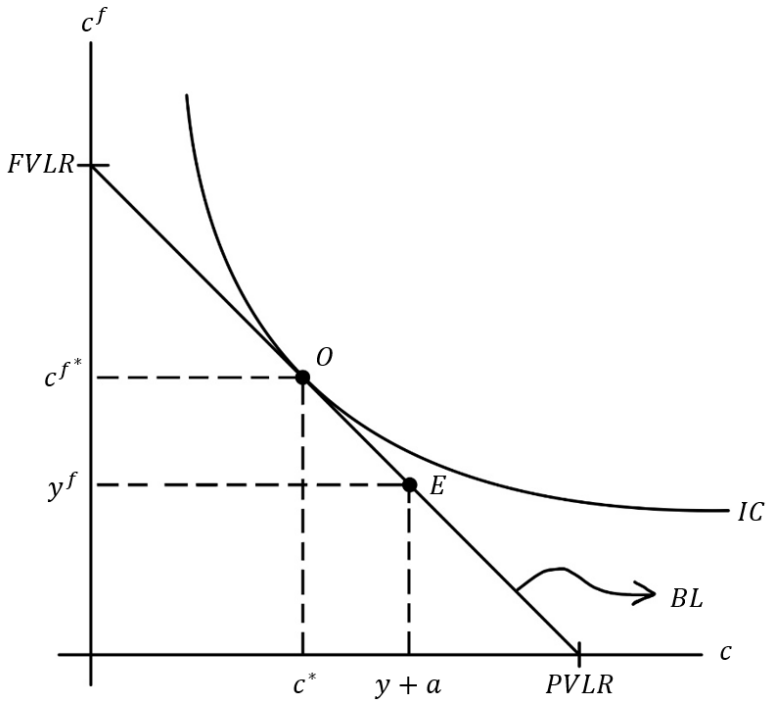


Figure 3. Optimal Consumption Point from Intertemporal Choice Model

Now, suppose the government spending shock hits, and the consumer experiences an increased lump-sum tax. Since this is a temporary shock, the increased tax only reduces current income $y$ by the same amount. Thus, the $BL$ and $IC$ curves shift inwards towards the origin; the consumer can now enjoy less $c$ and $c^f$ at the new optimal consumption level $O_2$ in Figure 4 (Abel et al., 165).

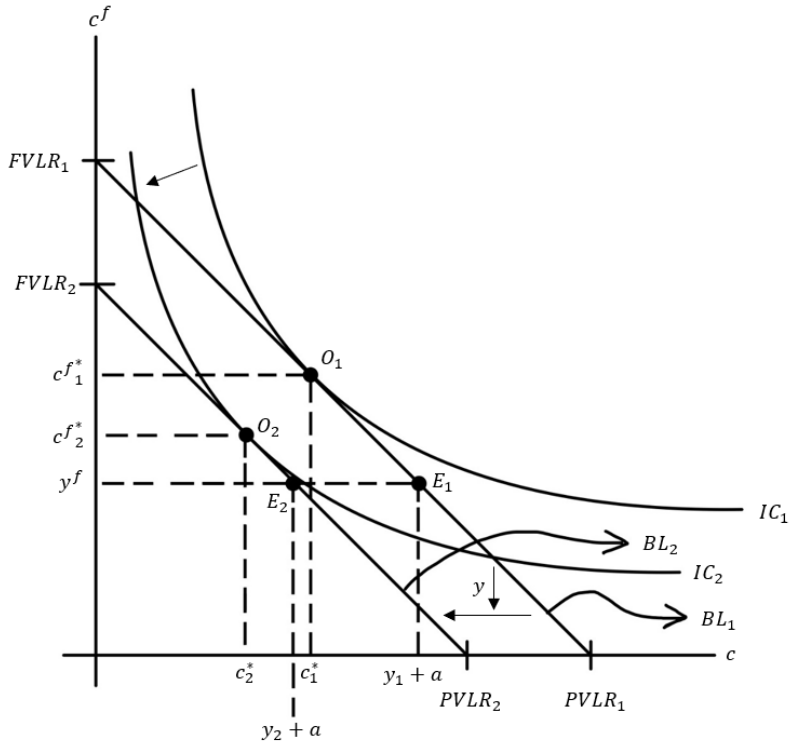


Figure 4. Effect of Reduced Current Wealth on Intertemporal Choice Model

We know that the consumer's saving $s$ equals $y - c$. Thus, $y$ falls, but $c$ falls by a smaller amount since the consumer's $MPC$ is between $0$ and $1$, and the consumer's saving falls. The result of the increased lump-sum tax to finance government spending is that $c$, $c^f$, and $s$ all fall.

The temporary rise in government purchases financed by lump-sum taxes affects national savings. We concluded from the intertemporal choice model that a fall in current income reduces current consumption. Desired saving is given by

$$S = Y - C - G \tag{4}$$

In Equation (4), we know that the reduction in $C$ is less than the increase in $T$ due to the consumption smoothing motive. As $T = G$, the increase in $G$ is greater than the reduction in $C$. Thus, the net effect is that desired saving falls.

