Slides for Chapter 8

The Twin Deficits:

Fiscal Deficits and the Current Account

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Motivation

An important question in macroeconomics is whether fiscal deficits cause current account deficits. There are 2 opposing views: (1) tax-cut induced fiscal deficits lead to current account deficits (*twin deficits*); and (2) tax cuts have no effect on the current account (*Ricardian equivalence*);

(1) Twin deficits: A tax cut increases household income and stimulates consumption spending, deteriorating the current account.

(2) Ricardian equivalence: A tax cut generates a fiscal deficit and hence public debt. In the future this debt must be repaid, which requires an increase in taxes. Households understand this and save the tax cut to pay the higher future taxes. Consumption is unchanged.

This chapter analyzes conditions under which each of the two views are valid. In addition, it studies whether similar opposing views arise when the fiscal deficit is a consequence of changes in government consumption rather than reductions in taxes (or increases in government transfers).

An Open Economy with a Government Sector

Two-period small open economy of Chapter 5 but with a government that consumes goods (government spending), levies taxes, and issues debt.

The Government

$G_t =$ government purchases of goods and services in period $t = 1, 2$, which are exogenously given.

$T_t =$ lump-sum taxes in period $t = 1, 2$. The term *lump-sum taxes* refers to taxes that do not depend on any economic characteristic of the taxpayer, such as income, spending, or wealth.

$B^g_{t-1} =$ bond holdings of the government at the start of period t for $t = 1, 2$. If $B^g_{t-1} < 0$, we say there is *public debt* outstanding.

The *government budget constraint* in period 1

$$G_1 + B_1^g - B_0^g = T_1 + r_0 B_0^g, \tag{1}$$

The left-hand side represents outlays in period 1: purchases of goods, G_1, and purchases of bonds, $B_1^g - B_0^g$. The right-hand side represents sources of funds in period 1: tax revenues, T_1, and interest income on bonds, $r_0 B_0^g$.

The government budget constraint in period 2

$$G_2 + B_2^g - B_1^g = T_2 + r_1 B_1^g. \tag{2}$$

At the end of period 2, the government cannot leave debts and does not want to leave assets. Thus

$$B_2^g = 0. \tag{3}$$

Combining (1)-(3) to eliminate B_1^g and B_2^g, we obtain the *intertemporal government budget constraint*,

$$G_1 + \frac{G_2}{1+r_1} = (1+r_0)B_0^g + T_1 + \frac{T_2}{1+r_1}. \tag{4}$$

It says that the present discounted value of government consumption (the left-hand side) must be equal to the sum of initial asset holdings including interest and the present discounted value of tax revenue (the right-hand side).

There exist many tax policies T_1 and T_2 that can finance a given path of government consumption, G_1 and G_2. But given taxes in one period, taxes in the other period are pinned down.

In particular, a tax cut in period 1 must be offset by a tax increase in period 2.

Firms

As in Chapter 5, firms borrow in period 1 to invest in capital goods that become productive in period 2.

$$Q_2 = A_2 F(I_1),$$

where Q_2 denotes output in period 2, A_2 is an exogenous productivity factor, I_1 is investment made in period 1 that becomes productive in period 2 and $F(\cdot)$ is an increasing and concave production function.

In period 2, the firm must repay the loan with interest. The firm chooses I_1 to maximize profits:

$$\Pi_2 = A_2 F(I_1) - (1 + r_1) I_1.$$

First-order optimality condition

$$A_2 F'(I_1) = 1 + r_1$$

which implies that investment is decreasing in r_1 and independent of taxes or government spending

$$I_1 = I(\underset{-}{r_1}). \tag{5}$$

Firms (continued)

Using (5), we can express profits as $A_2F(I(r_1)) - (1 + r_1)I(r_1)$. As in Chapter 5, we then have

$$\Pi_2 = \Pi(\underset{-}{r_1}). \tag{6}$$

Firms are assumed to be owned by households to whom they distribute profits in period 2. We introduce the household sector next.

Households

$$\max_{\{C_1, C_2\}} \ln C_1 + \ln C_2 \tag{7}$$

subject to

$$C_1 + B_1^h - B_0^h = r_0 B_0^h + Q_1 - T_1, \tag{8}$$

$$C_2 + B_2^h - B_1^h = r_1 B_1^h + \Pi(r_1) - T_2, \tag{9}$$

where B_t^h denotes the bond holdings of the household at the end of period t, for $t = 0, 1, 2$.

Income net of taxes is called *disposable income*, that is, $Q_1 - T_1$ and $\Pi(r_1) - T_2$ denotes disposable income.

The no-Ponzi game constraint and the transversality condition imply that

$$B_2^h = 0. \tag{10}$$

Households (continued)

Combining equations (8)-(10) yields the household's intertemporal budget constraint

$$C_1 + \frac{C_2}{1+r_1} = (1+r_0)B_0^h + Q_1 - T_1 + \frac{\Pi(r_1) - T_2}{1+r_1}. \tag{11}$$

Solve (11) for C_2

$$C_2 = (1+r_1)\left[(1+r_0)B_0^h + Q_1 - T_1 - C_1\right] + \Pi(r_1) - T_2. \tag{12}$$

Households (concluded)

To find the optimal consumption path, use (12) to eliminate C_2 from the utility function (7). This operation gives

$$\ln C_1 + \ln\left[(1+r_1)(\bar{Y} - C_1)\right], \tag{13}$$

where

$$\bar{Y} = (1+r_0)B_0^h + Q_1 - T_1 + \frac{\Pi(r_1) - T_2}{1+r_1}.$$

The household chooses C_1 to maximize (13), taking as given $\bar{Y}$ and r_1. The resulting optimality condition is $C_1 = \frac{1}{2}\bar{Y}$, or

$$C_1 = \frac{1}{2}\left[(1+r_0)B_0^h + Q_1 - T_1 + \frac{\Pi(r_1) - T_2}{1+r_1}\right]. \tag{14}$$

Note that C_1 depends only on the present discounted value of taxes, $T_1 + T_2/(1+r_1)$. Using (14) to eliminate C_1 from (12) gives

$$C_2 = \frac{1+r_1}{2}\left[(1+r_0)B_0^h + Q_1 - T_1 + \frac{\Pi(r_1) - T_2}{1+r_1}\right], \tag{15}$$

which says that also C_2 depends only on the present discounted value of taxes, $T_1 + T_2/(1+r_1)$.

