# Chapter 7
# Intertemporal Fiscal Policy

An issue that periodically receives much media attention is whether government spending and taxation decisions affect market interest rates. This issue was prominently in the news in the early 2000's when the Bush administration was considering lowering taxes and raising government spending. And it has again been prominent in the U.S. and in Western Europe as governments are faced with the specter of raising taxes and lowering government spending to reign in fiscal deficits.

The relationship between the government's fiscal position and market interest rates generates much debate among macroeconomists and politicians – some observers claim that there is a strong relationship between the two, while others claim there is no relationship at all.

In this chapter, we will study the theory behind this link, using as our basis a two-period framework, which highly resembles the two-period consumption-savings and the two-period investment analyses. Until now, we have neglected government in our two-period models, considering only consumers and firms. After defining some basic terms, we finally introduce a government into the framework. After working through the basic mechanics, we will consider under which circumstances there may be no relationship between the government's fiscal position and private-sector outcomes, as well as under which circumstances there may be.

There are two main "Fiscal Guideposts" that emerge from the analysis that helpfully place intellectual boundaries.

## Basic Terminology

You are probably familiar with terms such as a government budget deficit and budget surplus, but we briefly review the concepts. Items affecting the government's budget are termed **fiscal** items, and there are two notions of budget deficits/surpluses: primary and secondary. A **primary budget deficit (surplus)** exists in any given period if the tax revenue collected by the government in that period are smaller than (are larger than) the expenditures of the government in that period. A bit more mathematically, for any given period $t$, we compute the difference

$$\text{Government tax revenue}_t - \text{Government expenditure}_t \tag{26}$$

and if this quantity is negative the primary budget is in deficit in period $t$, while if this quantity is positive the primary budget is in surplus in period $t$. Finally, just to be clear, the primary budget is said to balanced if this quantity is exactly zero.

Another notion of the government's budget also takes into account interest payments (or interest receipts) on government assets. A **secondary budget deficit (surplus)** exists in any given period if the sum of the tax revenue and interest income collected by the government in that period are smaller than (are larger than) the expenditures of the government in that period. Mathematically, if in period $t$

$$\text{Government tax revenue}_t + \text{Government interest income}_t - \text{Government expenditure}_t \quad (27)$$

is negative the secondary budget is in deficit in period $t$, while if it is positive the secondary budget is in surplus in period $t$. The secondary budget is said to balanced if this quantity is exactly zero. Comparing expressions (26) and (27) shows that the primary and secondary budgets equal each other only when government interest income is zero.

The secondary budget generally receives less attention in the press in the U.S. because, despite the relatively large debt obligations of the federal government. This is because the interest rate on these debt obligations is actually relatively small compared to the other items in its budget (tax revenue and expenditures), so that the primary budget is usually approximately equal to the secondary budget in the U.S. But for other countries, especially for developing nations, this is often not the case.

We define real government savings in period $t$, which we denote by $s_t^{gov}$, to be equal to the secondary fiscal balance, so that if there is a secondary fiscal surplus, government savings is positive, while if there is a secondary fiscal deficit, government savings is negative.

# Government Budget Constraints

The important aspect of the government for studying the issue in which we are interested is the budget constraints of the government.[53] Just like the individual consumer in our two-period world, the government exists for each of the two periods. It has (real) budget constraints in period 1 and period 2, given, respectively, by

$$g_1 + b_1 = (1+r)b_0 + t_1 \quad (28)$$

and

$$g_2 + b_2 = (1+r)b_1 + t_2. \quad (29)$$

[53] We do not attempt to model a utility function for the government, because the welfare incentives of politically-elected leaders (who may want to design policy in such a way as to get re-elected) may not align with those the representative consumer's. This is a point of departure between macroeconomic analysis and political economy.