There is no effect on investment since firms do not update their $MPK^f$ based on a temporary shock.

### 3.2.3. Asset Market

Since this is a real shock, the asset market is unaffected.

## 3.3. Permanent Shock

The second shock we will consider is a permanent increase in government spending financed by an increase in lump-sum taxes on labor.

### 3.3.1. Labor Market

In the permanent case, our analysis using microfoundations will produce similar results. With the income-leisure tradeoff, we will see that in response to the tax increase, workers will consume less, have less leisure, and supply more labor. Arguably, the rise in labor supplied is more than in the temporary case since workers know that their future real wages are also going to be affected.

### 3.3.2. Goods Market

As for the intertemporal choice model, the permanent income theory plays a role. The theory states that income only affects consumption through the $PVLR$ (Abel et al., 167). Since both $y$ and $y^f$ are reduced in the permanent case (as opposed to only $y$ in the temporary case), $PVLR$ is more heavily impacted in the permanent case. This is seen through a larger inward shift of $BL$ in Figure 4. Therefore, the reduction in current consumption $c$ that we observed in the temporary case will be magnified.

Since we concluded that the permanent shock has a more profound impact on $C$, we can conclude that $S$ will fall by a higher amount in the permanent case than in the temporary case.

A significant difference in the permanent case is that we will see a change in firms' desired investment to maximize profit. Desired capital stock ($K^*$) is the level of capital at which the expected future marginal product of capital $MPK^f$ equals the user cost $uc$. $K^*$ is found by equating marginal benefit and marginal cost (Abel et al., 132).

As will be explained in the partial equilibrium analysis, an increase in labor supply will increase employment $N$. Let us turn to the aggregate production function ($APF$). The Cobb-Douglas form is given by

$$Y = A\,K^{\alpha}\,N^{1-\alpha} \tag{5}$$

where $A$ is total factor productivity. Then, $MPK = \frac{\partial Y}{\partial K} = \alpha\, A \left(\frac{N}{K}\right)^{1-a}$, which is the partial derivative of Equation (5) with respect to capital. Thus, an increase in $N$ raises the $MPK$. Since the shock is permanent, firms will update their expectations of $MPK^f$ such that it will increase as more workers are assigned to each unit of capital.

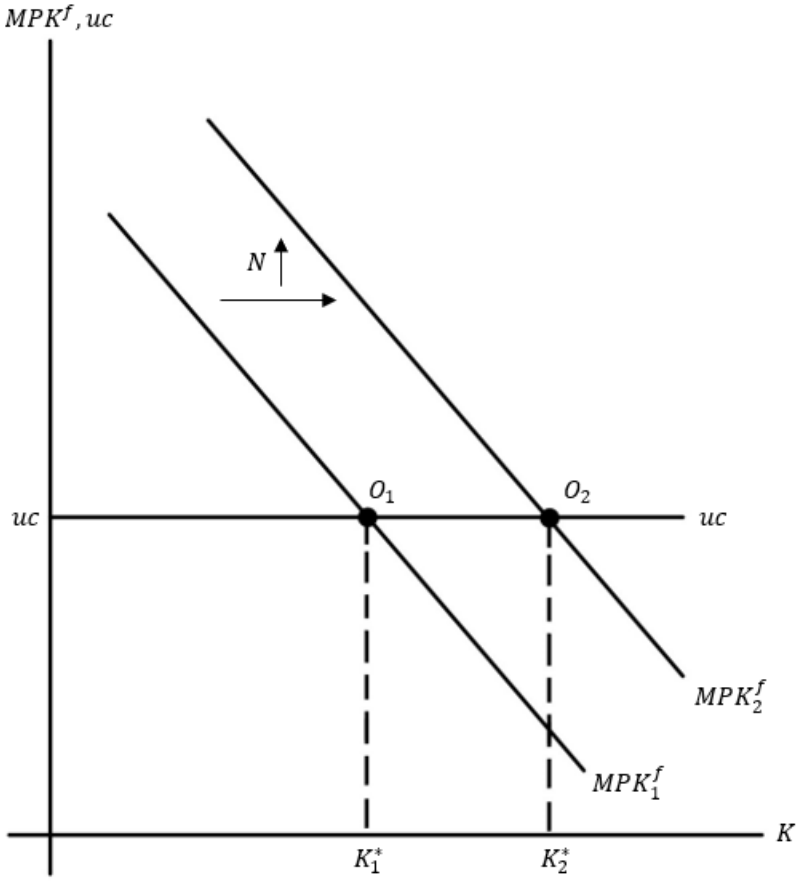


Figure 5. Effect of an Increase in Labor on Desired Capital Stock

As a result of this shift in the $MPK^f$ curve, firms' desired capital stock will increase.

### 3.3.3. Asset Market

Since this is a real shock, the asset market is still unaffected.

# 4. Partial Equilibrium Analysis

## 4.1. Temporary Shock

### 4.1.1. Labor Market

Under the assumption of a balanced government budget, we will analyze this shock of increased government spending assuming an increase in lump-sum taxes will cover that increase. Thus, each worker will be faced with effectively a smaller income. This manifests itself as less consumption and leisure, thus more labor supplied, as previously discussed in establishing the microfoundations of the labor market.