Equilibrium

Because the economy is small and there is free capital mobility, the domestic interest rate, r_1, equals the world interest rate, r^*

$$r_1 = r^*. \tag{16}$$

The country's net foreign asset position at the beginning of period 1, denoted B_0, is given by the sum of private and public asset holdings; that is,

$$B_0 = B_0^h + B_0^g. \tag{17}$$

Combining (4), (14), (16), and (17) yields the equilibrium level of consumption in period 1,

$$C_1 = \frac{1}{2}\left[(1 + r_0)B_0 + Q_1 - G_1 + \frac{\Pi(r^*) - G_2}{1 + r^*}\right]. \tag{18}$$

A similar operation using (15) delivers the equilibrium level of consumption in period 2,

$$C_2 = \frac{1 + r^*}{2}\left[(1 + r_0)B_0 + Q_1 - G_1 + \frac{\Pi(r^*) - G_2}{1 + r^*}\right]. \tag{19}$$

Equilibrium (concluded)

The trade balance in period 1, denoted TB_1, is

$$TB_1 = Q_1 - C_1 - G_1 - I_1.$$

Using (5) and (18) to eliminate I_1 and C_1, we have

$$TB_1 = \frac{1}{2}\left[-(1+r_0)B_0 + Q_1 - G_1 - \frac{\Pi(r^*) - G_2}{1+r^*}\right] - I(r^*). \tag{20}$$

and

$$CA_1 = \frac{1}{2}\left[-(1-r_0)B_0 + Q_1 - G_1 - \frac{\Pi(r^*) - G_2}{1+r^*}\right] - I(r^*). \tag{21}$$

Discussion Neither T_1 nor T_2 appear in equations (18)-(21). This means that given G_1 and G_2, any combination of taxes T_1 and T_2 satisfying the government's intertemporal budget constraint (4) is associated with the same equilibrium levels of private consumption, the trade balance, and the current account.

This result is known as **Ricardian equivalence**.

Intuition: Suppose the government cuts taxes in period 1, and leaves G_1 and G_2 unchanged. Then the tax cut must be financed with public debt. Repaying the higher public debt requires increasing taxes in period 2. In period 1, households anticipate that the tax cut will require higher taxes in period 2. Consequently, instead of spending part of the tax cut on consumption goods, households keep consumption unchanged and save all of the tax cut.

This intuition for why Ricardian equivalence holds in this economy is based on the idea that a tax cut (i.e., a reduction in government saving) is exactly offset by an increase in private saving. Let's show this result more formally.

Government saving, denoted S_1^g, is

$$S_1^g = r_0 B_0^g + T_1 - G_1.$$

Given G_1 and $r_0 B_0^g$, any change in T_1 must be reflected one-for-one by a change in government saving; that is,

$$\Delta S_1^g = \Delta T_1. \tag{22}$$

Private saving, denoted S_1^p, is

$$S_1^p = Q_1 + r_0 B_0^h - T_1 - C_1.$$

By (18), for given G_1 and G_2, C_1 is independent of taxes. Thus, given $Q_1 + r_0 B_0^h$, any change in T_1 leads to a change in private saving of equal size but opposite sign; that is,

$$\Delta S_1^p = -\Delta T_1. \tag{23}$$

National saving, denoted S_1, is

$$S_1 = S_1^g + S_1^p.$$

and changes in national saving hence are

$$\Delta S_1 = \Delta S_1^g + \Delta S_1^p = \Delta T_1 - \Delta T_1 = 0.$$

This expression confirms the intuition we gave for why Ricardian equivalence holds in this economy; namely, that given the path of government spending, a change in taxes causes changes in government and private saving that exactly offset each other, leaving national saving unchanged. With investment unaffected by the tax change, we have that the current account is also unchanged, that is, the model fails to predict twin deficits.

Next we study whether the model can predict twin deficits when fiscal deficits are caused by changes in government spending as opposed to changes in taxes.

Government Spending and Twin Deficits

A change in government spending in period 1, G_1, has the same effect as a change in the endowment but in the opposite direction. To see this, take a look at equilibrium conditions (18)-(21).

$$C_1 = \frac{1}{2}\left[(1+r_0)B_0 + Q_1 - G_1 + \frac{\Pi(r^*) - G_2}{1+r^*}\right] \tag{18}$$

$$C_2 = \frac{1+r^*}{2}\left[(1+r_0)B_0 + Q_1 - G_1 + \frac{\Pi(r^*) - G_2}{1+r^*}\right] \tag{19}$$

$$TB_1 = \frac{1}{2}\left[-(1+r_0)B_0 + Q_1 - G_1 - \frac{\Pi(r^*) - G_2}{1+r^*}\right] - I(r^*) \tag{20}$$

$$CA_1 = \frac{1}{2}\left[-(1-r_0)B_0 + Q_1 - G_1 - \frac{\Pi(r^*) - G_2}{1+r^*}\right] - I(r^*) \tag{21}$$

Notice that G_1 always appears in the form $Q_1 - G_1$. Hence all we have learned about the effects of endowment shocks in Chapter 3 is applicable to understanding the effects of government spending shocks. Let's start with a temporary increase in government spending.

A temporary increase in government spending

A temporary increase in government spending reduces private consumption but by less than the change in government spending itself. (Partial crowding out of private consumption)

$$\Delta C_1 = -\frac{1}{2}\Delta G_1$$

Because the world interest rate is unaffected, the change in government spending has no effect on investment

$$\Delta I_1 = 0$$

Hence overall effect on domestic absorption is positive

$$\Delta(C_1 + I_1 + G_1) = -\frac{1}{2}\Delta G_1 + 0 + \Delta G_1 = \frac{1}{2}\Delta G_1 > 0$$

Output in period 1 is fixed at Q_1

$$\Delta Q_1 = 0$$

A temporary increase in government spending (concluded)

Increase in G_1 leads to TB_1 and CA_1 deficits:

$$\Delta TB_1 = \Delta Q_1 - \Delta(C_1 + I_1 + G_1) = 0 - \frac{1}{2}\Delta G_1 = -\frac{1}{2}\Delta G_1 < 0.$$

$$\Delta CA_1 = \Delta TB_1 < 0$$

What about **twin deficits**?
– If the increase in government spending is not fully financed by an increase in current taxes, the fiscal deficit in period 1 increases. In this case, the expansion in government spending causes an increase in both the fiscal and the current account deficits ⇒ **twin deficits**.
– But if it is accompanied with a commensurate increase in current taxes ($\Delta T_1 = \Delta G_1$), then there is **no twin deficit**.