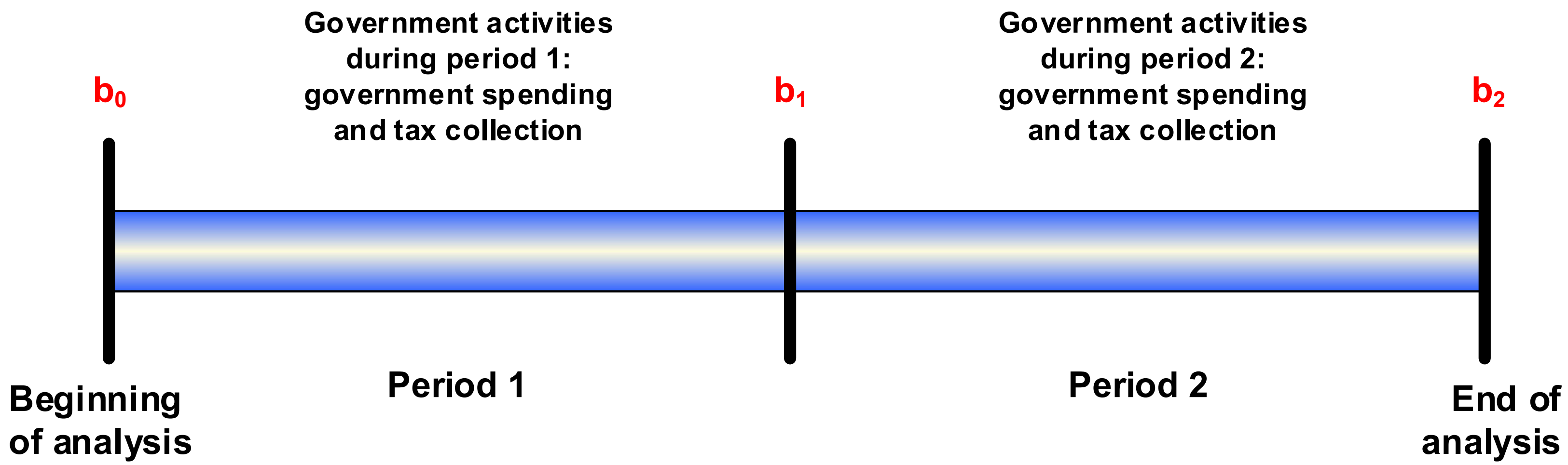


**Figure 39.** Timing of events for the government.

The notation is as follows: $g_1$ and $g_2$ denote real government spending in periods 1 and 2, respectively; $t_1$ and $t_2$ denote real tax revenue collected by the government in periods 1 and 2, respectively; and $b_0$, $b_1$, and $b_2$ denote the real asset holdings of the government at the end of periods 0, 1, and 2, respectively. As before, $r$ denotes the real interest rate between one period and the next. Compare these period-by-period budget constraints of the government with those of the individual consumer discussed in our initial look at the two-period model. Inspecting these reveals that they are completely analogous. The right-hand-side of expressions (28) and (29) is the income received by the government in each period, and the left-hand-side is the expenditure of the government in each period.

Again just like the consumer, the government knows that the economy ends at the end of period 2. Thus, there is no period 3 for the government to save for, and no rational institution (a bank or a foreign country, say) would allow the economy to end with the government indebted to it – thus, we must have that $b_2 = 0$. To further simplify matters, let us also make the assumption that the initial assets of the government are zero, i.e., $b_0 = 0$, an assumption which does not impact the main issue we want to consider, the relationship between the government's fiscal position and market interest rates.

As with the individual consumer in the two-period model, let us combine the two period-by-period constraints to find the **government lifetime budget constraint (LBC).** Solve equation (29) for $b_1$: after a couple of algebraic manipulations (and using the result that $b_2 = 0$) we have

$$b_1 = \frac{g_2}{1+r} - \frac{t_2}{1+r}. \tag{30}$$

Now insert this resulting expression into (28) (and note that we are assuming $b_0 = 0$) to get

$$g_1 + \frac{g_2}{1+r} = t_1 + \frac{t_2}{1+r}, \tag{31}$$

which is the government LBC. The government LBC has the usual interpretation of an LBC – it states the present discounted value of all current and future government spending must equal the present discounted value of all current and future tax revenue. In other words, the government must balance its budget in a lifetime sense, even if it does not balance it in any given period.