This shift in the decision of each household to supply more labor due to a temporary tax increase has a large impact on the partial equilibrium in the labor market. In looking at this market, we see the supply of labor as a function of real wage ($w$). For the aggregate national economy, we see an increase in the labor supply as $w$ increase as people are forced to sacrifice more leisure for the same level of earnings as previously discussed in the income-leisure tradeoff with the income effect. We also find that firms will increase how much labor they demand when $w$ decreases. Like the $MPK$, the $MPN$ experiences diminishing returns. Firms' hiring decision is directly impacted by the change in $w$ as $MPN$ is set equal to $w$ (Abel et al. 77). Due to the nature of the diminishing returns of $MPN$, firms will want to increase the amount of labor ($N$) they employ as $w$ decreases (represented by a movement along the $ND$ curve). These two relationships can be shown graphically if we look at $w$ vs $N$.

When we consider the household decision of how much labor to supply as a response to the tax increase, we find that more labor will be supplied for the same $w$. This manifests itself as a rightward shift in the labor supply curve.

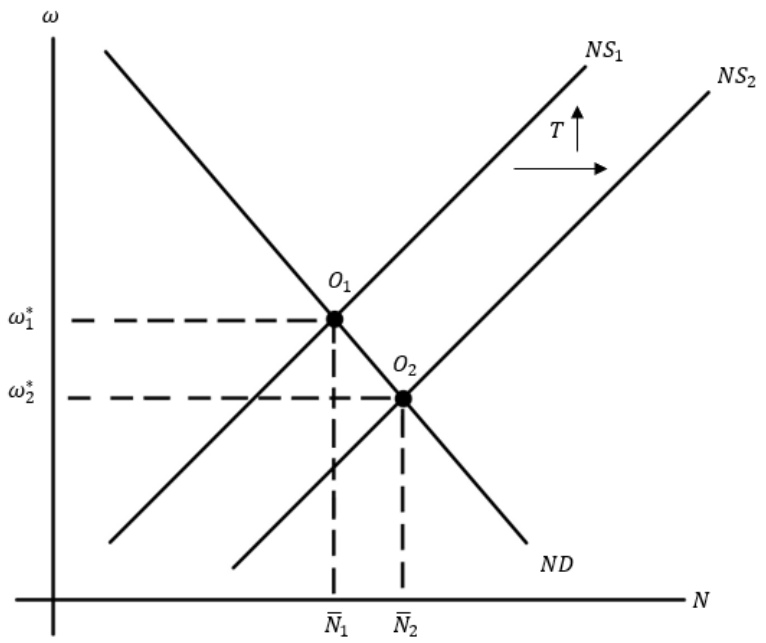


Figure 6. Labor Market Equilibrium Shift

Overall, this shock affects the labor market equilibrium in two ways: $w$ will decrease and $N$ will increase.

### 4.1.2. Goods Market

When analyzing the goods market for a temporary increase in government spending and an equivalent increase in taxes, we must first understand what it is that the goods market measures. Analyzing the goods market helps us to understand the relationship between national saving ($S$) and the real interest rate ($r$), as well as capital stock ($I$) and $r$. We can understand this model rationally by thinking about how different parties would respond to different levels of $r$. Those who are saving would want to increase the amount they save when $r$ increases as they experience a larger return on their savings. Those who invest could increase the amount of capital they purchase when $r$ decreases. We know that as a nation, saving is what funds investment, so these quantities must be equivalent under the assumption of a closed economy in equilibrium (Abel et al. 143). So, the intersection of these two curves will tell us what levels $S$, $I$, and $r$ will be at equilibrium. This is what a baseline case would look like in the goods market.

As discussed in establishing the micro foundation of the goods market, when government spending increases temporarily, we will find a net decrease in aggregate

savings according to Equation (4), which states that $S = Y - C - G$ (Abel et al. 143). Graphically, the goods market would change via a shift in the savings curve.

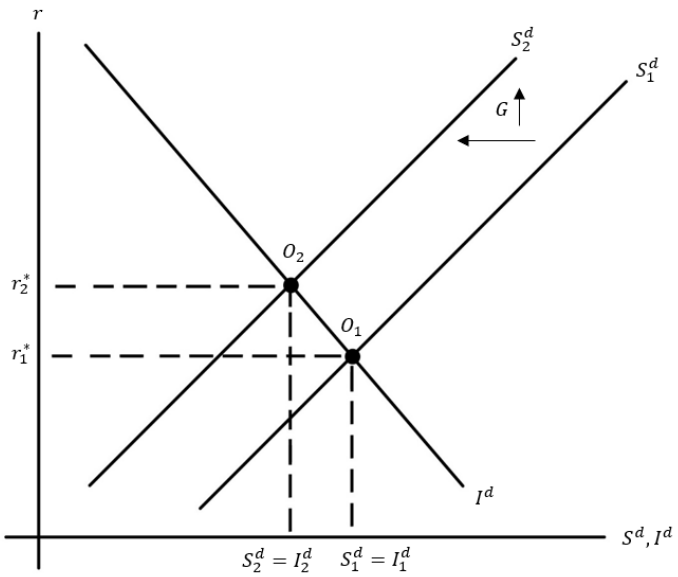


Figure 7. Goods Market Equilibrium Shift

As can be seen, the equilibrium $r$, $S$, and $I$ are all impacted by this shock. $S$ and $I$ will both decrease with the shift in the savings curve, and $r$ increases. The increase in $r$ is shown also through leftward movement on the investment curve, representing the crowding out effect of government spending. Investment falls since the user cost of capital is higher with a bigger real interest rate.

