

13

Spending and Income Determination in the Short Run

Overview

In this chapter, we learn:

●●● How to model desired spending

●●● How spending attains equilibrium in the short run

●●● How changes in government spending and taxes affect income

●●● How the trade deficit responds to changes in desired spending

●●● How a change in one country's output affects the output levels of trading partner countries

13.1 Introduction

> *[T]his recession has only now entered its fiercest phase, and economists say the pain will not end soon.*
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> *In an appearance on Sunday on "Meet the Press," President-elect Barack Obama promised a stimulus plan "large enough to get the economy moving," but conceded that "things are going to get worse before they get better."*
>
> – Michael Grynbaum, *New York Times*, December 7, 2008.

Things did indeed get worse. By the last quarter of 2008, the U.S. economy was shrinking at an annual rate of 8%, as the American economy sank into its deepest and longest recession since the Great Depression. In Chart 13.1, the blue line shows the drastic decline in the growth rate. Household consumption was trending downward a rate of nearly 5% per year, business investment in factories and equipment was falling at a rate of 21% per year, and new-home construction was plummeting by a disastrous annual rate of 33%. Clearly if something could be done, it should be, and swiftly.

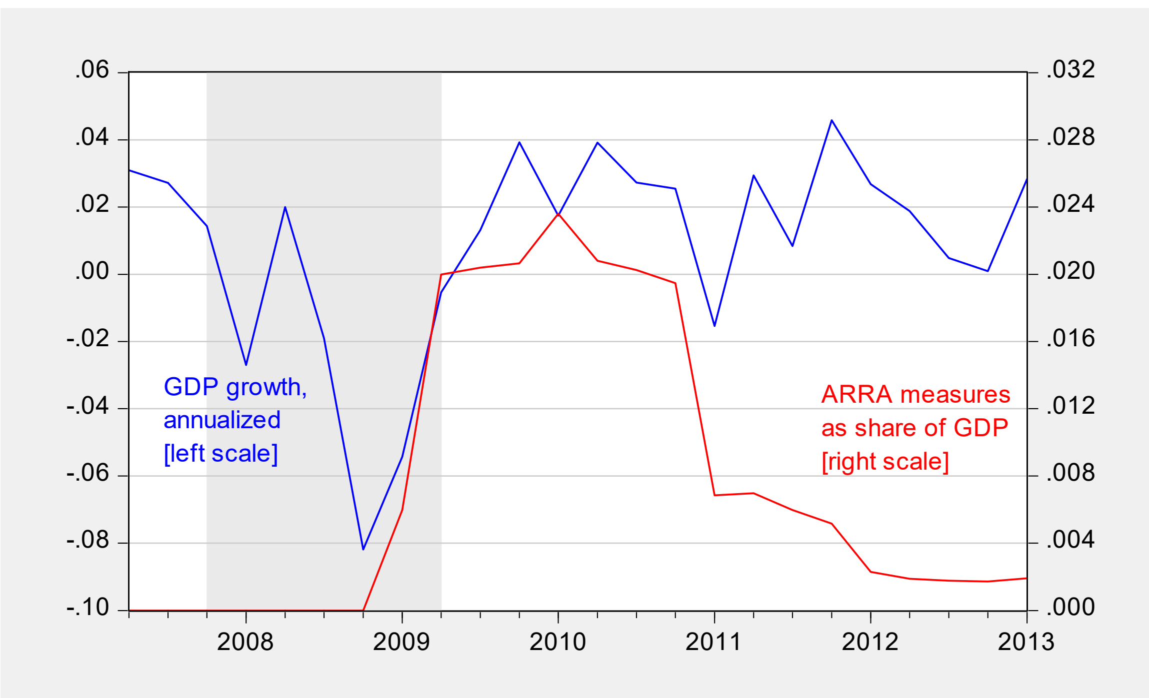

Chart 13.1: Real GDP annualized growth rate (blue), and American Recovery and Reinvestment Act (ARRA) measures expressed as a share of GDP (red). Recession dates shaded gray. Source: Bureau of Economic Analysis.

In January 2009, at the urging of President-elect Obama, the U.S. Congress passed legislation that provided for tax cuts and also for government spending equal to about 2% of GDP in 2009 (the red line in Chart 13.1). Boosted by the stimulus package, economic growth picked up in the latter half of 2009, rising into positive territory in the second quarter. According to the

Congressional Budget Office, the stimulus package raised GDP between 0.7 to 4.1 percent above what it would have been in 2010 in the absence of the stimulus; and unemployment was 0.4 to 1.8 percentage points lower.[1]

This episode highlights several important questions. First, why do large drops in the demand for goods and services occur in the first place? Second, how and why do such declines result in corresponding declines in the production of goods and services, as well as the income received by workers and the owners of firms? Third, why does a given decline in spending on building and equipping new factories and constructing new houses get magnified into a correspondingly larger drop in overall production? And finally, why would government spending and tax cuts be means of counteracting economic downturns?

In order to answer these questions, we develop a framework to show how all these parts – demand, production, and income – fit together, with other factors like the money supply, interest rates, and inflation. The process of building this framework proceeds in a series of steps.

To begin with, we examine the real side of the economy and focus on how the demand side acts as a driver of output. We set the financial sector aside for now; that is, we don't model explicitly the relationship between saving and borrowing as mediated by the market in bonds and other securities. On the other hand, our model will provide for the role of government policy in setting exchange rates. Building on this framework, we bring the financial sector into the picture in Chapters 14 and 15, to develop a more realistic depiction of the economy. In Chapter 16, we will further relax the assumption that demand determines output, by modeling the role of the supply side of the economy – its productive capacity, represented by the available labor force, capital stock, and technology.

As we have some in earlier chapters, here again we start with the analysis of a single economy, describing in detail how consumption and imports depend on income. We discuss what equilibrium looks like in such an economy. Then we examine the channels by which changes in government spending and tax policy affect the level of output. We'll also introduce a role for exchange rates, which were explained in Chapter 12. Finally, we allow for interactions between two countries, in order to highlight how economic effects spill over borders, and how those effects also "spill back." In this way, we illustrate the nature of economic interdependence in the global economy.

13.2 The Model

We begin with a simple model in which output is determined only by demand. This model is sufficient to illustrate several concepts: behavioral relationships, exogenous versus endogenous variables, and equilibrium. That machinery allows us to demonstrate how changes in policy cause changes in output, income and the balance of trade.

Aggregate Demand

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[1] Congressional Budget Office, *Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output in 2014* (February 2015).

The identity $Y \equiv C + I + G + CA$, introduced in Chapter 9, expresses the fact that on the side of the economy where supply arises, namely the production side, Y represents output and is defined as the sum $C + I + G + CA$. But Y also represents household income, which is earned mostly by providing the factors of production (labor, etc.), and on the demand side that income determines how much households are willing to spend on goods and services. Since their spending is where C, consumption expenditures, comes from and also determines the imports component of CA, on the demand side the sum $C + I + G + CA$ is a function of Y.

To investigate how the supply- and demand-side relationships lead to equilibrium, we break the identity $Y \equiv C + I + G + CA$ apart and introduce a new variable, AD, meaning **aggregate demand**:

(13.1) $$AD \equiv C + I + G + \underbrace{X - IM}_{\substack{\text{trade balance} \\ \text{or} \\ \text{net exports}}}$$

This equation defines total demand as the sum of planned or desired consumption, investment, government spending, and exports minus imports. For simplicity, we have assumed that in the definition $CA = X - IM + F + V$, the last two terms, net foreign income and transfers, are zero.

For the supply side, we now write the equation that describes what happens when production output matches aggregate demand:

(13.2) $$Y = AD$$

Unlike Equation (13.1), this equation is not an identity, because it is possible for production to get out of synch with demand. The key assumption we rely on to explain equilibrium is that the total amount of goods and services demanded determines the amount of goods and services produced: factories ramp up production to meet higher demand, and they cut production when demand falls. What Equation (13.2) is to specify the equilibrium condition, under which production matches demand.

While this model is not completely realistic, particularly in describing the behavior of the economy over the longer term, it serves as a useful starting point. Moreover, in the short run – over the course of a few months or a year – the assumption that firms respond to changes in demand for their goods and services mostly by changing production, rather than by changing prices, is not too far from reality. This approach, involving fixed prices, is sometimes termed "Keynesian," after the British economist John Maynard Keynes, who stressed, among other factors, the rigidity of wages and prices.[3]

Demand as a Function of Income

Let's now describe the behavior of each of the components of aggregate demand. Several of

[3] The assumption of fixed prices contrasts strongly with the classical model, wherein wages and prices were modeled as perfectly flexible, so that aggregate demand only fluctuated when production capacity changed, rather than demand.

these, namely *I*, *G*, and initially *X*, we will represent as **exogenous variables**, meaning that any change in their value is due to influences that lie outside the model. A change in government spending, for instance, is assumed to be driven by policy decisions (e.g., about military spending) that are not predictably related to other macroeconomic variables. When we need to identify a variable as *given* in this manner, though not *fixed*, we will place an overbar above it. So, the amount of investment in business plant and equipment, residential structures and inventories of goods and services is $\bar{I}$ ("I-bar"); government spending on goods and services is $\bar{G}$; and exports to the rest of the world is (for now) $\bar{X}$.