An expected future increase in government spending

Experiment: In period 1 it is learned that G_2 will increase.

In equilibrium conditions (18)-(21), G_2 always appears together with period-2 income, $\Pi(r^*) - G_2$. Thus, an expected increase in G_2 is equivalent to an expected fall in income in that period and should lower C_1:

$$\Delta C_1 = -\frac{1}{2(1+r^*)}\Delta G_2 < 0.$$

The fall in C_1 is smaller than the increase in G_2 because households smooth the adjustment over time.

By (20) and (21), the increase in G_2 leads to an improvement in the trade balance and the current account in period 1.

$$\Delta TB_1 = \Delta CA_1 = \frac{1}{2(1+r^*)}\Delta G_2 > 0.$$

Twin Surpluses/Deficits? **In general not, only** if taxes move to make it so.

A permanent increase in government spending

Experiment: $\Delta G_1 = \Delta G_2 = \Delta G > 0$

The current account should not change much. The intuition is similar to that behind a permanent fall in the endowment. (Adjust to permanent shocks.) Formally,

$$\Delta CA_1 = \Delta TB_1 = \Delta Q_1 - \Delta(C_1 + I_1 + G_1) = -\frac{r^*}{2(1+r^*)}\Delta G,$$

which is a small number if r^* is small.

It follows that permanent increases in government spending in general **do not lead to twin deficits**.

In sum, the present model can capture the twin deficit hypothesis when changes in the fiscal deficit are caused by temporary changes in government spending, but in general cannot capture it when they are caused by permanent or future expected changes in government spending. In the next section, we return to the question under what conditions tax cuts generate twin deficits.

Failure of Ricardian Equivalence: Tax Cuts and Twin Deficits

The conclusion that tax cuts don't cause twin deficits is a consequence of Ricardian equivalence. The assumptions under which Ricardian equivalence obtains, however, are special:

– households face no borrowing constraints,

– households expect tax cuts to be followed by higher future taxes

– all taxes are lump sum.

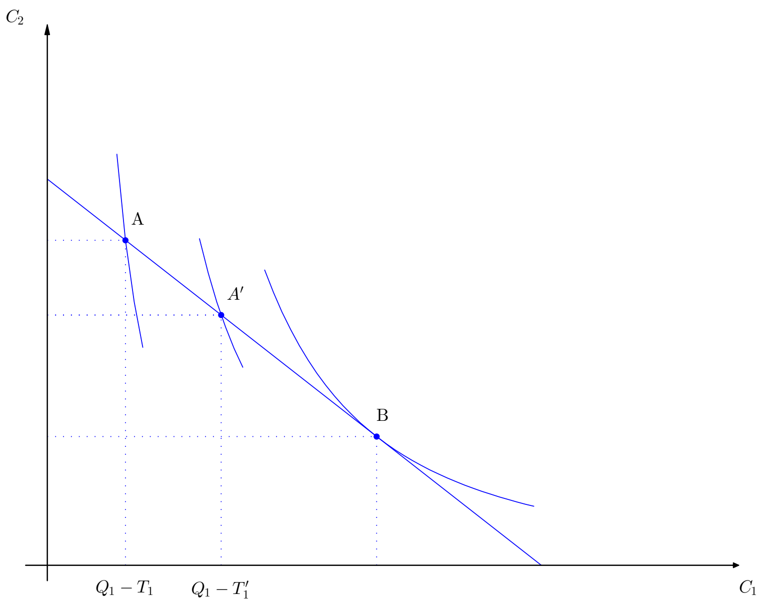
When relaxing any of these three assumptions, as we will show next, tax cuts can lead to twin deficits.

Main takeaway: Ricardian equivalence is a fragile result.

Borrowing Constraints

An example of a simple borrowing (or liquidity) constraint is that households can save but that they cannot borrow: $B_1^h \geq 0$

Adjustment to a Temporary Tax Cut When Households are Borrowing Constrained



The downward-sloping line is the household's intertemporal budget constraint. Initial wealth of the household is assumed to be zero, $B_0^h = 0$. Disposable income is at point A. In the absence of borrowing constraints, the household chooses a consumption allocation given by point B, where an indifference curve is tangent to the intertemporal budget constraint. In the presence of borrowing constraints, only allocations on the intertemporal budget constraint and northwest of point A are feasible. The borrowing constraint forces the household to consume its disposable income, point A. A tax cut equal to $T_1 - T_1'$ increases disposable income to point A'. Since the household is still borrowing constrained, consumption increases by the same amount as the tax cut ($\Delta C_1 = -\Delta T_1$), and the new allocation is at point A'.

Borrowing Constraints (continued)

In the figure, the borrowing constraint is binding before and after the tax cut. Thus, we have

$$\Delta C_1 = -\Delta T_1.$$

That is, **Ricardian equivalence fails.**

When neither firms nor the government are liquidity constrained, investment and government purchases are unaffected by the tax cut. Since output in period 1 is given by an exogenous endowment, the trade balance and the current account deteriorate by the same amount as the increase in consumption:

$$\Delta TB_1 = \Delta CA_1 = \Delta T_1 < 0.$$

Because the tax cut causes a reduction in public saving (or an increase in the fiscal deficit) in period 1,

$$\Delta S_1^g = \Delta T_1 < 0.$$

It follows that in the presence of borrowing constraints, tax cuts generate twin deficits.

Intergenerational Effects

A second reason why Ricardian equivalence could fail is that those who benefit from a tax cut are not the ones that pay for the tax increase later.