#### 4.1.3. Asset Market

Since the shock being analyzed is a real one, the asset market will be unaffected.

## 4.2. Permanent Shock

#### 4.2.1. Labor Market

Qualitatively speaking, a permanent increase in government spending and taxes will affect the labor market in the same manner as a temporary shock, but more intensely. This was established in the microfoundation section as future income is affected as well as current income in the permanent case. If we compare the resultant shift to the model space of the labor market, it will look something like this.

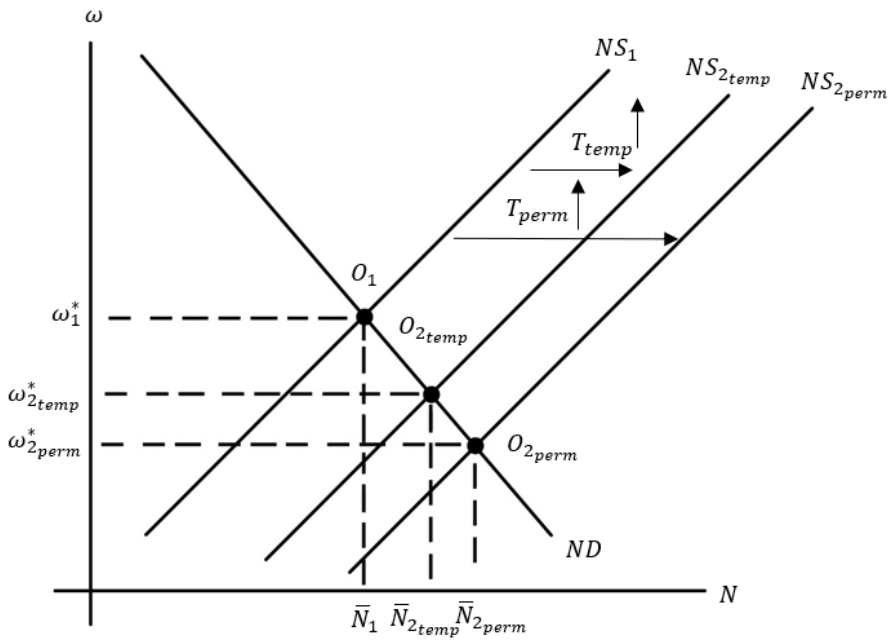


Figure 8. Temporary Versus Permanent Shocks in Labor Market

We see that $w$ and $N$ are affected in the same manner, but a permanent shock affects the supply curve more drastically than a temporary one.

### 4.2.2. Goods Market

As discussed in establishing the microfoundation for the goods market for a permanent increase in government spending and taxes, it was concluded that not only will the savings decision be affected as in the temporary case, but the capital stock will also be affected. This was found as $MPK^f$ increases when $N$ increases for a permanent shock. In other words, at any given $r$, firms will desire more capital stock as it will be put to better use with more $N$. We also see a more drastic decrease in $C$ for the same increase in $G$ for a permanent shock, thus the savings curve will be impacted slightly less than it was in the case of a temporary shock. Comparing the two shocks in the goods market model space shows us a different response.