That leaves *C* and *IM*. These variable are called **endogenous**, meaning that they depend on other variables in the model. First, consider the **consumption function**, which describes the behavioral relationship between households' income and their consumption of goods and services:

(13.3) $$C = \underbrace{\bar{C}}_{\substack{autonomous \\ consumption}} + c(Y - \bar{T})$$

On the right side, $\bar{C}$ is a constant term representing a baseline consumption level that doesn't vary with income. Think of winter heating costs and other unavoidable expenses that households will, if necessary, dip into their savings to cover. Spending that occurs regardless of other factors is sometimes called **autonomous spending**, so here $\bar{C}$ is called autonomous consumption.

A **parameter** quantifies how strongly one variable affects another. In Equation (13.3), the quantity $Y - \bar{T}$ models disposable income very simply, as total income minus a lump-sum tax.[4] The parameter *c*, called the **marginal propensity to consume**, indicates the extent to which disposable income affects consumption, *C*: consumers increase their spending by *c* units for every unit of increase in disposable income.

While Equation (13.3) appears to express a complicated process in an overly simple equation, it is a surprisingly good approximation to the real world behavior of consumers. Economic models typically assume that the marginal propensity to consume is greater than zero but less than 1. A reasonable value would be $c = 0.80$, meaning that when disposable income rises by 1 dollar, consumption rises by 80 cents.

Finally, consider imports. Again keeping things simple, we assume that exchange rates remain constant, so that imports only depend on domestic income:

(13.4) $$IM = \underbrace{\overline{IM}}_{\substack{autonomous \\ imports}} + mY$$

Imports, *IM*, rise because as income *Y* rises, consumption also rises, and some of that

[4] Disposable income is sometimes referred to as after-tax income, although it is more precisely income after taxes and transfers. (The latter are essentially negative taxes, things like Social Security payments.) We treat taxes as an exogenous lump sum, but in the real world they are endogenous; for instance, the income tax collects more revenue as income rises. A better tax model, then, would be $T = \bar{T} + tY$, where *t* is the marginal tax rate. However, for now simply subtracting $\bar{T}$ from *Y* will suffice to convey the main point about how taxes affect the economy.

consumption falls upon imported goods. The parameter *m* is the **marginal propensity to import**; it describes the change in imports for a one-unit change in income. The standard assumption is that *m* is greater than zero but less than *c*. We might suppose that $m = 0.20$; then when income rises by 1 dollar, imports rise by 20 cents.

The Economy in Equilibrium

Pulling together everything else we have established thus far, we obtain the following description of an economy in equilibrium:

$$\underbrace{Y = AD}_{\substack{equilibrium \\ condition}} \equiv \underbrace{\bar{C} + c(Y - \bar{T})}_{consumption} + \underbrace{\bar{I}}_{investment} + \underbrace{\bar{G}}_{government} + \underbrace{\bar{X}}_{exports} - \underbrace{(\overline{IM} + mY)}_{imports} \qquad (13.5)$$

Expanding the right side and collecting terms, we obtain

$$\underbrace{Y = AD}_{\substack{equilibrium \\ condition}} \equiv (\bar{C} - c\bar{T} + \bar{I} + \bar{G} + \bar{X} - \overline{IM}) + (c - m)Y \qquad (13.6)$$

The equilibrium condition on the left side of Equation (13.6) and the identity on the right side are both linear equations relating *Y* and *AD*, and therefore it is possible to describe equilibrium graphically as the intersection point of two lines. We will do that in a moment. Meanwhile, however, notice that setting *Y* on the left equal to the sum on the right produces a third equation, with *Y* as its only endogenous variable. We can therefore solve that third equation for Y_0, the equilibrium value of income *Y*:

$$Y_0 = \underbrace{\left(\frac{1}{1-c+m}\right)}_{\substack{multiplier \\ \equiv \bar{\alpha}}} [\underbrace{\bar{C} - c\bar{T} + \bar{I} + \bar{G}}_{\substack{autonomous \\ domestic \\ spending \\ \equiv \bar{A}}} + \bar{X} - \overline{IM}] \qquad (13.7)$$

$\bar{A}$ is the total amount of autonomous spending by domestic residents (on all final goods and services, including imports). $\bar{A} + \bar{X} - \overline{IM}$ incorporates an accounting for that part of autonomous domestic spending associated with trade with the rest of the world. Equation (13.7) states that equilibrium income is a multiple of the adjusted amount.

The fraction denoted by $\bar{\alpha}$ is **the multiplier** that determines how strongly the equilibrium level of income goes up in response to an increase in autonomous spending. From the assumptions $0 < c < 1$ and $0 < m < c$, it follows that $\bar{\alpha} > 1$. Also notice that lump sum taxes contribute in a negative fashion: the higher lump sum taxes go, the lower equilibrium income goes, all else being equal.[5]

[5] If we had instead modeled taxes as $T = \bar{T} + tY$, then at each round of income receipt, households would retain a smaller portion as disposable income, resulting in commensurately lower consumption. Hence, the multiplier $\bar{\alpha}$ would be smaller, due to an additional term $+ct$ in the denominator. Thus, raising tax rate *t* would cause equilibrium income to fall.

The Keynesian Cross

Now to the graphical depiction of Equation (13.6). In Figure 13.1, aggregate demand is on the vertical axis, and income (equal to GDP) is on the horizontal axis. The 45-degree line represents equation (13.2), while the flatter line represents the right side of equation (13.5). Together, the two lines form what is called the **Keynesian Cross**; their intersection point marks the equilibrium income level.

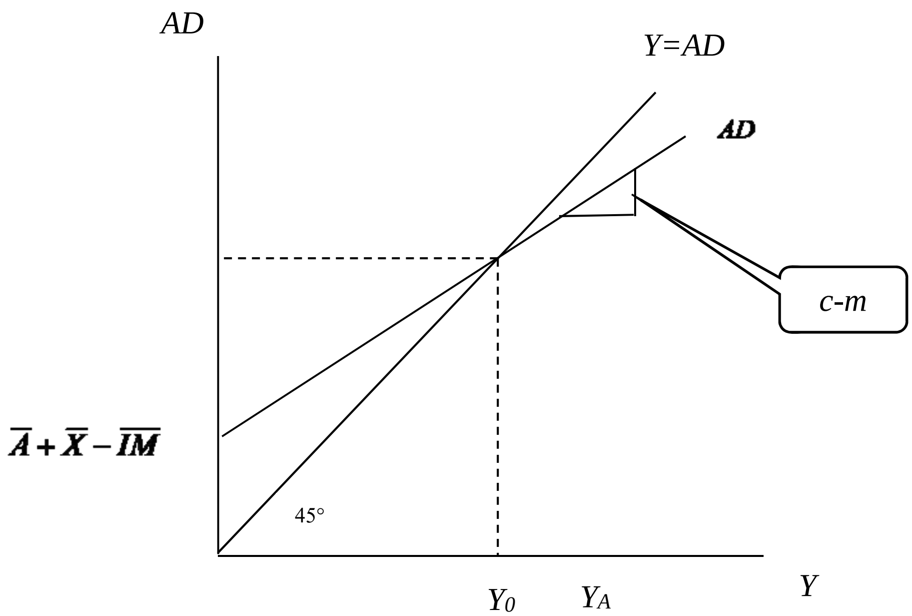

Figure 13.1: Equilibrium in the Keynesian Cross

Expanding the right side of Equation (13.5) produces the *Y*-terms cY and $-mY$, which means that the slope of the aggregate demand curve is $c - m$. Because $m < c$, the slope is positive, and so the equilibrium income Y_0 is greater than the *AD*-axis intercept, $\bar{A} + \bar{X} - \overline{IM}$. Each dollar of autonomous spending results in more than a dollar's worth of income in equilibrium. This effect can be viewed as a consequence of resources circulating through the economy not once but repeatedly—from consumers to producers in the form of spending, then back to consumers in the form of income, and so on.

We can model this cycle using Equation (13.6). Set *Y* to zero on the right side, use nonzero $\bar{A} + \bar{X} - \overline{IM}$ to evaluate *Y* on the left side, feed the resulting value back in as *Y* on the right side, and repeat *ad infinitum*. Each iteration adds another term to this infinite sum:

(13.8) $Y = (\bar{A} + \bar{X} - \overline{IM}) + (c - m)(\bar{A} + \bar{X} - \overline{IM}) + (c - m)^2(\bar{A} + \bar{X} - \overline{IM}) \cdots$

You may recognize this as an infinite geometric series. Because our assumptions about *c* and *m* imply that $0 < c - m < 1$, the series converges to the expression on the right side of Equation (13.7). The multiplying effect of circulation and re-circulation of autonomous spending can have fairly dramatic consequences. Using our earlier rough estimates of $c = 0.80$ and $m = 0.20$, we find that \$1000 of autonomous spending leads, per Equation (13.7), to \$2500 worth of economic output. It is no wonder some economists like government policies aimed at increasing autonomous spending. We will consider the consequences of such policy moves in the next section.