Consider an endowment economy in which households live for only one period.

Budget constraint of the generation alive in period 1: $C_1 + T_1 = Q_1$

Budget constraint of the generation alive in period 2: $C_2 + T_2 = Q_2$.

Tax cut in period 1 paid for with tax increase in period 2: $\Delta C_1 = -\Delta T_1 > 0$ and $\Delta C_2 = -\Delta T_2 < 0$. $\Rightarrow$ trade balance and the current account in period 1 decline one-for-one with the decline in taxes.

Distortionary Taxation

Finally, Ricardian equivalence may also break down if taxes are distortionary rather than lump sum.

Example: proportional tax on consumption, τ_1 and τ_2. After-tax cost of consumption becomes $(1+\tau_1)C_1$ and $(1+\tau_2)C_2$.

Effect of tax cut in period 1, a decline in τ_1, financed with an increase in τ_2: C_1 becomes cheaper relative to C_2 inducing households to consume more in period 1 and less in period 2. Thus, unlike changes in lump-sum taxes, changes in distortionary taxes can have real effects.

Let's derive this breakdown of Ricardian equivalence more formally.

Distortionary Taxation (continued)

Household problem

Household budget constraints in periods 1 and 2

$$(1+\tau_1)C_1 + B_1^h - B_0^h = r_0 B_0^h + Q_1, \tag{24}$$

$$(1+\tau_2)C_2 + B_2^h - B_1^h = r_1 B_1^h + \Pi(r_1). \tag{25}$$

Combining these two budget constraints and the transversality condition (10) yields the intertemporal budget constraint

$$(1+\tau_1)C_1 + \frac{(1+\tau_2)C_2}{1+r_1} = (1+r_0)B_0^h + Q_1 + \frac{\Pi(r_1)}{1+r_1}. \tag{26}$$

Distortionary Taxation (continued)

Household chooses C_1 and C_2 to maximize

$$\max_{\{C_1,C_2\}} \ln C_1 + \ln C_2 \tag{7}$$

subject to (26), taking as given τ_1, τ_2, Q_1, $(1+r_0)B_0^h$, and r_1.

Solve (26) for C_2 and then eliminate C_2 from utility function (7), to obtain

$$\max_{\{C_1\}} \left\{ \ln C_1 + \ln \left[\frac{1+r_1}{1+\tau_2} \left(\bar{Y} - (1+\tau_1)C_1 \right) \right] \right\},$$

where $\bar{Y} \equiv (1+r_0)B_0^h + Q_1 + \frac{\Pi(r_1)}{1+r_1}$.

Distortionary Taxation (continued)

Taking the derivative with respect to C_1 and equating it to zero yields the following Euler equation

$$\frac{C_2}{C_1} = \frac{1+\tau_1}{1+\tau_2}(1+r_1). \tag{27}$$

It says that cuts in τ_1 financed by increases in τ_2 will make the household consume relatively more in period 1 and relatively less in period 2.

A consumption tax distorts the intertemporal relative price of consumption. The household perceives that one unit of consumption in period 1 costs $\frac{1+\tau_1}{1+\tau_2}(1+r_1)$ units of consumption in period 2, whereas the true relative price is $1+r_1$.

Only if the government sets $\tau_1 = \tau_2$, does this intertemporal distortion disappear.

Distortionary Taxation (continued)

Firms

The problem of the firm is the same as in the economy with lump-sum taxes studied earlier in this chapter. The investment and profit schedules continue to be given by (5) and (6) and therefore they are independent of the consumption tax rates τ_1 and τ_2.

Distortionary Taxation (continued)

Equilibrium

Under free capital mobility, $r_1 = r^*$.

Solve the Euler equation (27) for C_2. Eliminate C_2 from the household's intertemporal budget constraint (26). Replace r_1 with r^*. This yields the equilibrium level of C_1

$$C_1 = \frac{1}{2(1+\tau_1)}\left[(1+r_0)B_0^h + Q_1 + \frac{\Pi(r^*)}{1+r^*}\right]. \tag{28}$$

In equilibrium C_1 is decreasing in τ_1. An increase in τ_1 makes C_1 more expensive, inducing households to cut demand.*

This result represents **a departure from Ricardian equivalence:** Given the path of government spending, changes in the timing of distortionary taxes have an effect on the equilibrium level of consumption.

*Note that consumption in period 1 does not depend on taxes in period 2, τ_2. This is a special result due to the assumption of log-linear preferences. Under this type of preferences, an increase in τ_2 creates income and substitution effects that exactly offset each other. By the substitution effect, an increase in τ_2 raises the demand for C_1 because it makes it relatively cheaper. By the income effect, an increase in τ_2 makes the household poorer and reduces the demand for C_1. Under different preference specifications, the income and substitution effects associated with a change in τ_2 may not exactly offset each other.

Distortionary Taxation (continued)

Consumption tax cut leads to current account deficit

The trade balance equals $TB_1 = Q_1 - G_1 - I_1 - C_1$. Cut in τ_1, holding constant G_1, deteriorates TB_1 through the increase in C_1:

$$\Delta TB_1 = -\Delta C_1 < 0$$

The current account is equal to $CA_1 = r_0 B_0 + TB_1$. It also deteriorates and by the same magnitude as the trade balance:

$$\Delta CA_1 = \Delta TB_1 = -\Delta C_1 < 0.$$

This shows that when taxes are distortionary, a cut in period-1 taxes can lead to an **increase in the current account deficit.**

To establish whether the tax cut causes twin deficits, it remains to show that the tax cut, holding government expenditures constant, leads to a fiscal deficit.

Distortionary Taxation (concluded)

Consumption tax cut also leads to fiscal deficit

Tax revenue in period 1 is $\tau_1 C_1$. Government saving in period 1:

$$S_1^g = r_0 B_0^g + \tau_1 C_1 - G_1. \tag{29}$$

The tax cut lowers revenue because τ_1 falls but it also increases revenue because the tax base, C_1, increases. Which effect dominates?