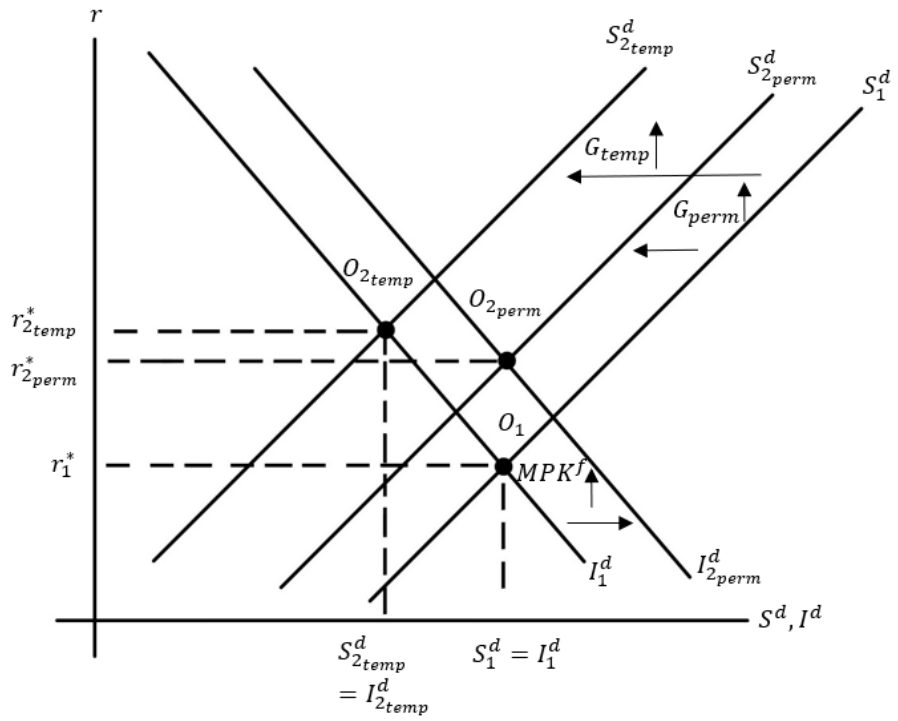


Figure 9. Temporary Versus Permanent Shocks in Goods Market

As can be seen in the figure, it is ambiguous what direction $S$ and $I$ will change, or if there will be a change at all. However, we will undoubtedly see a rise in $r$ as the changes in both the savings curve and investment curve result in an increased $r$.

#### 4.2.3. Asset Market

Since the shock being analyzed is a real one, the asset market will be unaffected.

## 4.3. Long-Run Growth Effects

Although we cannot know for certain how certain factors, such as $MPC$, would change in the long-run case if this policy were in place for a long period, we can still try to make predictions based on reasonable assumptions to inform policy decisions as best we can. If we want to look at what is likely to occur in the long run as an effect of a balanced government budget, we can start by looking at the results of endogenous growth theory.

Endogenous growth theory states that $Y = AK$ and through the capital evolution equation:

$$\frac{\Delta Y}{Y} = s\,A - d \tag{6}$$

where $s$ is the savings rate, $A$ is total factor productivity, and $d$ is the depreciation rate of capital (Abel et al. 236-237). In the long run, the initial labor market effects would essentially have no impact on national growth according to the growth theory. However, we still would see a decrease in $s$ as an implication of increased taxes relative to government spending as we find in the consumption smoothing motive microfoundation. This effect alone would tell us that the economy would decrease if the budget was balanced. However, with increased funding to the government budget, we may also find that this change increases $A$ as well. Through different programs such as infrastructure improvements and education spending, we may see an increase in productivity and human capital that leads to the increase in $A$ outweighing the decrease in $s$.

As a result, using a simple endogenous growth model, such as the one presented, to predict what would be the implications of balancing the budget net ambiguous qualitative shifts. This would have to be assessed more in-depth quantitatively using realistic proposed budget numbers and potentially a better but more complex model to reach a more straightforward conclusion on this front. Also, we cannot accurately predict what would happen to the savings rate in our current economic system unless we get rid of our assumption of a closed economy as different international factors could potentially play a large role in assessing the actual advantages and disadvantages associated with balancing the budget.

# 5. General Equilibrium Model

## 5.1. Temporary Shock

From the partial equilibrium analysis of the labor market, we find an increase in labor supply due to the increased taxation decreasing disposable income. From the goods market, we find an increase in real interest rate due to the decrease in savings. We assumed that the shock is real and does not affect the asset market.

### 5.1.1. IS/LM/FE Model

The increase in labor supply will increase the full employment level and shift the $FE$ line to the right. The increase in the goods market real interest rate will shift the $IS$

curve to the right. Since the increase in labor supply is an indirect effect of the increased taxation and government spending, while the decrease in desired level of savings and investment is a direct effect, we assume that the shift in $FE$ line is smaller than the shift in the $IS$ curve. Thus, in the short run, the economy moves from $E_0$ to $m$; the output increases from $\bar{Y}_0$ to $Y_1$; the real interest rate increases from $r_0^*$ to $r_1$. In the long run, $LM$ curve will shift up to restore the general equilibrium, price level will increase, economy will move from $m$ to $E_1$; the output decreases from $Y_1$ to $\bar{Y}_1$; the real interest rate increases from $r_1$ to $r_1^*$.