Compared to Equation (13.7), the graphical, Keynesian-Cross analysis has the advantage that it facilitates investigation of what happens if the economy drifts out of equilibrium. Suppose production exceeds aggregate demand, $Y_A > AD$, as shown in Figure 13.2. Then goods enter inventory from production faster than they exit through consumption, and inventories grow above desired levels. The excess production is shown by the large blue arrow.

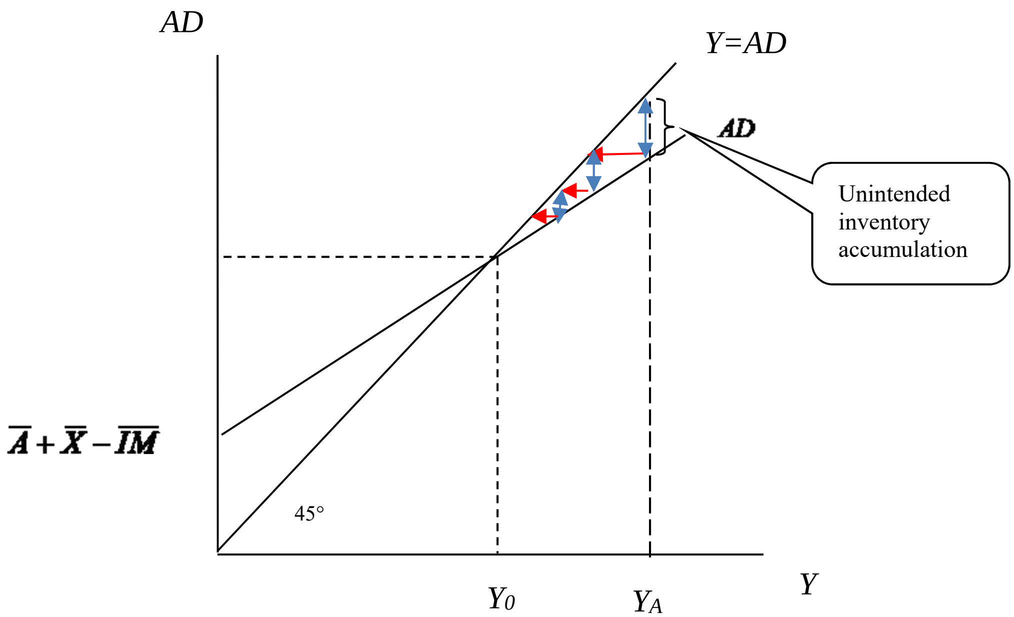

Figure 13.2: Adjustment to Equilibrium

Since storage costs money and ties up funds in the form of purchased materials, firms will seek to reduce inventory by cutting back on production—the large red arrow. As production falls, income falls. However, production remains higher than aggregate demand, so unintended inventory accumulation (again denoted by a blue arrow) continues. Hence, firms decrease production again (another red arrow).

This process continues, in smaller and smaller increments. Only when income equals aggregate demand ($Y = AD$) will there be no more unintended inventory accumulation. A similar process on the left side has producers ramping up production in response to too-low inventories that risk stocks running out, leading to lost sales.

13.3 How Do Government Spending and Taxes Affect Income?

With our model in hand, we are now able to describe how a change in one (exogenous) variable affects another variable. In particular, we can see how income responds to changes in the variables the government controls. It also allows one to examine the behavior of endogenous variables in pairs—when they move together in the same direction and when they move in opposite directions.

The Effects of Government Spending

To understand how a change in autonomous spending affects equilibrium income, think about a change of income (ΔY) as being attributable to changes in each of those autonomous spending components. From Equation (13.7),

(13.9) $$\Delta Y = \bar{\alpha}\left[\Delta A + \Delta X - \Delta IM\right]$$ [6]

This indicates that any change in GDP has to be attributable to a change in one or more of the autonomous components of spending. If the only spending component that changes is government spending, then ΔA becomes ΔG, ΔX and ΔIM zero out, and

(13.10) $$\Delta Y = \bar{\alpha}\Delta G$$

A change in government spending by 1 dollar leads to an $\bar{\alpha}$ -dollar increase in income. This result can be interpreted graphically. In Figure 13.3, the increase in government spending shifts the aggregate demand curve upward by an amount ΔG. The new equilibrium level of income is Y_1.

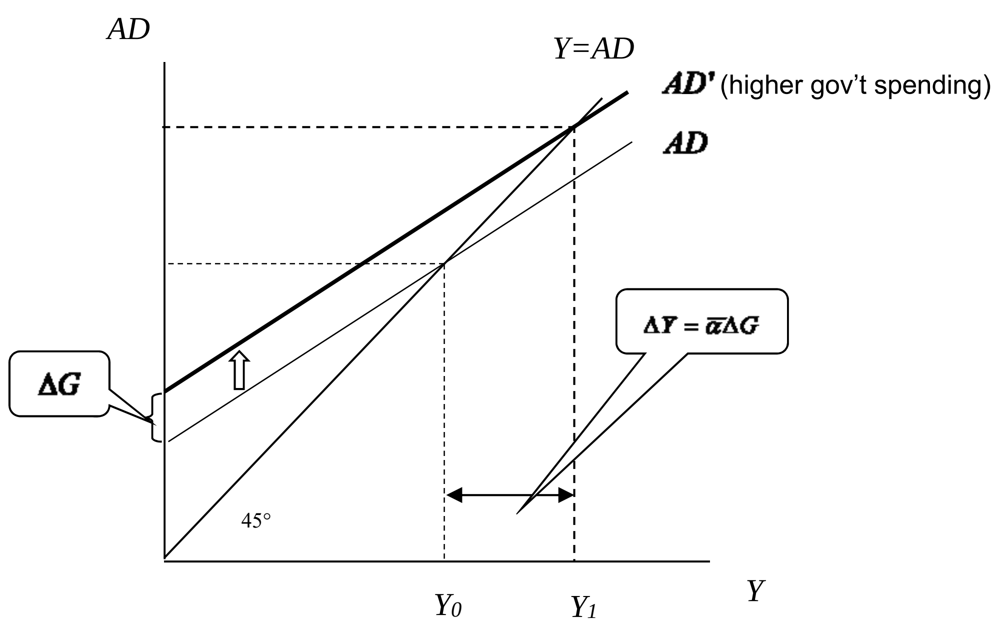

Figure 13.3: Change in income due to a change in government spending

As the graph illustrates, the increase in GDP, $\Delta Y = Y_1 - Y_0$, is larger than the increase in government spending, because $\bar{\alpha} > 1$. To restate the point in different form,

[6] This is a "total differential," holding $\bar{\alpha}$ constant.

(13.11) $$\frac{\Delta Y}{\Delta G} = \bar{\alpha} \equiv \frac{1}{1-c+m} > 1$$

In other words, the change in GDP for a dollar change in government spending on goods and services is greater than 1. For this reason, $\bar{\alpha}$ is often called the **multiplier for government spending**.

Notice that c and m represent opposing influences on ΔY, because nonzero c increases $\bar{\alpha}$, while nonzero m decreases it. Consider an increase in government spending of one dollar. That one dollar adds to GDP immediately, by increasing the G component. From there, the dollar circulates back to those providing labor and other factors of production, and now the dollar is ready to be spent again, this time by the private sector. Whatever part of that dollar is spent on domestically produced final goods contributes to C, further boosting GDP. By contrast, whatever part of the dollar is spent on foreign imports is in effect taken out of circulation, since only a small fraction of it is likely to return via foreign purchases of exports. In that sense, spending on imported goods "leaks out" of the economy.

The Impact of Taxes

Compared to government spending, taxes have the reverse effect: they reduce output. But in contrast to government spending, which directly increases GDP, taxes increase consumption only indirectly. The direct impact is on disposable income, which *then* causes changes in consumption.

To see the impact of an increase in taxes, ΔT, consider Figure 13.4. As in our discussion of government spending, income starts out at Y_0 and the change ΔY is obtained from Equation (13.9). This time, however, from Equation (13.7) the nonzero component of autonomous spending, $\Delta A \equiv \Delta C - c\Delta T + \Delta I + \Delta G$, is $-c\Delta T$, and instead of Equations (13.10) and (13.11) we get

(13.12) $$\Delta Y = \bar{\alpha}(-c\Delta T)$$

Because the rise in taxes decreases disposable income, $Y - \bar{T}$, consumption falls, and so the aggregate demand curve shifts down. As the aggregate demand curve shifts down, equilibrium total income declines to Y_1.