Use equation (28) to eliminate C_1

$$S_1^g = r_0 B_0^g + \frac{\tau_1}{2(1+\tau_1)}\left[(1+r_0)B_0^h + Q_1 + \frac{\Pi(r^*)}{1+r^*}\right] - G_1.$$

The factor $\tau_1/(1+\tau_1)$ is strictly increasing in τ_1. Therefore, a decline in τ_1 reduces government saving; that is, it increases the fiscal deficit.

We have therefore established that with distortionary consumption taxes, tax cuts can generate twin deficits.

The Optimality of Twin Deficits

Let's revisit the question of whether an increase in government spending can generate a twin deficit. Earlier in this chapter we showed that this is the case when taxes are lump sum and the increase is temporary. We now wish to see whether this result is robust to assuming that taxes are distortionary.

Given τ_1, by (28) C_1 is independent of G_1. Hence, $CA_1 = r_0 B_0 + Q_1 - C_1 - I(r^*) - G_1$ falls one for one as G_1 increases. Given τ_1, equation (29) says that government saving also deteriorates one for one with G_1.

Thus, under distortionary consumption taxes it continues to be the case that an increase in government spending in period 1 holding the tax rate in period 1 constant causes a twin deficit.

The Optimality of Twin Deficits (continued)

But why would the government want to keep τ_1 constant when G_1 increases and finance the spending increase entirely with an increase in τ_2?

Note that given (G_1, G_2), there is an infinite number of tax rate paths, (τ_1, τ_2), that guarantee the satisfaction of the government's intertemporal budget constraint and are consistent with equilibrium.

Each of these tax rate paths gives rise to a different consumption path, (C_1, C_2), and as a result generates a different level of welfare for the household.

A natural question therefore is which of these tax rate paths a benevolent government should choose. The objective of this section is to address this question.

The Optimality of Twin Deficits (continued)

Ramsey Optimal Consumption Tax Policy

A *benevolent government* is a government that implements policies that maximize the welfare of households. The equilibrium tax rate path that maximizes the welfare of households is called the *Ramsey optimal* tax policy.

How to find the Ramsey optimal tax path, (τ_1, τ_2)? Let's start by stating the equilibrium conditions. For simplicity, let's assume that $B_0^g = B_0^h = 0$.

The Optimality of Twin Deficits (continued)

Given the path of government spending (G_1, G_2), an equilibrium is a path of tax rates (τ_1, τ_2) and a path of private consumption (C_1, C_2), that satisfy the household's Euler equation (27) and intertemporal budget constraint (26), both evaluated at $r_1 = r^*$, and the following intertemporal government budget constraint

$$G_1 + \frac{G_2}{1+r^*} = \tau_1 C_1 + \frac{\tau_2 C_2}{1+r^*}. \tag{30}$$

These are three equations in four unknowns, C_1, C_2, τ_1, and τ_2. It follows that there are in principle many choices for the consumption tax path.

The government can pick one of the two tax rates arbitrarily. This choice has welfare consequences for the household, because, in general, it affects the path of consumption. The question we wish to address is how should the government use this degree of freedom to maximize the household's well-being, or, as Ramsey would have it, "to minimize the decrement of utility."

The Optimality of Twin Deficits (continued)

The Ramsey Problem

$$\max_{\{C_1, C_2, \tau_1, \tau_2\}} \ln C_1 + \ln C_2 \tag{7}$$

subject to

$$\frac{C_2}{C_1} = \frac{1+\tau_1}{1+\tau_2}(1+r^*), \tag{31}$$

$$(1+\tau_1)C_1 + \frac{(1+\tau_2)C_2}{1+r^*} = Q_1 + \frac{\Pi(r^*)}{1+r^*}, \tag{32}$$

$$G_1 + \frac{G_2}{1+r^*} = \tau_1 C_1 + \frac{\tau_2 C_2}{1+r^*}, \tag{30}$$

given G_1 and G_2.

The Ramsey problem seems daunting, as it involves three constraints and four control variables. However, as it turns out, it is a fairly easy problem to solve.

The Optimality of Twin Deficits (continued)

Solving the Ramsey problem

Combine equilibrium conditions (32) and (30), to obtain

$$C_1 + \frac{C_2}{1+r^*} = Q_1 - G_1 + \frac{\Pi(r^*) - G_2}{1+r^*}. \qquad (33)$$

Note that equations (31), (32), and (30) are satisfied if and only if equations (31), (32), and (33) are satisfied.

So we can restate the Ramsey problem as picking C_1, C_2, τ_1, and τ_2 to maximize the utility function (7) subject to (31), (32), and (33).

Here is the trick that makes solving this problem easy. Consider solving the less restricted problem of picking C_1 and C_2 to maximize the utility function (7) subject to (33) only. (This problem has to deliver at least the same level of utility as the Ramsey problem, because it contains fewer restrictions.) If we can show that the solution to the less restricted problem satisfies the omitted restrictions (31) and (32), we have found the solution to the Ramsey problem.

The Optimality of Twin Deficits (continued)

The Less Restricted Ramsey Problem

Solve (33) for C_2

$$C_2 = (1 + r^*)(\bar{Y} - C_1), \tag{34}$$

where $\bar{Y} \equiv Q_1 - G_1 + [\Pi(r^*) - G_2]/(1 + r^*)$

Use (34) to eliminate C_2 from the utility function (7)

The less restricted Ramsey problem then is

$$\max_{\{C_1\}} \ln C_1 + \ln[(1 + r^*)(\bar{Y} - C_1)].$$

The first-order condition is

$$\frac{1}{C_1} - \frac{1}{\bar{Y} - C_1} = 0. \tag{35}$$

Solving for C_1 yields

$$C_1 = \frac{1}{2}\bar{Y}. \tag{36}$$

The Optimality of Twin Deficits (continued)

Using (34) to eliminate $\bar{Y} - C_1$ from (35) gives

$$\frac{C_2}{C_1} = 1 + r^*. \tag{37}$$

This completes the solution of the less restricted Ramsey problem.

Let's now show that the solution to the less restricted problem also solves the Ramsey problem; that it, that it satisfies restrictions (31), (32), and (33).