With our definition of government savings above and our assumption of b(0) = 0, government savings in period 1 is given by

$$s_1^{gov} = t_1 - g_1. \tag{32}$$

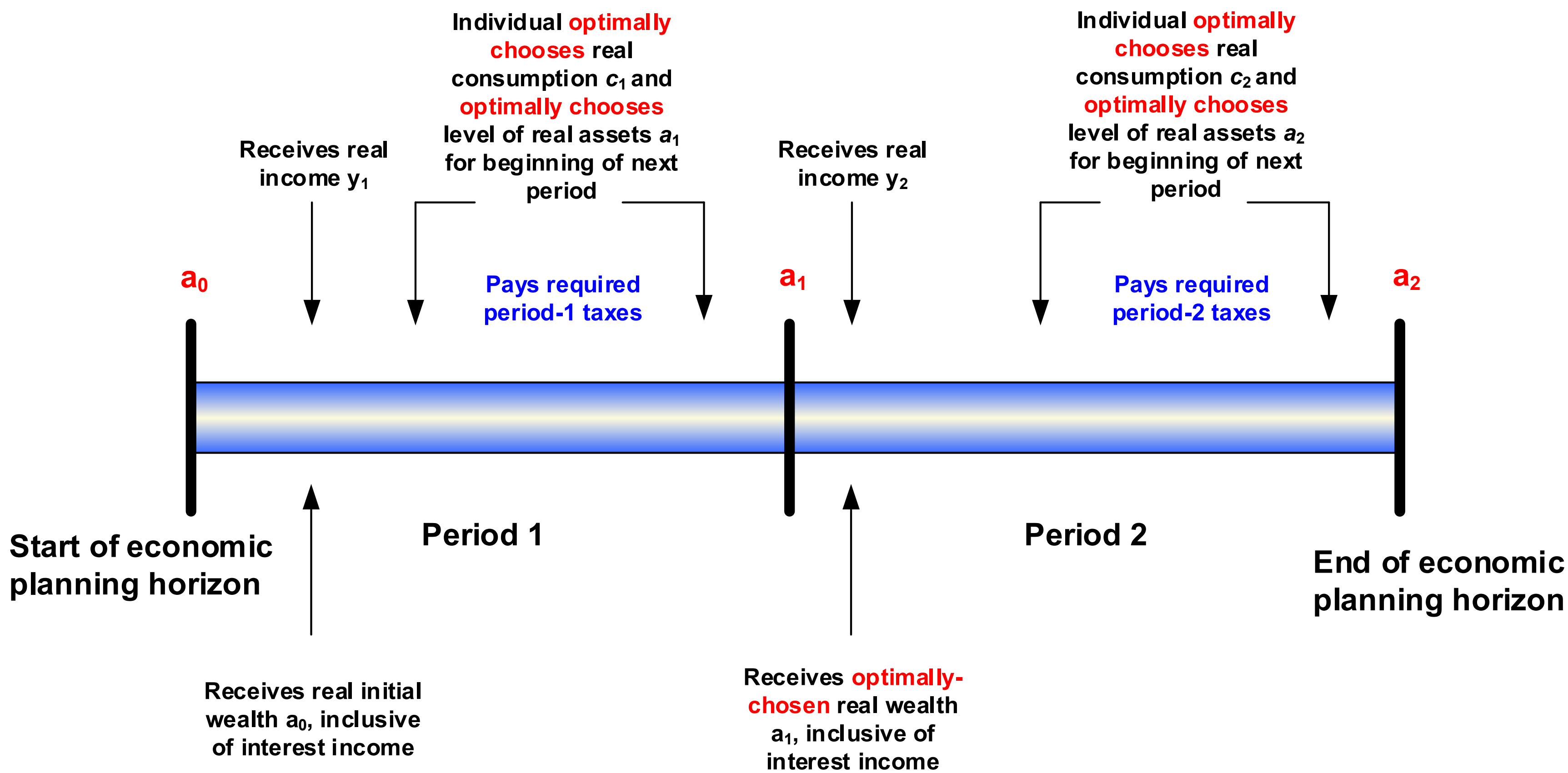


**Figure 40.** Timing of events in consumption-savings framework with taxes.

## Consumer Analysis Reconsidered

We also need to modify appropriately the consumer analysis to take into consideration that consumers must now pay taxes to the government. Figure 40 generalizes the two-period consumption-savings timeline to include payments of taxes. In real terms, the period 1 and period 2 budget constraints of the representative consumer are now given by