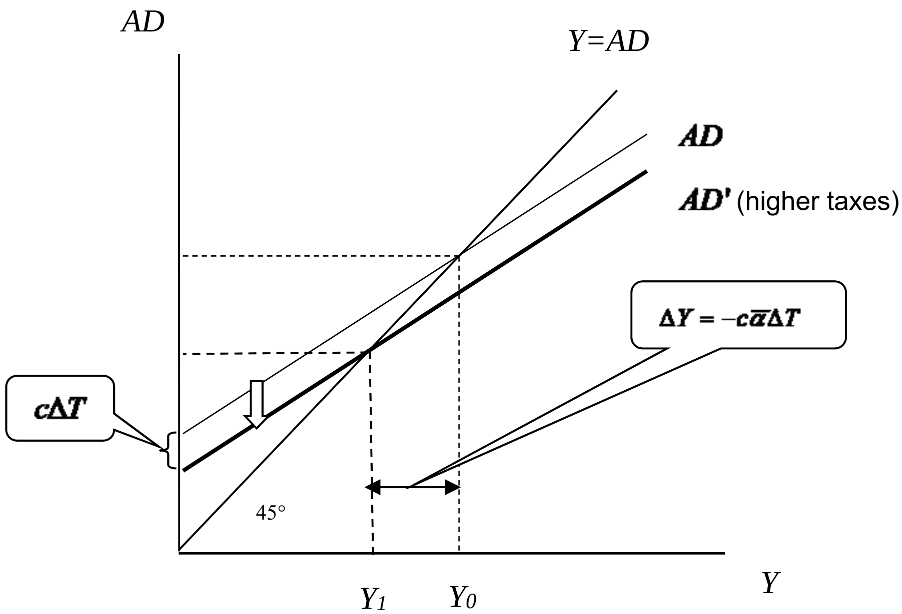

Figure 13.4: Change in income due to a change in lump sum taxes

The tax-hike counterpart to Equation (13.11) is

(13.13) $$\frac{\Delta Y}{\Delta T} = -c\bar{\alpha} \equiv -\frac{c}{1-c+m}$$

Again the total impact on output is a result of the recirculation, only this time it is a negative one. The higher taxes reduce disposable income, causing a reduction in consumption (part of aggregate demand). That reduction of consumption causes further reductions in production and hence income, feeding into more reductions in consumption.

Given that an increase in government spending boosts income Y, it is no big surprise that an increase in lump-sum taxes reduces income. Accordingly, a lump-sum tax cut will increase income. However, the *c* in the numerator of Equation (13.13) indicates that a dollar's decrease in taxes yields a *smaller impact* than a dollar's increase in government spending.

The reason the magnitudes are not the same is related to how each policy affects income. A dollar's worth of government spending immediately boosts GDP, to the tune of one full dollar (of *G*). A dollar's worth of tax cuts increases disposable income – but that isn't the same as GDP. The rise in disposable income only induces a *c* dollar increase in GDP (*c* dollars of *C*). In short, a dollar's worth of increased government spending on goods and services has a bigger impact on GDP than a dollar's worth of tax cuts.

Even more interestingly, once the leakage effect of spending on imports is accounted for, it's not necessarily the case that a dollar's worth of tax cuts produces even a full dollar's worth of increase in income. Suppose that in Equation (13.13), *c* equals 0.60 instead of 0.80, and *m* equals

0.40 instead of 0.20. Then $-c\bar{\alpha} = 0.75$, which means that a dollar's worth of tax cuts only boosts economic output by 75 cents.

It follows from our admittedly highly simplified analysis that if the government is prepared to let its **budget balance**, $\bar{T} - \bar{G}$, go negative for a while in order to jump-start the economy, the government will get more benefit from the same-size deficit by increasing spending $\bar{G}$ than by a cutting taxes $\bar{T}$ by the same amount. The result that one can increase economic activity even while keeping the budget deficit constant is called the balanced budget multiplier.

13.4 How Are the Government Budget and Trade Balances Related?

Returning to our earlier discussion in Chapter 9 of the Twin Deficits, we can now examine the link between government spending and tax policies on the one hand and developments in the external accounts on the other. In particular, one sometimes hears the argument that running a budget deficit causes a trade deficit. This certainly seems to have been the case during the mid-1980s, as shown in Figure 13.2.

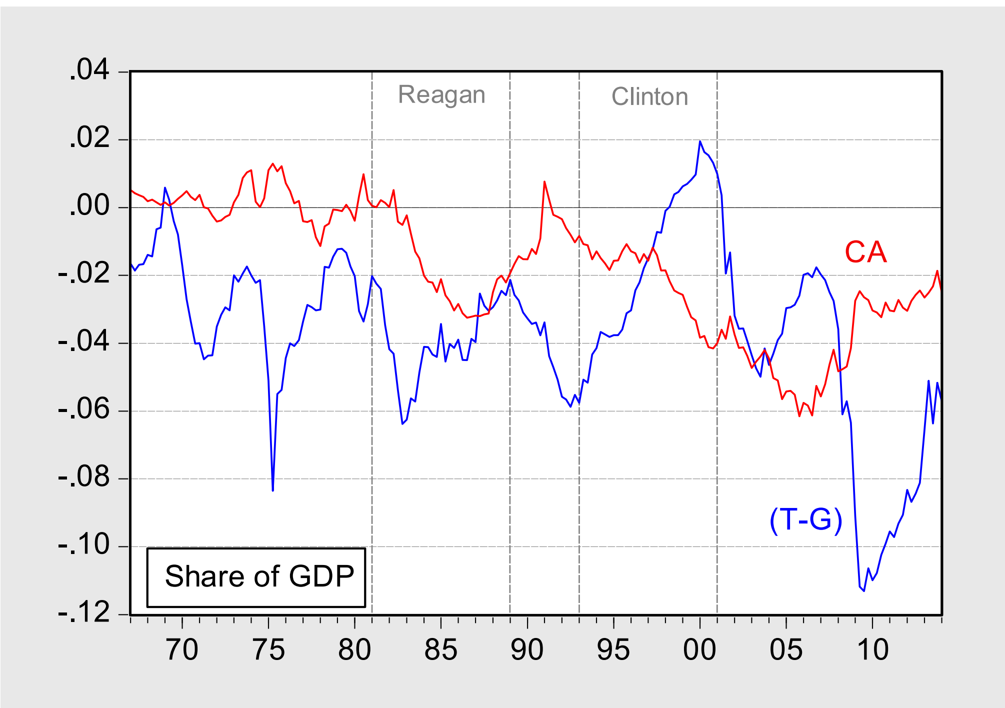

Chart 13.2: Current account (red) and government budget balance (blue), all as a share of GDP. Source: BEA, 2014Q1 third release.

The blue line drops at the start of the Reagan Administration. A couple of years later, the current account also declines. After the government's budget balance improves, toward the end of the 1980s, the current account follows, once again with a time lag.

To examine why this pattern makes sense, let's show algebraically what happens to the trade balance and the government budget balance in response to changes in government spending.

Take the trade balance, also known as net exports, the difference between exports and imports:

(13.14) $TB = \bar{X} - IM = \bar{X} - (\overline{IM} + mY)$

When income rises then, holding all else constant, the trade balance worsens. (Obviously, changes in foreign consumption of home goods, $\bar{X}$, and in autonomous spending on foreign goods, $\overline{IM}$, also have an impact, but we'll hold those constant.) As we showed in the last section, income is positively influenced by government spending. Hence, an increase in government spending causes a deterioration in the trade balance, holding everything else constant, because the resulting higher income brings with it higher imports:

(13.15) $\Delta TB = -m \underbrace{\bar{\alpha}\Delta G}_{=\Delta Y} < 0$

What about the budget balance? We defined this in the last section as government tax revenue minus government expenditures:

(13.16) $BuS = \overline{T} - \overline{G}$

Clearly an increase in government spending reduces the budget balance or increases the budget deficit:

(13.17) $\Delta BuS = -\Delta G < 0$

To summarize the impact on the two balances from changes in government spending: an increase in government spending causes a deterioration in both the trade and budget balances. This is the "causal" interpretation of the Twin Deficits hypothesis.

Notice that if taxes depended on income (perhaps because there was an income tax) and were modeled as $T = \bar{T} + tY$, then if *investment*, rather than government spending, were to increase exogenously, this would send the two balances in opposite directions: the positive ΔI would produce a positive ΔY, and then $\Delta TB = -m\Delta Y$ would still be negative but $\Delta BuS = t\Delta Y$ would be positive. Thus the Twin Deficits phenomenon is not an iron law. The correlations between these two deficits depends on which variables are changing exogenously. Economists call these exogenous changes to variables "**shocks**."

This point is also highlighted in Chart 13.2: during the 1990s, the budget balance went into surplus, while the current account balance went very negative. From the accounting perspective discussed in Chapter 9, the only way this could happen is if the private saving-investment balance went very negative. However, that's not a causal explanation. In fact, there *was* a boom in investment, while at the same time personal saving declined. In the context of the model developed in this chapter, there was a positive shock to investment (an increase in $\bar{I}$) and, for good measure, a positive shock to consumption (an increase in $\bar{C}$) that had similar effects.

13.5 The Role of the Real Exchange Rate

In Chapter 10, we introduced the concepts of a real exchange rate – the nominal exchange rate between two countries, adjusted by the respective price levels. The real exchange rate can also be described as the relative price of a bundle of goods produced in the foreign country, in terms of the same bundle produced in the home country. From the perspective of the United States, the real exchange rate is the number of U.S. bundles required to purchase one foreign bundle. As this number rises, American goods become relatively cheaper, thus affecting the desirability of American exports and imports.