Equation (33) is trivially satisfied, as it is the constraint of the less restricted problem. Now pick $\tau_1 = \tau_2 = \tau$. Then, restriction (31) collapses to equation (37) from the less restricted problem. Finally, replacing τ_1 and τ_2 by τ in equation (32) gives the value of τ that makes this equation hold

$$\tau = \frac{Q_1 + \frac{\Pi(r^*)}{1+r^*}}{Q_1 - G_1 + \frac{\Pi(r^*) - G_2}{1+r^*}} - 1. \tag{38}$$

This completes the proof that the solution of the less restricted problem is indeed the solution of the Ramsey problem.

The Ramsey Optimal Taxation Problem — taking stock

First, equation (37) says that the optimal tax policy completely eliminates the distortions introduced by the consumption tax. This is because under the Ramsey optimal tax policy, the intertemporal price of consumption perceived by the household, $\frac{1+\tau_1}{1+\tau_2}(1+r^*)$, is equal to the intertemporal price of consumption in the world market, $1+r^*$.

Second, the way in which the benevolent government achieves a nondistorted path of consumption is by *tax smoothing*; that is, by setting a constant consumption tax rate over time, $\tau_1 = \tau_2$.

Third, the Ramsey optimal allocation is the same as under lump-sum taxes. That is, the household consumes one half of the economy's lifetime resources net of government spending, $\bar{Y}$, in period 1 and leaves the rest for consumption in period 2.

Are Twin Deficit Optimal?

$CA_1 = Q_1 - C_1 - I(r^*) - G_1$. Replacing C_1 by its Ramsey optimal value $\bar{Y}/2$, we have that

$$CA_1 = \frac{1}{2}\left[Q_1 - G_1 - \frac{\Pi(r^*) - G_2}{1 + r^*}\right] - I(r^*), \tag{21}$$

which is the same as under lump-sum taxation, see equation (21) on slide 17. (Recall that here we are assuming that $B_0^g = B_0^h = 0$.)

$S_1^g = \tau_1 C_1 - G_1$. Replacing τ_1 and C_1 by their Ramsey optimal values,

$$S_1^g = \frac{1}{2}\left[-G_1 + \frac{G_2}{1 + r^*}\right].$$

Let's now consider a change in G_1. Then we have that

$$\Delta CA_1 = \Delta S_1^g = -\frac{1}{2}\Delta G_1.$$

This means that the benevolent government finds it optimal to run twin deficits in response to an increase in G_1.

Intuition for the Optimality of Twin Deficits

–Why a current account deficit? An increase in G_1 makes households poorer. By the income effect households cut consumption in both periods making the fall in C_1 less than the increase in government spending. Since investment is constant at $I(r^*)$, the fact that consumption falls by less than government spending increases means that aggregate demand goes up. With the endowment unchanged, the increase in aggregate demand causes a deterioration in the current account.

–Why an fiscal deficit? In response to the increase in government spending in period 1, the government, to avoid distortions in the intertemporal allocation of consumption, increases the consumption tax rate in both periods by the same amount. Thus, in period 1 only part of the increase in government spending is financed with higher taxes and the rest by issuing public debt.

Fiscal Policy in Economies with Imperfect Capital Mobility

A common concern about expansionary fiscal policy is that by driving up interest rates it crowds out investment and private consumption. Thus far, this effect was absent because by free capital mobility and the fact that the economy is small $r_1 = r^*$. We now relax these assumptions, first in small economies with different degrees of capital mobility and in the next section in a large economy.

Consider again the effects of a change in government spending in period 1 financed with consumption taxes.

Let's begin by deriving the current account schedule.

$$CA_1 = r_0 B_0 + Q_1 - C_1 - I_1 - G_1.$$

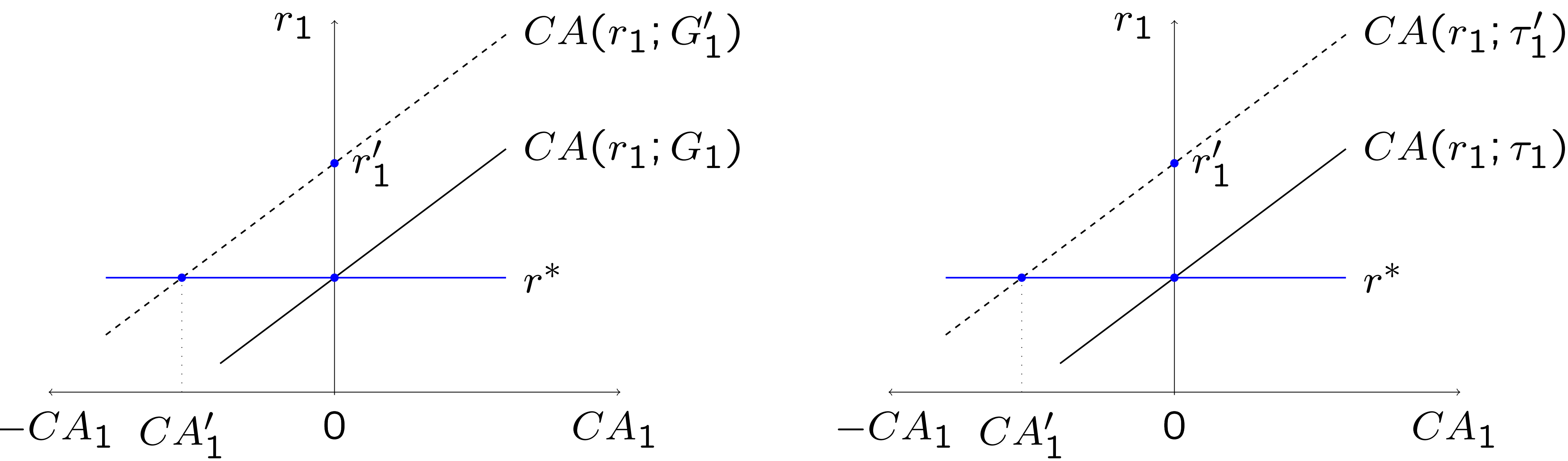
Using (28) evaluated at r_1 to eliminate C_1 and recognizing that I_1 is a function of r_1 alone yields the CA schedule:

$$CA_1 = r_0 B_0 + Q_1 - \frac{1}{2(1+\tau_1)}\left[(1+r_0)B_0^h + Q_1 + \frac{\Pi(r_1)}{1+r_1}\right] - I(r_1) - G_1.$$

which we write compactly as

$$CA_1 = CA(\underset{+}{r_1}; \underset{+}{Q_1}, \underset{+}{\tau_1}, \underset{-}{G_1}). \tag{39}$$