$$c_1 + t_1 + a_1 = (1+r)a_0 + y_1 \tag{33}$$

and

$$c_2 + t_2 + a_2 = (1+r)a_1 + y_2, \tag{34}$$

where we have defined the real wealth of the individual as $a = A/P$. That is, real wealth is simply nominal wealth divided by the price level.[54] Thus, $a_0$, $a_1$, and $a_2$ denote real wealth of the individual at the ends of periods 0, 1, and 2, respectively. For reasons already discussed, we have that $a_2 = 0$ and we again assume $a_0 = 0$. The tax terms $t_1$ and $t_2$ on the left-hand-side represent the fact that taxes are an expenditure item for the consumer.

Proceeding as we have done a couple of times now, we can derive the LBC for the consumer:

$$c_1 + t_1 + \frac{c_2}{1+r} + \frac{t_2}{1+r} = y_1 + \frac{y_2}{1+r}, \tag{35}$$

or, moving the tax terms to the right-hand-side,

$$c_1 + \frac{c_2}{1+r} = (y_1 - t_1) + \frac{(y_2 - t_2)}{1+r}. \tag{36}$$

This is the consumer's LBC in real terms, modified to include taxes. The second expression emphasizes that it is the present discounted value of *after-tax* income (i.e., the present value of lifetime *disposable* income) that the consumer has available to him to spend on lifetime consumption.

We must also extend the definition of private savings to take account of taxes. Real private savings in period 1 is now defined as

$$s_1^{priv} = y_1 - t_1 - c_1 \tag{37}$$

that is, private savings is disposable income less consumption.

[54] Just as any nominal variable is converted into a real variable.

## Ricardian Equivalence

We are now ready to begin considering our main issue, whether government spending and taxes affect interest rates, in particular whether they affect real interest rates. Throughout our discussion, we have taken the real interest rate $r$ as given from the perspective of the representative consumer, the representative firm, and the government.

Recall from the preview of the representative-agent approach that the intersection of the upward-sloping savings curve (in a graph with $r$ on the vertical axis and savings on the horizontal axis) and the downward-sloping investment curve determines the equilibrium real interest rate in the economy. Technically, it is the interaction of **national savings** and investment that determines the equilibrium $r$. National savings is defined as the sum of private and government savings,

$$s_t^{nat} = s_t^{priv} + s_t^{gov}. \qquad (38)$$

In our earlier analysis without government, $s_t^{gov}$ was implicitly zero, so that national savings coincided with private savings, but with government this is no longer the case. However – and this is a subtle yet crucial observation for the subsequent analysis – **government savings (or dis-savings) does not typically depend on market real interest rates.** Many politically-related issues affect government spending and taxation, which in turn directly affects government savings, regardless of what market interest rates might be. Political economy issues are outside the scope of our analysis.

However, recall that private savings does depend on the market real interest rate, through its effect on the slope of the consumer's LBC. As we have already studied, private savings is an increasing function of the real interest rate. Government savings, though, is much less reliant on market real interest rates because spending and taxation legislation can largely reflect other concerns.

Supposing that government savings is independent of the real interest rate, national savings is thus also an increasing function of the real interest rate. Thus, the equilibrium real interest rate is determined as shown in **Figure 41**, in which both savings and investment are plotted on the horizontal axis.

Next, we perform a number of algebraic manipulations to examine the relationship between government savings and the real interest rate. Adding together the consumer's LBC and the government LBC, we get the **LBC of the economy:**