Exchange Rate Effects

Consider the following example: American tractors start out trading one-for-one for Chinese tractors. Then the U.S. dollar depreciates against the Chinese yuan by 50%, meaning that a yuan costs 50% more dollars than before. However, the dollar price of American tractors remains the same, and the yuan price of Chinese tractors remains the same. At this point the same amount of money, exchanged as needed, will buy either have two-thirds of a Chinese tractor or a whole American tractor. With this new tradeoff, both Americans and Chinese buyers will tend to buy more American tractors and fewer Chinese ones. U.S. tractor exports to China will increase, and U.S. imports of Chinese tractors will decrease.

We can incorporate this important factor into our model by making exports and imports depend on the real exchange rate. For imports:

(13.18) $$IM = \overline{IM} + mY - nq$$

The parameter *n* is the sensitivity of imports to the real exchange rate, q. As q rises, it takes more units of the home good to buy a single unit of the foreign good. When home goods become relatively cheaper in this way, the quantity of imports declines.

Exports, instead of being a fixed amount, are now dependent on the real exchange rate just as imports are.

(13.19) $$X = \bar{X} + vq$$

Here *v* is the sensitivity of exports to the real exchange rate. When q rises, foreign goods become more expensive. The home country's exports thus become more attractive to foreigners, and the quantity of exports rises.

We will treat q as a variable whose value is set by government policy and can be changed by the government when it decides to do so.[7] In other words, we treat the real exchange rate as an exogenous variable. We denote this fact with an overbar: $\bar{q}$.

Solving for the equilibrium income, as we did to obtain Equation (13.7) but now using the new expressions for imports and exports, leads to the following result:

[7] The government can "peg" the exchange rate, as is described in Chapter 12, by intervening in the foreign exchange market. This is discussed further in Chapter 14.

(13.20) $$Y_0 = \bar{\alpha}[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q}]$$

Now the equilibrium income is a multiple of total autonomous spending *plus* a constant times the real exchange rate. The autonomous-spending component is familiar; the higher its level, the higher the equilibrium level of income. The second component is new to this model. Changes in real exchange rates (which equal changes in the nominal rates when the price levels are fixed) affect the international components of aggregate demand, namely exports and imports.

To analyze the effect of changes in autonomous spending or exchange rates on equilibrium income, we once again consider our equation for Y_0 and relate a change on the left side to changes on the right side:

(13.21) $$\Delta Y = \bar{\alpha}[\Delta A + \Delta X - \Delta IM + (n+v)\Delta q]$$

If, now, the real exchange rate is the only variable allowed to change, then all the other Δ terms drop out and we can relate the change in Y to the change in q that caused it:

(13.22) $$\frac{\Delta Y}{\Delta q} = \bar{\alpha}(n+v) > 0$$

A devaluation of the domestic currency causes an increase in GDP. The size depends on the parameters; when the currency is devalued by one unit, imports decrease by n dollars and exports increase by v dollars. The combined increase in net exports is scaled by multiplier $\bar{\alpha}$.

If, as we are assuming, the government controls the exchange rate, then the government can boost the economy by lowering the currency's real value, as shown in Figure 13.5.

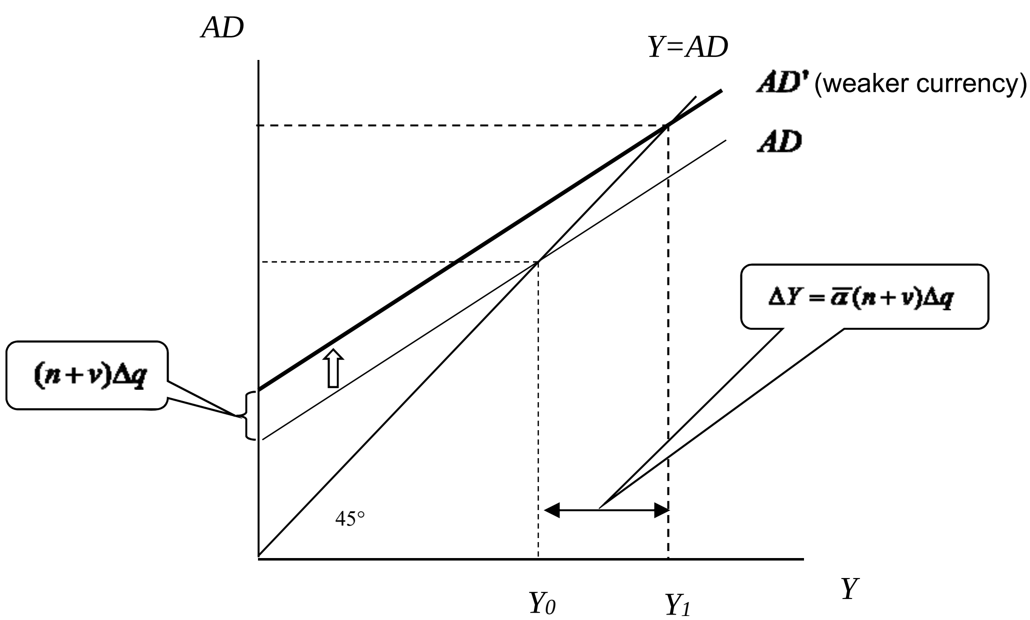

Figure 13.5: Change in income due to a real devaluation

As the example of Chinese-made and American-made tractors illustrated, a rise in q makes for increased purchases of domestically produced goods. The additional goods have to be produced, and the domestic factors of production (labor, capital) have to be paid for. The higher income results in higher consumption, and now the multiplying cycle kicks in.

The Exchange Rate and the Trade Balance

Now that we have introduced a role for the real exchange rate, we can talk fruitfully about different ways of affecting the trade balance. In brief, one can improve the trade balance either by reducing income (and hence reducing imports), or by letting the currency lose value – and hence increasing exports and reducing imports. These two ways of reducing a trade deficit (or improving a trade surplus) are called the **expenditure reduction** and **expenditure switching** approaches.

To show the workings of the expenditure reduction versus expenditure switching approaches, consider again the formal definition of the trade balance, using the revised formulas for exports and imports:

(13.23) $$TB = (\bar{X} + v\bar{q}) - (\overline{IM} + mY - n\bar{q})$$

Suppose policymakers face a trade deficit they consider too large. How could they respond? We know from Section 13.3 that they could cut government spending, which would reduce income Y, which would reduce imports and thus reduce the trade deficit. This is the expenditure reduction route. But on the other hand, the government could hold spending constant and instead devalue the currency. The effect of raising the value of $\bar{q}$ ($\Delta q > 0$), per Equation (13.23), is an improvement in the trade balance. Foreigners buy more of the now-cheaper exported goods, home residents buy fewer of the now-more-expensive imports, and with exports up and imports down, the trade deficit goes down. This is the expenditure switching channel.

Chart 13.3 illustrates the fact that when the dollar exchange rate appreciates (q falls), the non-oil trade balance deteriorates, with a lag of about two years.[8] That pattern is consistent with the expenditure switching effect of exchange rate depreciations. (The two year lag accounts for the fact that it takes some time for exchange rate changes to affect the behavior of firms and households.)

[8] Since oil prices are largely denominated in U.S. dollars, oil imports are excluded so as to focus on that part of the trade balance that is affected by the exchange rate.

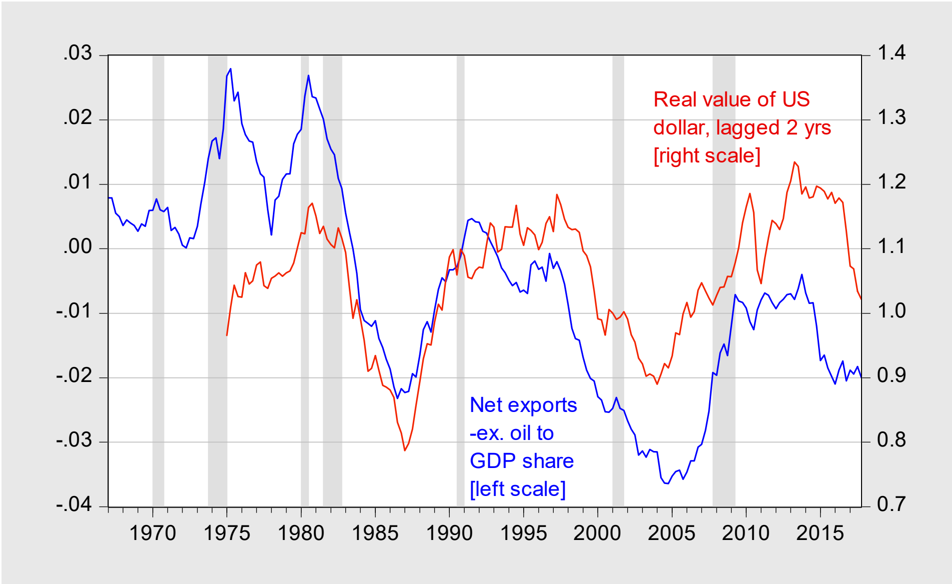

Chart 13.3: Ratio of trade balance excluding oil imports to GDP (blue line, left scale) and the real exchange rate of the U.S. dollar lagged two years (red line, right scale). Source: Bureau of Economic Analysis and Federal Reserve Board.