Adjustment to Expansionary Fiscal Policy (increase in G_1 or cut in τ_1) under Free Capital Mobility and Financial Autarky



Notes. The left panel depicts the adjustment of the current account and the interest rate to an increase in government spending from G_1 to $G_1' > G_1$, holding constant the consumption tax rate τ_1. The upward-sloping solid line is the current account schedule before the fiscal expansion. (To avoid clutter, all arguments of the current account schedule other than r_1 and G_1 are omitted.) In the initial equilibrium, the interest rate is $r_1 = r^*$ and the current account is zero. The increase in government spending shifts the current account schedule up and to the left (broken line). Under free capital mobility, the interest rate stays at r^* and the current account deteriorates to $CA_1' < 0$. Under financial autarky, the interest rate increases to $r_1' > r^*$ and the current account stays at zero. The adjustment to a tax cut ($\tau_1' < \tau_1$), holding constant G_1, is shown in the right panel and is qualitatively similar to that of an increase in government spending.

In reality, economies are neither completely open nor completely closed to international capital movements. In such an intermediate situation, as we will show next, expansionary fiscal policy causes:
– an increase in the interest rate,
– a deterioration in the current account, and
– some crowding out of investment.

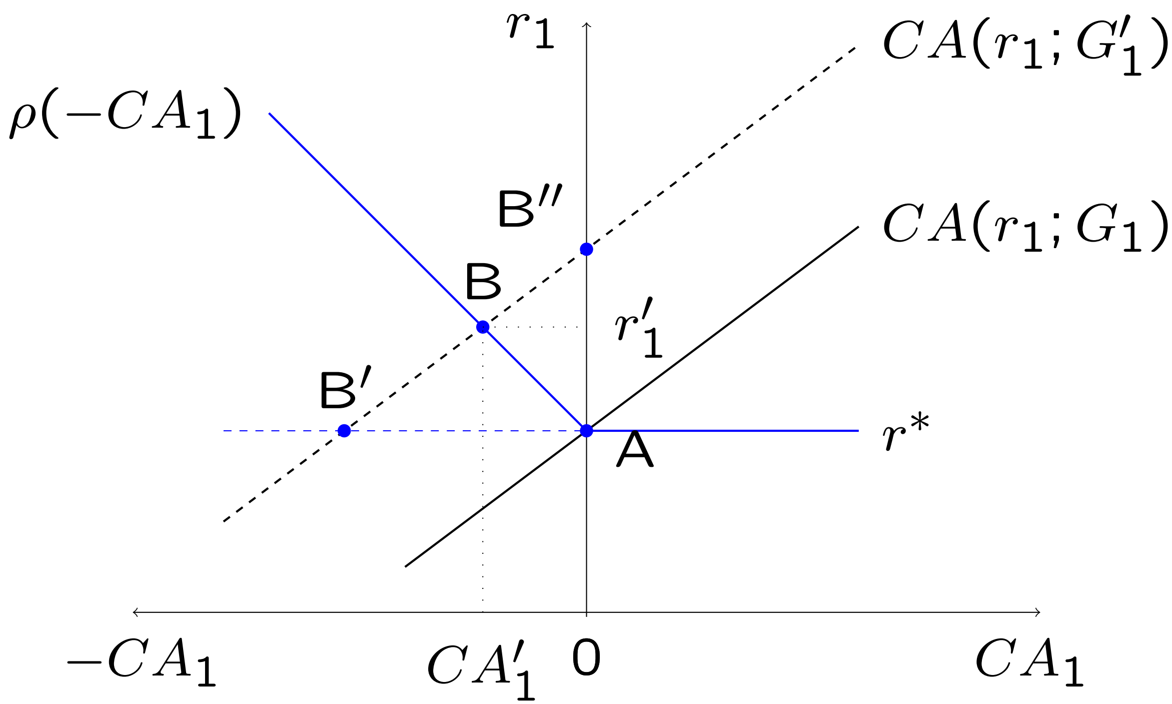
Suppose the government imposes capital controls to discourage external indebtedness. Assume that $r_1 = r^*$ if the country is a net external creditor ($B_1 > 0$), and that r_1 is an increasing function of the country's net debt position, $-B_1$, if the country is a debtor ($B_1 < 0$).

Assume that $B_0 = 0$. Then $B_1 = CA_1$. Then we can write the capital control policy as:

$$r_1 = \rho(-CA_1) = \begin{cases} r^* & \text{if } CA_1 \geq 0 \\ \geq r^* \text{with } \rho' > 0 & \text{if } CA_1 < 0 \end{cases}$$

The graph on the next slide shows the current account adjustment in this case.

Adjustment to an Increase in Government Spending under Imperfect Capital Mobility



Notes. The initial equilibrium occurs at point A, where the current account schedule, $CA(r_1; G_1)$ intersects the interest rate schedule, $\rho(-CA_1)$. (To avoid clutter, all arguments of the current account schedule other than r_1 and G_1 are omitted.) Initially, the interest rate is r^* and the current account is zero. An increase in government spending from G_1 to $G_1' > G_1$ shifts the current account schedule up and to the left (upward sloping broken line). The interest rate schedule is unchanged. The new equilibrium is at point B, where the interest rate is higher ($r_1' > r^*$), and the current account is negative ($CA_1' < 0$). Equilibria under free capital mobility and financial autarky are at points B' and B'', respectively.

Discussion of the figure from the previous slide

Comparing the equilibrium in the economy with imperfect capital mobility (point B) with the equilibria under the two polar cases of free capital mobility (point B') and financial autarky (point B''), we conclude that the more open to international capital mobility the economy is, the smaller the crowding out of investment, the smaller the increase in the interest rate, and the larger the deterioration of the current account following an expansion in government spending will be.