$$c_1 + \frac{c_2}{1+r} = (y_1 - g_1) + \frac{(y_2 - g_2)}{1+r} \qquad (39)$$

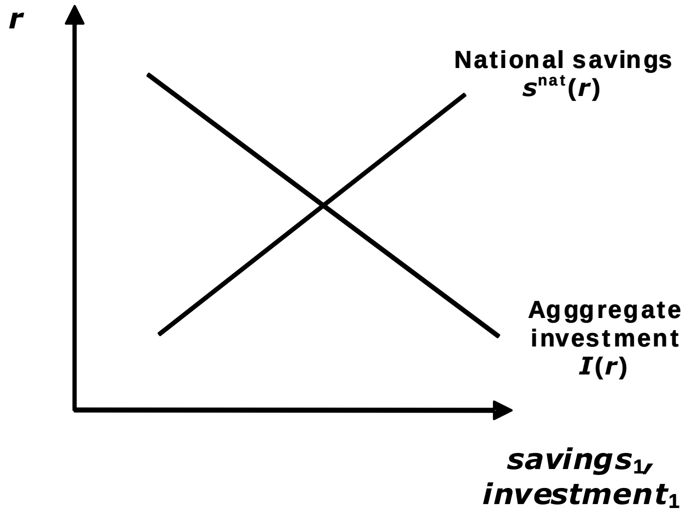


**Figure 41.** The interaction of national savings and investment determines the equilibrium real interest rate.

Next, from our definitions above, we can express national savings as

$$\begin{aligned} s_1^{nat} &= s_1^{priv} + s_1^{gov} \\ &= y_1 - t_1 - c_1 + t_1 - g_1 \\ &= y_1 - c_1 - g_1 \end{aligned}$$

Now let's conduct the following thought experiment. Suppose the government has decided on a particular path for government spending, $g_1$ and $g_2$, as well as a path for taxes, $t_1$ and $t_2$. It must of course be the case that these chosen values for government spending and taxes satisfy the government's LBC, equation (31). Now suppose that the government chooses to leave its spending plans unchanged, but decides to lower $t_1$ for some reason (perhaps a new administration has taken over, say). This necessarily means that $t_2$ must rise, because the government's present value of lifetime spending is unchanged – if it raises less revenue in the current period, it must raise more revenue in the future to balance its lifetime budget. The question we are interested in is whether this decrease in taxes in period 1 affects national savings in period 1. Examining the expression $s_1^{nat} = y_1 - c_1 - g_1$ suggests that it does not because $t_1$ seemingly does not appear in this expression. Before we can draw this conclusion, however, we need to determine how, if at all, consumption $c_1$ changes due to the change in the timing of taxes.

For this part of the analysis, return to the household LBC in real terms (36). The only way that the change in the timing of taxes would affect the optimal consumption choice of the individual is if the consumer's LBC is affected. We are assuming that neither $y_1$

nor $y_2$ changed (remember, in our simple two-period consumption-savings model labor income is outside the control of the individual – here we augment this assumption by supposing that it is also outside the control of the government). We can compute by how much taxes in period 2 must change for a given change in taxes in period 1 and given that government spending is assumed to remain unchanged. Because the government has to satisfy its lifetime budget constraint, the amount by which taxes in period 2 change is

$$\Delta t_2 = -(1+r)\Delta t_1 \tag{40}$$

which we obtain by inspecting the government LBC. Specifically, because government spending is assumed to be unchanging, the *change in* the left-hand-side of equation (31) is zero, which means that the *change in* the right-hand-side must also be zero. But our thought experiment is that the change in taxes in period 1, denoted by $\Delta t_1$, is not zero. So the only way that the overall change in the right-hand-side of equation (31) is if the change in taxes in period 2, denoted by $\Delta t_2$, is also non-zero. The relationship (40) then follows.

Expression (40) formalizes the idea discussed above, that if the path of government spending is held constant, then any change in taxes in period 1 must be met by a change in taxes in period 2 of the opposite sign. Furthermore, the change in taxes in period 2 takes into account the interest rate between period 1 and period 2 because of discounting. Finally, it remains to determine how these changes in taxes affect the LBC of the consumer. Computing the *change in* the right-hand-side of the consumer LBC (36) (and note that the right-hand-side of (36) measures the present value of lifetime disposable income of the consumer – in other words, the lifetime resources the individual has available for consumption purposes) shows that this *change* is exactly zero. If the *change* in the individual's lifetime resources is zero due to the change in the timing of taxes, then the consumer's optimal consumption choice $(c_1, c_2)$ is also unchanged.