Chart 13.3 also illustrates the expenditure reduction effect, albeit more subtly. The shaded areas denote **recessions** – periods when the U.S. economy contracts. Notice that as the economy enters recessions, in all but one case the trade balance is rising. When income declines, consumption declines, and because some of the goods and services consumed are imported, imports decline. Since imports are a negative entry in the trade balance, declining imports result in an improved trade balance.

Box 13.1: Exchange Rates and Trade Flows

According to the model described in this chapter, real exchange rate devaluation straightforwardly raises exports and decreases imports. Although reality is more complex and the pattern doesn't always hold, it does seem to hold as a general rule.

To see how a devaluation works, consider the following partial equilibrium analysis, where income Y is held constant in order to isolate the impact of exchange rates. Prices at home and abroad are also held constant, so that changes in the nominal exchange rate translate directly into changes in the real exchange rate.

First, consider imports—specifically, widgets imported from China in quantity $\widetilde{IM}$. In Figure 13.6, the downward-sloping demand curves indicate that at any given exchange rate *S*, import quantity $\widetilde{IM}$ depends negatively on the widgets' price in yuan, $P^*\{¥\}$. The perfectly flat supply curve reflects our assumption that the widgets ship at a fixed price in yuan, $\bar{P}^*_{IM}\{¥\}$. We justify this assumption by supposing that exports are much smaller than China's domestic market, so that changes in export quantities have a negligible impact on producers and therefore do not affect the price. In short, we are assuming infinite price elasticity of the foreign supply.

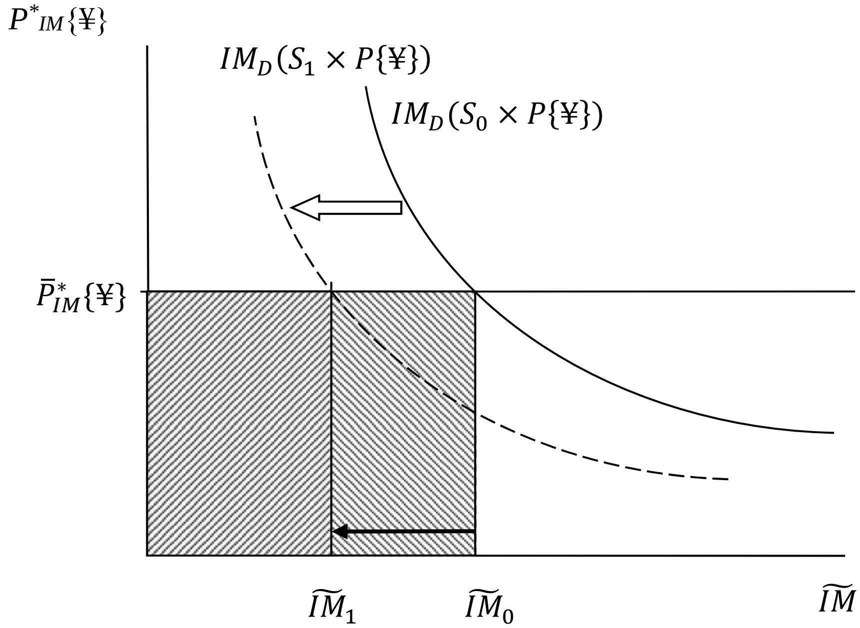

Figure 13.6: Shifted import demand due to currency devaluation

Initial imports are $\widetilde{IM}_0$ when the exchange rate is S_0. Since American demand for Chinese goods depends on the *dollar* prices, a dollar depreciation ($S_1 > S_0$) will shift the demand curve, resulting in a reduction of imports to $\widetilde{IM}_1$.

Now we turn to the export market, depicted in Figure 13.7. As with the widgets made in China, so with those exported from the U.S., we assume infinite price elasticity of domestic supply and therefore a fixed price, this time in dollars. When the price is converted to yuan, however, the *level* of the flat export supply curve depends on the exchange rate. At initial rate S_0, U.S. exports will be X_0. Devaluing the dollar (S rises to S_1) decreases the price Chinese buyers face, reflected in a downward shift of the supply curve. As Chinese buyers take advantage of the lowered yuan price, exports rise from X_0 to X_1.

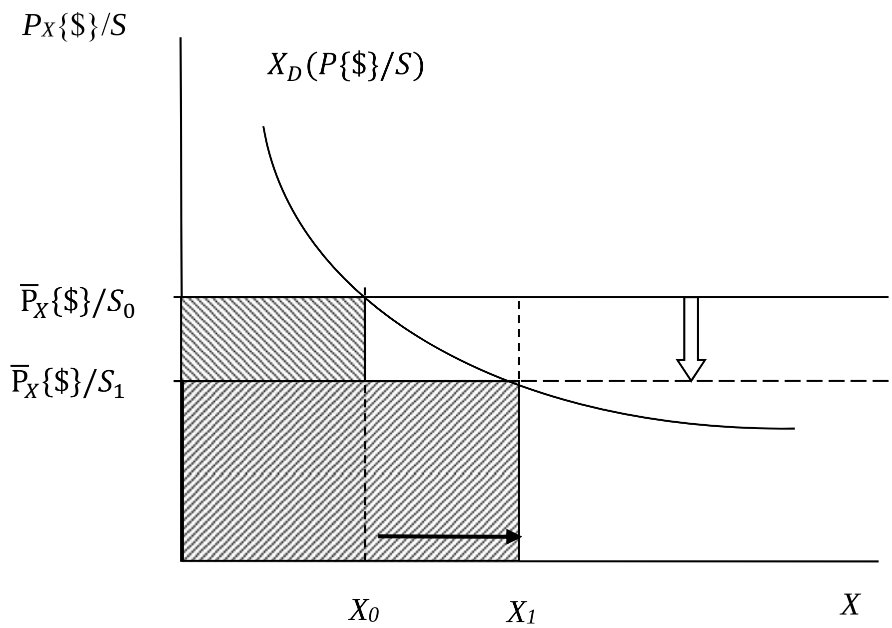

Figure 13.7: Shifted export supply due to currency devaluation

Notice that in Figure 13.6, foreign exchange expenditures on imports decline, from $\bar{P}_{IM}^{*} \times \widehat{IM}_0$ to $\bar{P}_{IM}^{*} \times \widehat{IM}_1$. In Figure 13.7, by contrast, foreign exchange earnings from exports are ambiguously affected. Earnings change from $(\bar{P}_X\{\$\}/S_0) \times X_0$ to $(\bar{P}_X\{\$\}/S_1) \times X_1$. The net effect on earnings of foreign exchange is uncertain, as it depends on the shapes of the demand curves.

The difference between foreign exchange earnings and foreign exchange expenditures on imports is the U.S. trade balance, denominated in yuan:

$$TB\{¥\} = \left(\frac{\bar{P}}{S}\right) \times X - \bar{P}^{*}\{¥\} \times \widetilde{IM}$$

Given that the dollar's value undergoes change, we may wish to measure the devaluation's overall impact on the trade balance in real terms—widgets instead of dollars. To convert to real terms, we multiply both sides by *S* (measured in $/¥) and divide by the U.S. price in dollars, $\bar{P}$, to obtain:

$$TB = X - \left(\frac{S\bar{P}^{*}}{\bar{P}}\right) \times \widetilde{IM} = X - qX^{*}$$

TB is the trade balance in real terms, i.e., in U.S. widgets, defined as the difference between exports, *X*, and imports ($\widetilde{IM}$) converted into U.S. widgets by the real exchange rate, $q \equiv (SP^{*}/P)$.

To see how a devaluation shifts the balance of trade when trade is initially balanced, $X = gX^*$, we take the partial derivative of the trade balance with respect the real exchange rate.

(13.24) $$\frac{\partial TB}{\partial q} = \frac{\partial X}{\partial q} - q\frac{\partial X^*}{\partial q} - X^*$$

For a devaluation to improve the trade balance, $\frac{\partial TB}{\partial q}$ must be greater than zero:

(13.25) $$0 < \frac{\partial X}{\partial q} - q\frac{\partial X^*}{\partial q} - X^*$$

We move the X^* to the left side and divide both sides by X^*:

(13.26) $$1 < \frac{\partial X/X^*}{\partial q} - q\frac{\partial X^*/X^*}{\partial q}$$

Our assumption that $X = gX^*$ enables a substitution of X/q for X* in the first term, followed by rearranging of the q in both terms:

(13.27) $$1 < \frac{\partial X/X}{\partial q/q} - \frac{\partial X^*/X^*}{\partial q/q}$$

The first term on the right is positive, because as we've seen, an increase in the exchange rate leads to increased exports. Including the subtraction as part of the imports term makes that term positive, as well. The two terms can be interpreted as the respective (positive) elasticities of exports and imports with respect to the real exchange rate:

(13.28) $$1 < \varepsilon_X + \varepsilon_{IM}$$

This is the **Marshall-Lerner-Robinson condition**: when the sum of the export and import elasticities is greater than 1, the real trade balance improves in response to a devaluation.

Remember, this derivation assumes:

- Export and import supply price elasticities are infinite.
- Prices of exports are fixed in domestic currency terms, and prices of imports are fixed in foreign currency terms.
- Trade is initially balanced.