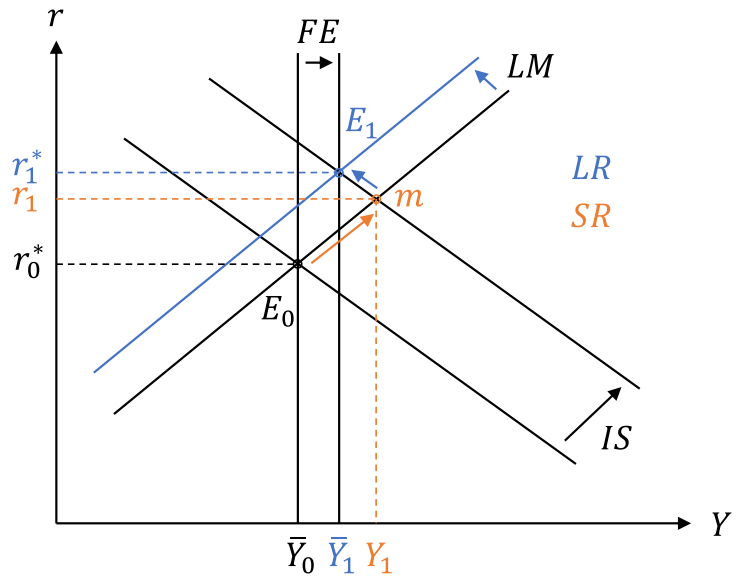


Figure 10. General Equilibrium in IS-LM Model

### 5.1.2. AD/AS Model

The increase in labor supply will increase the full employment level and shift the $LRAS$ line to the right. The increase in government spending will shift the $AD$ curve to the right. Since the increase in labor supply is an indirect effect of the increased taxation and government spending, we assume that the shift in $LRAS$ line is smaller than the shift in the $AD$ curve. Thus, in the short run, the economy will move from $E_0$ to $m$; the output increases from $\bar{Y}_0$ to $Y_1$; the price level increases from $P_0^*$ to $P_1$. In the long run, $SRAS$ will shift up to restore the general equilibrium, price level will increase, economy will move from $m$ to $E_1$; the output decreases from $Y_1$ to $\bar{Y}_1$; the price level increases from $P_1$ to $P_1^*$.

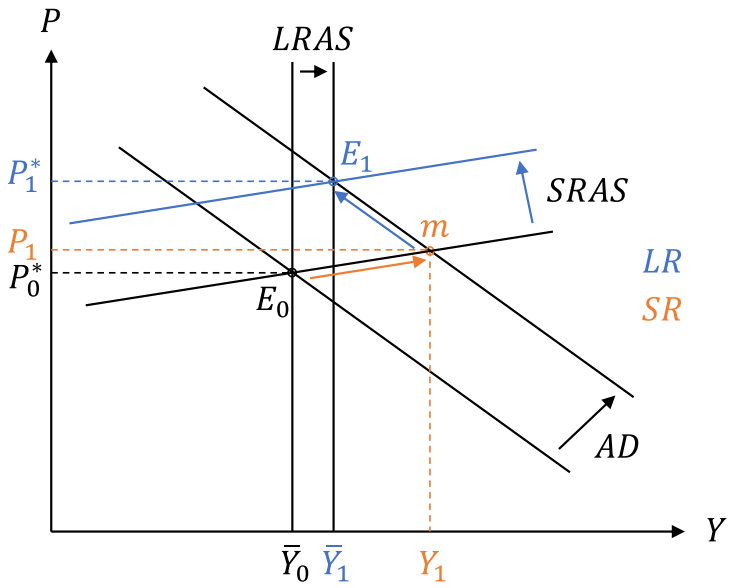


Figure 11: General Equilibrium in AD-AS Model

#### 5.1.3. Impact on Endogenous Variables

Table 1. Predicted Effect on Endogenous Variables (Temporary)

| | $Y$ | $w$ | $N$ | $r$ | $C$ | $I$ | $P$ |
|---|---|---|---|---|---|---|---|
| Short Run | ↑ | ↓ | ↑ | ↑ | ↓ | ↓ | ↑ (slightly) |
| Long Run | ↑ | ↓ | ↑ | ↑ | ↓ | ↓ | ↑ |

## 5.2. Permanent Shock

For the general equilibrium models, the difference between temporary shock and permanent shock cases are small. From the partial equilibrium analysis, we found that the shock would have the same effects, just with larger magnitudes.

#### 5.2.1. IS/LM/FE Model

The magnitudes of the shift in the $FE$ line and the $IS$ curve will be larger for the permanent shock case. Otherwise, the analysis would be the same.

#### 5.2.2. AD/AS Model

The magnitudes of the shift in the $LRAS$ line and the $AD$ curve will be larger for the permanent shock case. Otherwise, the analysis would be the same.

### 5.2.3. Impact on Endogenous Variables

Table 2. Predicted Effect on Endogenous Variables (Permanent)

| | $Y$ | $w$ | $N$ | $r$ | $C$ | $I$ | $P$ |
|---|---|---|---|---|---|---|---|
| Short Run | ↑ | ↓ | ↑ | ↑ | ↓ | ? | ↑ (slightly) |
| Long Run | ↑ | ↓ | ↑ | ↑ | ↓ | ? | ↑ |

## 5.3. Consumption Function Estimation

### 5.3.1. Developing an Equation

We estimated the consumption function with U.S. data from 1970 to 2020 to determine the marginal propensity to consume of the United States. Our data were obtained from the U.S. Bureau of Economic Analysis, the Organization for Economic Co-operation and Development, the World Bank, and the Board of Governors of the Federal Reserve System. The value of the marginal propensity to consume will help us evaluate our theoretical analysis by understanding the severity of shocks discussed in earlier sections. When determining which variables to include, we found that "mainly unexpected, not expected, change in income and wealth … causes consumption to change" (Deaton, 505). Our consumption function will be of the form

$$C = c_0 + c_y \cdot (Y - T) + c_{yf} \cdot (Y^f - T^f) - c_r \cdot r + c_a \cdot a \tag{7}$$

where our variables are defined by the following table.