Graphically, the position of the representative-consumer's LBC is unaffected by changes in the timing of taxes. Finally, then, we are able to conclude that, in fact, consumption in period 1 does not change despite the tax cut in period 1. The implication of this, based on our analysis is above, is that national savings in period 1 is unaffected by the tax cut of period 1.

More precisely, it is the position of the entire national savings function that is unaffected by this change in the timing of taxes, because the analysis we just conducted holds for any given $r$. If the national savings function does not shift, and by assumption the investment function is not shifting either, then the equilibrium real interest rate is unchanged. This result is known as Ricardian Equivalence.

**Ricardian Equivalence** is the notion that, holding fixed a path for government spending, a change in the timing of taxes does not affect the equilibrium real interest rate because it does not affect national savings. It is true that in the thought experiment we just conducted government savings in period 1 declined – in other words, the secondary fiscal budget balance deteriorated (i.e., went further into deficit if it was in deficit to begin with). But private savings increased by exactly the same amount as the decrease in government savings, leaving national savings unaffected, which in turn leaves the equilibrium real interest rate unaffected. Ricardian Equivalence thus states that there is no connection between fiscal deficits (induced by changes in the pure timing of taxes) and real interest rates. The intuition for the offsetting rise in private savings is that fully rational consumers understand that because the government must balance its budget in a lifetime sense, if it decreases taxes in the present it will be obliged to raise taxes in the future (which, in the two-period model, is period 2). In order to pay more taxes in the future, then, fully rational consumers will simply save the entire tax cut they receive today – which is what it means to say that private savings increases by exactly the amount that government savings decreases.

## Distortionary Taxes and the Failure of Ricardian Equivalence

Let's think a little more carefully about the nature of the taxes that the government collected in the above description. The taxes collected in period 1 and 2 did not depend in any way on any choices that individual consumers made. That is, regardless of a consumer's income or consumption in period 1, say, he has to pay the mandated amount $t_1$. In reality, though, the total amount of taxes an individual pays is somehow related to some economic choices he makes. For example, total income taxes paid depend on how much an individual earns, which is at least somewhat under the control of an individual, total sales taxes an individual pays depends on how much an individual spends buying things, and total property taxes paid depend on how valuable a house an individual owns, which is at least somewhat of a choice. Suppose we introduce this type of taxation, taxes that depend on a choice the consumer makes, into our two-period model. In our simple two-period model, the only choice the consumer makes is regarding consumption – recall that labor income $y_1$ and $y_2$ are outside the individual's control. Let's now suppose that consumption is subject to a sales tax rate of $\tau_1$ in period 1 and $\tau_2$ in period 2. The sales tax rate is a number such that $0 < \tau < 1$. So for example, if the sales tax rate in period 1 is 6%, we would have $\tau_1 = 0.06$.

The consumer's period-by-period budget constraints are now modified as follows,

$$(1+\tau_1)c_1 + a_1 = (1+r)a_0 + y_1 \tag{41}$$

and

$$(1+\tau_2)c_2 + a_2 = (1+r)a_1 + y_2 . \tag{42}$$

Again assuming $a_0 = 0$ and using our familiar result that $a_2 = 0$, we can combine these period-by-period budget constraints to obtain the LBC

$$(1+\tau_1)c_1 + \frac{(1+\tau_2)}{(1+r)}c_2 = y_1 + \frac{y_2}{1+r}. \tag{43}$$

If we solve this LBC for $c_2$, so that we can easily plot it in a graph with $c_2$ on the vertical axis and $c_1$ on the horizontal axis, we have

$$c_2 = -\frac{(1+\tau_1)}{(1+\tau_2)}(1+r)c_1 + (1+r)y_1 + y_2. \tag{44}$$

The slope of the LBC now clearly depends on the tax rates $\tau_1$ and $\tau_2$. Now let's conduct a thought experiment analogous to the one above: holding fixed a path for government spending, suppose the government decides to lower the *tax rate* in period 1. To balance its lifetime budget, this obliges the government to raise the *tax rate* in period 2. The question now is whether this change in the timing of *tax rates* changes consumption in period 1.