The failure of any of these conditions to hold would limit the efficacy of devaluation. The last one is perhaps the most important assumption. Countries seldom devalue their currency when trade is balanced. Usually, devaluations occur when imports exceed exports. In such cases, the elasticities would have to sum to more than 1 in order for the devaluation to improve the trade balance.

It's likely that the elasticities are very small, particularly in the very short term. If the elasticities are smaller in the shorter term than in the longer term, then the response of the trade balance will probably vary over the time horizon. In response to a devaluation, the trade balance may initially deteriorate, and only improve over time. This pattern of response is called "the J-curve", since the trade balance plotted over time looks like a tilted letter J.

13.6 The Spillover Effects of Fiscal Policy

When America sneezes, the rest of the world catches cold. – common aphorism

Up to this point, we've assumed that the rest of the world is unaffected by domestic events. While this is a useful simplification, often one wants to examine how large economies interact with other, equally large economies. To model such interactions, we imagine two countries, named Home and Foreign, that trade with, and only with, each other. In addition, to simplify the analysis, we hold the real exchange rate constant, and subsume that effect into the constants of the export and import functions. The algebraic details for what follows are given in the Appendix at the end of the chapter; here we focus on the results and on the graphic representation.

Suppose Home's export function is modified to account for the fact that when Foreign's income (Y^*) rises, Home's exports increase. The intuition is straightforward: Home's exports are Foreign's imports, and their imports depend on their income, just as Home's imports depend on Home's income. Replacing $\bar{X}$ with $\bar{X} + m^*Y^*$ in Equation (13.5) makes Home's income depend on Foreign's, with $m^*/(1 - c + m)$ being the parameter describing the influence of Y^* on Y—the amount by which Home's income rises in response to a unit increase in Foreign's.

By the same reasoning, Foreign's income depends on Home's income, rising by $m/(1 - c^* + m^*)$ for every unit rise in Home's income. If, now, we consider the effect of income-boosting government policy moves, like tax cuts and government spending, then it turns out that the impact of such moves is larger in this model than in the single-country model.

The reason for this result is that an increase in, say, government spending induces higher consumption and, as in the single-country model, higher imports. But in contrast to what happens in the single-country model, here part of the spending that leaks out of Home's economy in the form of imports is returned back to Home in the form of higher exports. That's because when Home's imports rise, Foreign's exports rise and, hence, so does its GDP. That higher GDP induces more imports into Foreign. But in this two-country world, Foreign's imports are Home's exports, and so some of the leaked-away spending comes back to Home.

To be sure, not all of the leaked spending comes back. Rather, the end result depends on the sensitivity of each country's imports to its own GDP, i.e. on the marginal propensity to import. For a given m, the larger m^* is, the more of Home's spending circulates back as export demand.

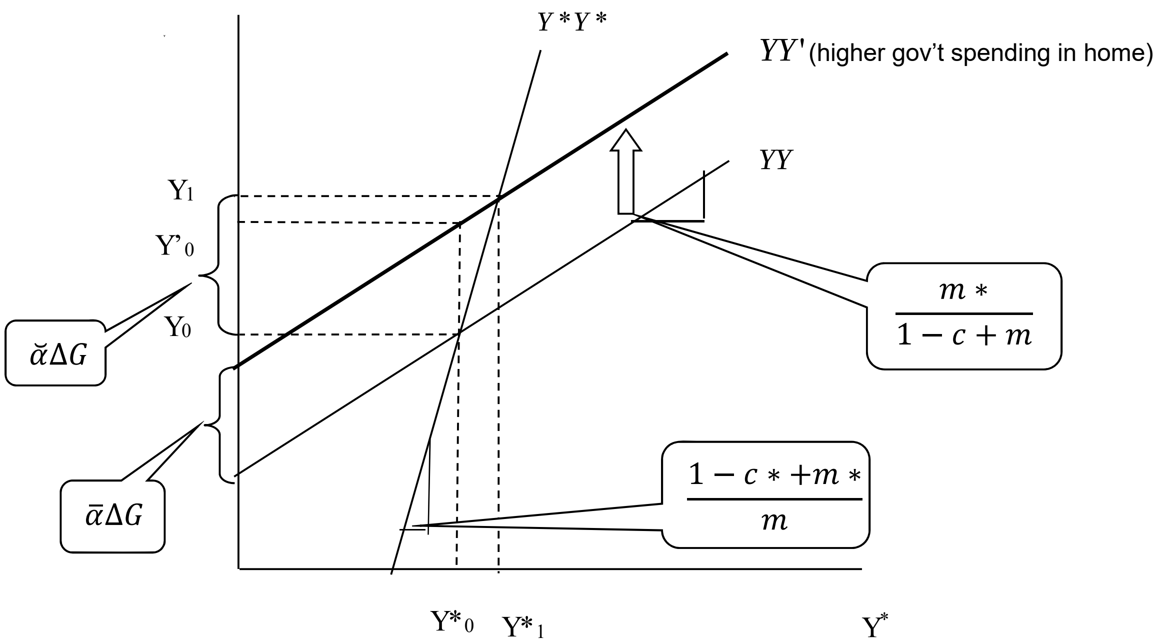

Figure 13.8: The impact of increased government spending in a two-country model

Figure 13.6 represents the interaction of the two economies graphically, with Home income on the vertical axis and Foreign income on the horizontal. The flatter line, *YY*, describes how Home's income depends on Foreign's, where the parameter $m^*/(1 - c + m)$ becomes the slope of the line. The vertical intercept is $\bar{\alpha}[\bar{A} + \bar{X} - \overline{IM}]$. (See equation A13.2 in the Appendix.) The steeper line, Y^*Y^*, similarly describes how Foreign's income depends on Home's; that line has a slope of $(1 - c^* + m^*)/m$. Equilibrium, $Y = Y_0$ and $Y^* = Y^*_0$, is given by the intersection of the two lines.

Suppose, now, that Home's government decides on an economic stimulus in the form of an increase in spending, ΔG; this is shown as an upward shift in the *YY* curve. The shift distance $Y'_0 - Y_0$ is equal to $\bar{\alpha}\Delta G$, the answer we obtained as $Y_1 - Y_0$ for the single-country model (Figure 13.3). However, a rise in Home's income leads to a rise in Home's imports and therefore a spillover rise in Foreign's income from Y^*_0 to Y^*_1. Consequently, Foreign's demand for Home's exports rises, giving an extra boost to Home income's—a spill*back* effect. Hence, the total change in Home's income is given not by $Y'_0 - Y_0$ but by the longer distance $Y_1 - Y_0$. In short, in the two-country model $\Delta Y/\Delta G$ is not $\bar{\alpha}$ but a larger multiple, $\breve{\alpha}$. The expression for $\breve{\alpha}$ is derived in the Appendix.

13.7 Application: Responding to the Global Great Recession

How relevant are these spillover and spillback effects? Apparently, policymakers believe they are important. During the worldwide economic crisis that began in 2008, policymakers from the

G-20 countries – the twenty largest developed and developing economies – agreed that their countries should all simultaneously increase government spending and cut taxes. The idea was that for any given country, the bang for the buck would be greater if all countries stimulated their economies simultaneously.

Figure 13.7 depicts this effect using a modified two-country model, with the U.S. and the Euro Area as the two countries. If government spending in the U.S. increases, the flatter, $Y^{US}Y^{US}$ curve, describing how Y^{US} depends on Y^{EU}, shifts up. By itself, that shift will cause Y^{US} to increase in to Y_1, as greater U.S. income spurs greater Euro Area income and hence greater U.S. exports that boost U.S. income. With a coordinated stimulus, the $Y^{EU}Y^{EU}$ curve shifts, as well, so that U.S. income rises all the way to Y_2, higher even than Y_1. The output increase in the home country is larger with a simultaneous stimulus than if the stimulus occurs only in the home country.

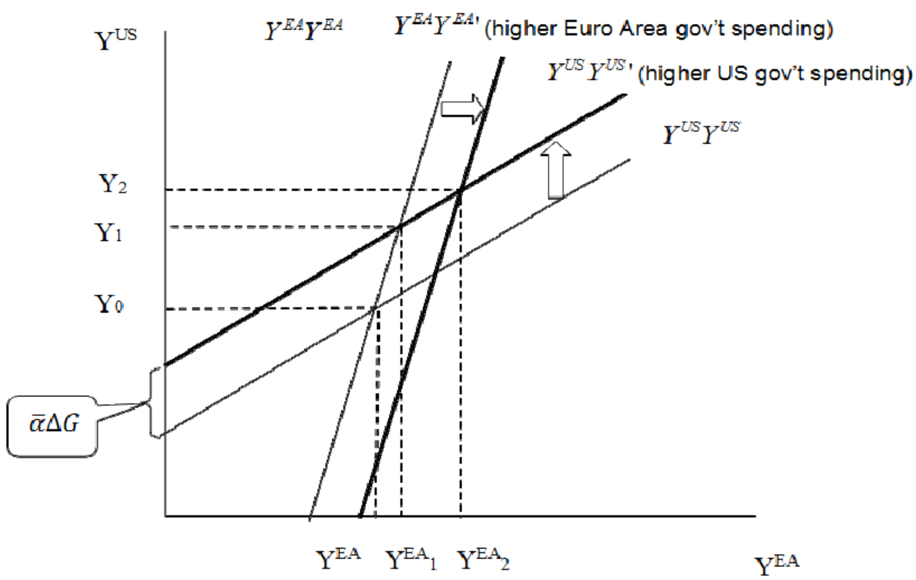

Figure 13.9: Coordinated stimuli in the U.S. and the Euro Area

Simulations conducted by the IMF in order to provide guidance to the policymakers of the G-20 countries reflect the spillover and spillback effects in the two-country model. While the IMF's model is substantially more complicated than that described above – in particular, its model incorporates a financial side and considerations about expectations about the future – our model confirms the significance of interdependencies.[9]

Table 13.1 records the commitments to discretionary fiscal stimuli that were agreed to by the

[9] The simulations, which use the IMF's Global International Money and Finance model (GIMF), hold monetary policy constant by setting the policy interest rates constant. That suggests that this chapter's use of a Keynesian model that ignores the financial side is not objectionably artificial.

respective G-20 governments.