Next, we drop the assumption that the government imposes the capital control schedule $\rho(-CA_1)$ and return to the case of free capital mobility. But we assume that the economy is large. We will see that the adjustment to fiscal expansions is similar to that just discussed.

Fiscal Policy in a Large Open Economy

What are the domestic and international effects of fiscal policy in a large economy like the United States? To analyze this let's start with the current account schedules.

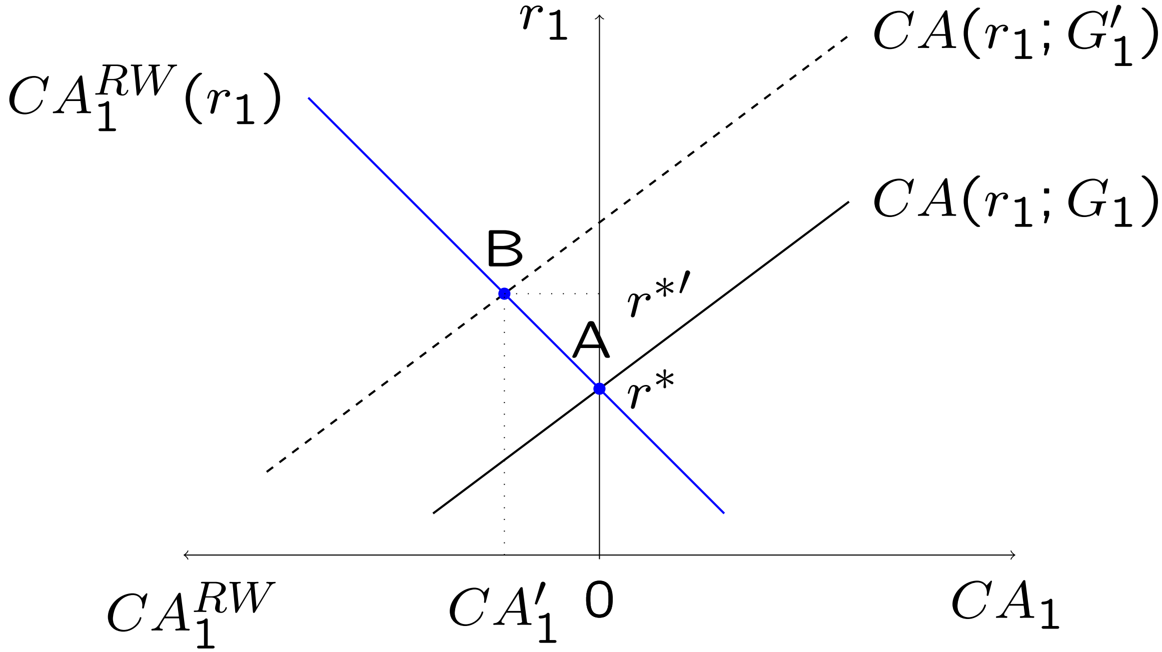
The current account schedule of a large economy is given by equation (39).

Let the current account schedule of the rest of the world be given by

$$CA_1^{RW} = CA(\underset{+}{r_1}; \underset{+}{Q_1^{RW}}, \underset{+}{\tau_1^{RW}}, \underset{-}{G_1^{RW}}). \tag{40}$$

The current account schedule of the rest of the world has the same properties as that of the domestic economy, as it is derived from the same microeconomic foundations.

Adjustment to an Increase in Government Spending in a Large Open Economy



Notes. The figure depicts the effects of a fiscal expansion in a large open economy. The initial situation is at point A, where the current account schedule of the large economy (the upward-sloping solid line) intersect the current account schedule of the rest of the world (the downward-sloping solid line). At point A, the world interest rate is equal to r^* and the current account deficit is equal to 0. The increase in government spending in the large economy from G_1 to $G_1' > G_1$ shifts the current account schedule of the large economy up and to the left (the upward-sloping broken line). The current account schedule of the rest of the world is unchanged. The new equilibrium is at point B, where the world interest rate is higher, $r^{*\prime} > r^*$, the large open economy is running a current account deficit and the rest of the world a current account surplus.

Observations on the figure

The fiscal expansion raises the interest rate ($r^{*'} > r^*$). As a consequence, the current account of the domestic economy deteriorates and the current account of the rest of the world improves. The increase in the interest rate produces a contraction in investment in both the domestic economy and the rest of the world.

Intuitively, the increase in government spending in the domestic economy reduces national saving. Given the interest rate, this produces a reduction in the global supply of funds, which pushes up the world interest rate. In turn, the increase in the interest rate discourages investment and fosters saving in the domestic economy and in the rest of the world, restoring equilibrium in the international capital market.

The effects of a tax cut are qualitatively the same (not shown).

Summing Up

This chapter analyzes how fiscal deficits stemming from tax cuts, increases in government transfers, or increases in government spending affect the current account and other macroeconomic indicators.

• The twin deficit hypothesis states that fiscal deficits cause current account deficits.

• When taxes are lump sum, changes in the timing of taxes, holding the path of government spending unchanged, do not cause changes in the trade balance or the current account. This result is known as Ricardian equivalence.

• Ricardian equivalence is a fragile result. It requires that taxes are lump sum, that households are not borrowing constrained, and that all agents receiving a tax cut expect to pay the future higher taxes required to balance the budget. If any of these conditions is relaxed, Ricardian equivalence fails and tax cuts cause current account deficits (twin deficits).

• A temporary increase in government spending causes a deterioration of the current account (twin deficits).

• If an increase in government spending is perceived to be permanent, the current account is not significantly affected.

• A cut in the consumption tax rate, holding the path of government spending constant, causes a deterioration of the current account (twin deficits).

• A benevolent government finds it desirable to smooth consumption tax rates over time. Consequently, temporary increases in government spending generate both fiscal and current account deficits. In this sense, twin deficits are Ramsey optimal.

• In a small open economy with free capital mobility, temporary increases in government expenditures or tax cuts do not crowd out investment. However, crowding out of investment does occur in small open economies with imperfect international capital mobility.

• In a large open economy with free capital mobility, a temporary increase in government expenditure or a tax cut deteriorates the current account, raises the world interest rates, and crowds out investment domestically and in the rest of the world.