The answer is that it does, because it changes the slope of the consumer's LBC, which in turn, in general, leads to a new optimal choice of consumption in both periods 1 and 2. Under the initial LBC, there is some initial optimal choice of consumption in each period. Following the decline in $\tau_1$ (and attendant rise in $\tau_2$) the LBC flattens (i.e., the absolute value of the slope of the LBC decreases). The optimal choice, in particular the optimal choice of period-1 consumption, changes, due essentially to substitution effects – purchase less quantity of the more (tax-inclusive) expensive good.

We will continue to assume that the change in period-1 consumption in response to a change in the slope of the LBC is as described when we studied the aggregate private savings function – in particular, optimal period-1 consumption rises when the slope of the LBC decreases.[55]

Returning to our expression $s_1^{nat} = y_1 - c_1 - g_1$, we see that because consumption in period 1 increases, national savings in period 1 decreases. More precisely, the entire national savings function decreases, because the analysis we just conducted holds for any given $r$. Graphically, the national savings function shifts left, which raises the equilibrium real interest rate, as **Figure 42** shows.

[55] It turns out this conclusion does not follow as an immediate consequence of how consumption seems to respond to changes in the slope of the LBC (i.e., the **after-tax real interest rate)**. This is because In addition to the change in the slope of the LBC, a change in the timing of proportional taxes causes a shift in the LBC as well. It turns out that for most practical applications of this model, however, that the induced shift in the LBC is small enough to be negligible in the analysis.

Thus, here we have the result that despite an unchanged path of government spending, a change in the timing of taxes does affect the equilibrium real interest rate – that is, Ricardian Equivalence does not hold. Clearly the reason for the difference from the earlier analysis is in how taxes are levied.

In this section, the way we have specified taxes is in a proportional, or **distortionary,** way. Total taxes paid in a particular period depend on how much consumption individuals undertake in that period. In turn, the tax rate affects, or *distorts*, the consumer's choices because it impacts the slope of the consumer's LBC. In contrast, in our earlier discussion of Ricardian Equivalence, taxes were assumed to be lump-sum. **Lump-sum taxes are taxes whose incidence does not depend on any choices individuals make.**

# Fiscal Guideposts

These two examples together illustrate two crucial guideposts for fiscal policy analysis:

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**Ricardian Guidepost 1:**
**Lump-sum taxation is an important reason why Ricardian Equivalence holds.**

**Ricardian Guidepost 2:**
**Distortionary taxation is an important reason why Ricardian Equivalence disappears.**

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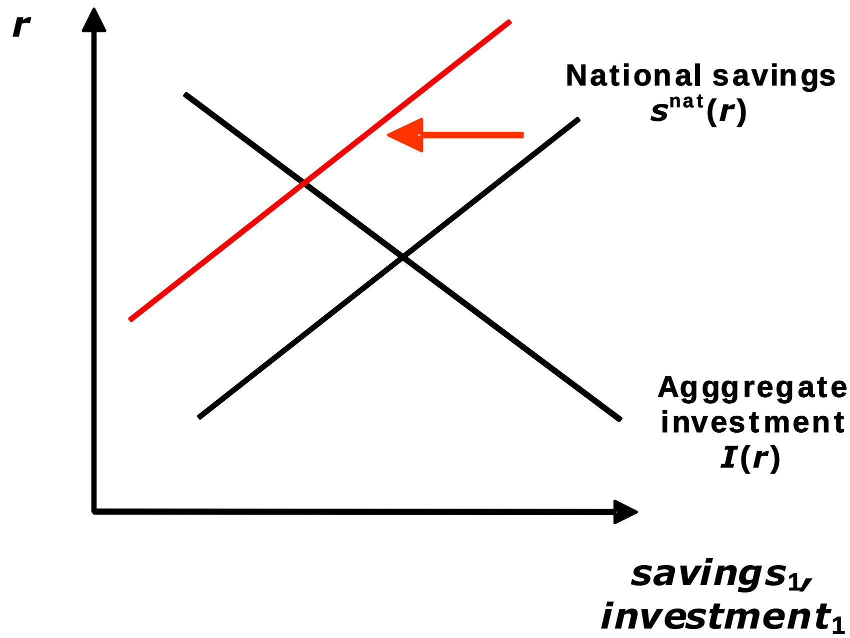


**Figure 42.** With proportional taxes on consumption, a decrease in the tax rate in period 1 raises consumption in period 1, which causes national savings in period 1 to shift inwards. The equilibrium real interest rate thus rises.