Table 3. Variable Description

| Variable Name | FRED Code | Description |
|---|---|---|
| Real GDP ($Y$) | GDPC1 | Real Gross Domestic Product, Billions of Chained 2012 Dollars, Annual, Seasonally Adjusted Annual Rate |
| Nominal Interest Rate ($i$) | IRLTLT01USM156N | Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for the United States, Percent, Annual, Not Seasonally Adjusted |
| Inflation ($\pi$) | FPCPITOTLZGUSA | Inflation, consumer prices for the United States, Percent, Annual, Not Seasonally Adjusted |
| Tax Revenue ($T$) | W006RC1Q027SBEA | Federal government current tax receipts, Billions of Dollars, Annual, Seasonally Adjusted Annual Rate |
| Wealth ($a$) | BOGZ1FL892090005Q | All Sectors; U.S. Wealth, Level, Millions of Dollars, Annual, Not Seasonally Adjusted |
| Real Personal Consumption ($C$) | PCECCA | Real Personal Consumption Expenditures, Billions of Chained 2012 Dollars, Annual, Not Seasonally Adjusted |

Note that future tax revenue ($T^f$) and future real GDP ($Y^f$) were obtained using data from the next annual period. We then took the natural log of every variable besides the real interest rate and ran a regression on the data. Our new consumption function equation is of the form:

$$ln\, C = \mathrm{a}_0 + \mathrm{a}_1 \cdot \mathrm{r} + \varepsilon \cdot ln(Y - T) + \varepsilon_{\mathrm{f}} \cdot ln(Y^f - T^f) + \varepsilon_a \cdot ln\, a + e \quad (8)$$

### 5.3.2. Regression Analysis

From our regression analysis, we found that after-tax income, after-tax future income, and real interest rate were all statistically significant in determining consumption. The only variable we found to be statistically insignificant was wealth, which we used the wealth in all U.S. sectors to estimate. One possible reason wealth may not have been

statistically significant is because of the estimation provided by the proxy of U.S. sector wealth. There is no real, established measure of wealth across the nation and we decided it was our best option. The best way to improve this estimation would be to find a clearer proxy for wealth.

We also found that after-tax income, future after-tax income, and wealth all are positively related to consumption, which matches our model prediction. In our analysis, the real interest rate was inversely related to consumption, also matching our theoretical model.

Table 4. Regression Result

| Variable Name | Coefficient | P-value |
|---|---|---|
| ln (After Tax Income) | 0.864219416 | 1.36167E-11 |
| ln (Future After Tax Income) | 0.280358963 | 0.002263857 |
| Real Interest Rate | -0.001654023 | 0.048376965 |
| ln (Wealth) | 0.004213239 | 0.776640426 |

### 5.3.3. Implications for our Model

We then used the coefficients of our regression analysis to determine the marginal propensity to consume of the United States. We multiplied the $\varepsilon$ coefficient provided by the regression by the ratio of average consumption over our period to the average after-tax income of our period. The equation looks like

$$\varepsilon \cdot \frac{C_{avg}}{(Y-T)_{avg}} = MPC \tag{9}$$

Using Equation (9), we found that, for the average consumer, marginal propensity to consume ($MPC$) was 0.57. This means that for each extra dollar in after-tax income, 57 cents will be spent on private consumption. We had chosen 0.5 as a benchmark for the $MPC$ to which we would compare out results. Because the $MPC$ was greater than 0.5, changes in the real gross domestic product will have a relatively large effect on desired consumption (compared to $MPC = 0.5$). Since $MPC$ is inversely related to the slope of the $IS$ curve, this means that the slope of our $IS$ curve will be steeper than when the $MPC$ is less than 0.5. So, when the FED conducts monetary policy to shift

the $LM$ curve, there will be less effect on output because the output does not change significantly with a steep $IS$ curve. Thus, monetary policy may not be a very effective tool.

# 6. Empirical Data Comparison

The first challenge we came across when collecting empirical data was finding a time when government expenditures were equal to or similar tax revenue. In the 1990s, America was running a nearly balanced budget and even a slight surplus in the late 1990s. So, we started our search there. We found that in 1998, the federal government expenditures were $1788.4 billion, and tax receipts totaled $1095.3 billion ("Table 3.2"). Our main shock analysis that $G = T$ is not completely met by this year; however, when comparing the change in billions of dollars from the previous year, the change in tax revenue was almost identical to the increase in government expenditures, so this could simulate an increase in government expenditures funded almost entirely by an increase in tax. So, we will compare our model assumptions to empirical data in the year 1998, and possibly explain why our model predictions and empirical data aren't identical.