There are caveats to these guideposts that can arise.

But with the disappearance of Ricardian Equivalence in the current example, another phenomena arises. Because the real interest rate rises, investment falls, which follows simply from the fact that investment is a negative function of the real interest rate. The decline in investment due to a deterioration in the fiscal balance (which is what happens when tax revenues decline but government spending is unchanged) is termed **crowding out.** The government, because it is competing more heavily with firms for loans in order to fund its government spending, drives out, or "crowds out," some firms that are looking for loans because of the higher interest rates.

## Changes in Government Spending

An important point to note from the above analysis is that we were always assuming government spending was held fixed, regardless of whether taxes were lump-sum or distortionary. If government spending changes, then it immediately follows that national savings and hence real interest rates are affected.[56] That is, with a change in government spending, whether or not Ricardian Equivalence holds is no longer an issue – the resulting change in the government's fiscal balance will be accompanied by a change in real interest rates.

For example, suppose that $g_1$ rises and $g_2$ remains unchanged. For the economy as a whole, the LBC (39) shows that the resources of the economy left over for consumption fall. Graphically, the LBC of the entire economy shifts in due to the rise in $g_1$. Consumption in period 1 will therefore fall, but not enough to offset the rise in government spending. Thus national savings in period 1 will decline overall due to the rise in $g_1$. That is, the national savings function will shift inwards, causing the equilibrium real interest rate to rise and resulting in crowding-out of private investment. Thus, if a change in the government's fiscal position is brought about by a change in government spending, then real interest rates are affected.[57]

## Lump-Sum vs. Distortionary Taxes

At this point you may be wondering why the notion of Ricardian Equivalence is important at all considering that it depends crucially on the existence of lump-sum taxes, a type of tax that does not seem prevalent in the real world. That is, it is hard to think of any tax that consumers or firms pay in reality that does not depend *somehow* on some choices they make. As we have seen, as soon as taxes are (even somewhat) distortionary, Ricardian Equivalence disappears, meaning that changes in the government's fiscal position likely will be accompanied by changes in the equilibrium real interest rate.[58]

Yet the notion of Ricardian Equivalence holds sway amongst some economists and policy makers. Part of the reason for this may simply be political convenience. For example, if a politician is ideologically committed to lowering taxes and must fend off criticisms that interest rates will rise as a result, using this economic argument may help insulate him from criticism because, after all, economic theory predicts that this will not happen. This is true, of course, but only given the specific assumption of lump-sum taxes, which most likely is left out of the political discussion.

A more important reason to not simply discard Ricardian Equivalence as a possibly important element of policy debates is that at times, macroeconomic data seems to show

[56] More specifically, if the *present value of current and future government spending changes,* then national savings and hence real interest rates are affected.

[57] Again, more specifically, it is a change in *the present value of current and future government spending* that is required for an impact to be felt on real interest rates. Try analyzing for yourself the (harder) case in which $g_1$ and $g_2$ change in such a way that the present value of all government spending does not change.

[58] The "likely" wording is a subtle reminder that there are caveats to the two take-away fiscal guideposts.

that total taxes collected by the government are unrelated to major macroeconomic variables, such as GDP or consumption, even though at the microeconomic level they clearly must be. When this happens, lump-sum taxes seem to be not too inaccurate a description of the tax system. In other words, even though taxes are certainly not lump-sum when levied on individual consumers and firms, in the aggregate some sort of "cancellation" often seems to occur that makes them appear lump-sum at the macroeconomic level. This in part reveals the limitations of the representative-agent approach to macroeconomics – in the representative-agent approach, we cannot see the differing effects of tax policy on different types of individuals which must be occurring for the aggregate "cancellations" to be taking place because by assumption there is only one type of consumer, the representative consumer.

In conclusion, whether or not changes in the government's fiscal position affect market interest rates depend on what the source of the change in the fiscal position is (a change in taxes or a change in government spending) and on what type of tax system is in place (lump-sum or distortionary). These are summarized in the two major "fiscal guideposts" regarding effects of changes in tax policy.