In 1998, there was both an increase in government expenditures and tax revenue. Under our assumption that these were lump-sum taxes, this would cause a decrease in expendable income, so we predicted that the labor supply would shift right because of this income effect. In 1998, we saw an increase in the civilian labor force level, which agrees with our prediction that labor supply would increase ("Civilian Labor Force Level"). Because of our increase in labor supply, we predicted that the real wage would decrease, and total employment would increase. The United States experienced an increase in employment and real wage during this time ("All Employees, Total Nonfarm"; "Median Usual Weekly Real Earnings"). One possible explanation for the increasing real wage is that this was a time of economic expansion in the U.S., so firms' capital stock may have been rising causing a larger shift in the marginal product of labor so that real wages would grow.

While full employment is increasing, we expected the full employment level of output to also increase. This was reflected in the empirical data, as 1998 real GDP had grown almost 4.5% from the previous year ("Real Gross Domestic Product"). We also predicted that total consumption in the United States would decrease due to disposable

income decreasing while taxes increased. However, the data states otherwise. Consumption in the U.S. grew by nearly $400 billion from the previous year ("Real Personal Consumption Expenditures"). One possible explanation for this consumption growth is the economic expansion that was witnessed during this period. This can be compounded by the general good feeling of the population, causing them to have a better outlook of the future and spend more money now.

The next prediction that came from our theoretical model was that national savings would decrease due to an increase in government savings. The data did not agree with this prediction. The gross national savings had risen by about $150 billion from the previous year ("Gross Saving"). One possible explanation for an increase in saving during this period of economic expansion is that stock prices were rapidly growing at that time, increasing investment demand, and optimal level of savings and investment in the goods market. We also predicted that the real interest rate would increase as our predicted national savings decreased. This was also not seen in the empirical data; we used the Fisher equation (Abel 54) to determine the real interest rate (Abel 54). We found that real interest rates declined from about 4% in 1997 to about 3.75% in 1998 ("Long-Term Government Bond Yields"; "Inflation, Consumer Prices"). This could have been since national savings were rising in 1998 rather than our model prediction that they were falling. Also, there was a slight increase in money supply during the period that our model did not consider ("M1"). This increase in the money supply would inversely affect the real interest rate in the short run.

Our model predicted an increase in aggregate demand, therefore causing an increase in the price level. This empirical data supports this conclusion, as there was a 1.55% increase in prices, which we discovered from the inflation rate at the time ("Long-Term Government Bond Yields", Organization for Economic Co-operation and Development) ("Inflation, Consumer Prices", World Bank).

Overall, we believe most of our predictions were slightly skewed because of our model assumption of ceteris paribus. There were lots of economic shocks happening in the late 1990s that were not considered in our model predictions. Even so, the balance of the government budget during the late 1990s was rarely seen before in U.S. history and hasn't been seen since, so we are confident that we analyzed the period that most closely resembles the theoretical shock.

# 7. Concluding Remarks

We faced several obstacles when conducting our research, specifically in the empirical comparison performed. The U.S. has never really operated under a balanced budget for an extended interval. It was also difficult to find individual government spending shocks during the 1990s, which is when the U.S. was closest to a balanced budget. Therefore, we were forced to find a year in which government expenditures increased by the same amount as taxes, which occurred in 1998. This, however, was during an economic boom, which means that the increase in government spending and taxes was not ceteris paribus; other factors in the prospering economy were also changing, making it difficult to isolate the effects of the real-life shock.

Future research can perhaps find other countries which maintain a more balanced budget than the U.S. and analyze its impact on their economy. Our analysis also assumes that the economy is closed, so further analysis should allow for an open economy, especially since the government deficit and current account deficits are so closely related that they are called the "twin deficits."

The assumption of a closed economy also has potential distorting effects when attempting to assess the long-run effects of a balanced government budget using an endogenous growth model. We cannot reasonably assess the implications such a policy would have relative to the current system if we do not present a more realistic picture of the current benefits and drawbacks associated with deficit spending.

Another limitation of our paper is that we assumed that the government uses lump-sum taxes to allow for analysis under economically efficient conditions. However, in the U.S., the government uses mostly distortionary taxes, which cause great inefficiencies in the economy and may cause worse results than we predicted with our analysis.

A balanced budget has important policy implications. The first is about the form of taxation. It would be best for the government to minimize distortions created by taxes, regardless of whether the government is balancing its budget. A potential solution is taxing based on ability rather than income. Of course, due to information asymmetry, it is hard to measure an individual's earning ability (Mankiw 4). A solution is lowering tax rates on the high-income brackets, contrary to progressive taxation theory. This

would incentivize "high-ability taxpayers to keep producing at the high levels that correspond to their ability" (Mankiw 5). Heavily taxing higher income brackets may distort the incentives of high-ability workers, who would then opt not to use their full ability and get a lower-paying job which has a smaller positive effect on the economy. Further research should go into optimal taxation methods since they can improve both the practicality of a balanced budget as well as long-run economic growth under a balanced budget constraint.

If the government must strictly balance its budget, then a lot of the business cycle smoothing will be up to the FED. However, from our consumption function estimation, we found that monetary policy will have a minimal output effect due to the relatively high $MPC$. Thus, government policy should allow for some short-run deviations but can keep a balanced budget overall across a longer period. This will allow for $AD$ shocks through government spending to reduce the severity in a recession, for example.

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