Table 2. Fiscal Stimulus Packages Announced for 2009–10 as of January 17, 2009 *(As a percent of GDP in the region)*		
	2009	2010
United States	**1.9**	**2.9**
Tax cuts	0.9	1.2
Infrastructure	0.3	0.8
Other	0.6	1.0
Euro area	**0.9**	**0.8**
Tax cuts	0.3	0.3
Infrastructure	0.4	0.0
Other	0.2	0.4
Japan	**1.4**	**0.4**
Tax cuts	0.1	0.1
Infrastructure	0.3	0.1
Other	1.0	0.2
Asia excluding Japan	**1.5**	**1.3**
Tax cuts	0.1	0.1
Infrastructure	1.1	0.0
Other	0.3	1.2
Rest of G-20	**1.1**	**0.3**
Tax cuts	0.5	0.1
Infrastructure	0.2	0.1
Other	0.4	-0.1
Total (PPP-weighted)	**1.4**	**1.3**
Tax cuts	0.4	0.4
Infrastructure	0.5	0.3
Other	0.5	0.7

Table 13.1 - Fiscal Stimulus Packages, as a percent of GDP
Source: Charles Freedman, Michael Kumhof, Douglas Laxton, and Jaewoo Lee, "The Case for Global Fiscal Stimulus," *IMF Staff Position Note* 09/03 (March 2009).

Table 13.2 compares the effects, in the IMF's simulations, of the agreed-on global stimulus package (the first column) to the effects of a stimulus in just one nation or group of nations at a time (the remaining columns). So, for example, for 2010 the impact of a U.S.-only stimulus on U.S. output was a 2.7% boost relative to what would have occurred in the absence of the stimulus. With the planned world-wide stimulus, on the other hand, U.S. output was 3.1% higher. This difference comes from other countries' higher economic activity spilling over onto the U.S.

Table 4. Level Effects of Fiscal Stimulus in 2009 and 2010
(Percent deviation from baseline in percent)

	Stimulus in:					
	All	U.S.	Euro Area	Japan	Em. Asia	RoW
Effects on GDP in 2009						
World	1.4	0.5	0.2	0.1	0.4	0.2
United States	1.5	1.3	0.0	0.0	0.1	0.1
Euro Area	0.9	0.2	0.5	0.0	0.1	0.1
Japan	1.1	0.2	0.0	0.7	0.1	0.0
Emerging Asia	2.1	0.6	0.1	0.1	1.3	0.1
Remaining Countries	1.0	0.3	0.1	0.0	0.2	0.4
Effects on GDP in 2010						
World	2.0	1.4	0.1	0.1	0.2	0.2
United States	3.1	2.7	0.1	0.1	0.1	0.1
Euro Area	1.2	0.6	0.3	0.1	0.1	0.1
Japan	1.5	0.7	0.1	0.5	0.1	0.1
Emerging Asia	2.3	1.6	0.1	0.1	0.4	0.1
Remaining Countries	1.7	1.0	0.1	0.1	0.2	0.3

Table 13.2 - Level Effects of Fiscal Stimulus in 2009 and 2010
Source: Charles Freedman, Michael Kumhof, Douglas Laxton, and Jaewoo Lee, "The Case for Global Fiscal Stimulus," *IMF Staff Position Note* 09/03 (March 2009).

The spillover effect is even more pronounced for the other regions. A 2010 stimulus in just the Euro Area improved the projected output there by 0.3%. On the assumption that the entire world undertook the coordinated stimulus, the Euro Area output was 1.2% higher. The reason for the dramatic difference is that the Euro Area stimulus itself was quite modest (less than 1/3 the size of the U.S. stimulus); most of the Euro Area's boost with a global stimulus was due to spillover.

13.8 Conclusion

This chapter begins the construction of an economic model that will continue in later chapters. In its present form, the model applies mainly to the short run, where prices are assumed to remain constant. Changes in the amount of desired spending by households, firms, the government or foreigners results can increase or decrease output. To the extent that the spending recirculates as increased income that is spent again, the effect of increased autonomous spending is amplified. On the other hand, to the extent that the spending leaks out of the economy as spending on imports, the amplification effect is reduced.

When it comes to policy, increased government spending is a somewhat more effective means of raising output than cutting taxes is. However, any boost in overall income tends to increase the consumption of exports and thereby tends to worsen the balance of trade. An alternate way to raise income is currency devaluation, as an expanded version of the economic model demonstrates. However, closer analysis reveals that devaluation can only be expected to work when the elasticities of supply on the two sides of the trading relationship are together sufficiently large. This is a sounder assumption in the longer term.

The cross-border leakage of spending due to imports is not an entirely bad thing. Some of the benefits of one country's fiscal policy moves spill over to trading partners, but as the partners' economy is boosted, some of benefits spill back to the home country. Even more powerful is coordinated action, where countries agree to simultaneous policy moves for mutual increased benefit. A two-country version of our economic model demonstrates this result.

Summary

1. In a model where the demand side determines output (sometimes called a Keynesian model), changes in government spending and taxes can affect output.

2. When government spending is increased, output rises by more than the increase in government spending. This is also true for increases in other types of spending, such as autonomous consumption, investment, and exports.

3. When taxes are reduced, output is also rises, but to a smaller extent than for a government spending increase of equal magnitude.

4. An increase in government spending will tend to increase the trade deficit.

5. The budget balance and the trade balance need not move in the same direction. Whether they do depends on the types of shocks that hit the economy.

6. When prices are held constant, a devaluation of the home currency will lead to a weaker real exchange rate, which will typically lead to a larger trade balance, all else held constant.

7. There is no guarantee that a currency devaluation will improve the trade balance. The Marshall-Lerner-Robinson condition states that the trade balance will improve if, starting from balanced trade, the price elasticities sum to greater than one. Typically, it's assumed that the trade elasticities are sufficiently large to meet these conditions, particularly over the longer term, when there is sufficient time for firms and households to adjust.

8. In a two country-model, increases in government spending will have an even larger impact on output because of spillover and spillback effects.

9. In the two-country model, a coordinated increase in government spending will lead to even larger increases in output for a given dollar increase in spending, and a smaller deterioration in the trade balance.

Key Concepts

Aggregate demand

Autonomous

Demand determined

Equilibrium

Endogenous

Exogenous

Expenditure reducing

Expenditure switching

Lump-sum taxes

Marginal propensity to consume

Marginal propensity to import

Marshall-Lerner-Robinson condition

Multiplier

Net exports

Recession

Shocks

Stimulus

Trade balance

Two-country model

Review Questions

1) How do endogenous variables differ from exogenous variables?

2) What constitutes equilibrium in the model?

3) Do prices adjust to restore equilibrium in the model?

4) How are the government budget deficit and trade deficit related?

5) Does a devaluation always result in an improvement in the trade balance (net exports)?

6) In what ways can the government reduce a trade deficit?

7) When consumers consume a large share of each additional dollar's worth of after-tax income, will the government spending multiplier be relatively large or relatively small?

8) When there are two large countries exporting to each other, will the government spending multiplier be larger than or smaller than in the single country case?

Exercises

1) In the Keynesian model, after each round of spending, some proportion of the resulting income is consumed by the recipients. Does this mean the multiplier is infinite?

2) When the marginal propensity to consume is large, is the multiplier is larger or smaller?

3) Is the multiplier larger or smaller in countries that import a lot of goods and services?

4) Suppose we are using the Keynesian model with constant real exchange rates.
   a) Consider an increase in government spending. What happens to the budget balance and the trade balance?
   b) Consider an increase in autonomous investment. What happens to the budget balance and the trade balance?
   c) Why do the budget and trade balances move in different directions in the two cases?

5) In the Keynesian model, if autonomous consumption declines, what happens to the trade balance and the budget balance? Does the national saving identity still hold? What happens to CA, $S – I$, and $T – G$?

6) Using the model in Section 13.6, suppose autonomous exports increase by $1 billion. What happens to output? What happens to the trade balance? (Does it also increase by $1 billion?)

7) Over time, Americans have shown an increased preference for foreign goods, even when holding constant the exchange rate and income. How do you interpret this in context of the Keynesian model?

8) Consider the Marshall-Lerner-Robinson condition, holding output constant.
   a) Suppose that each 1% depreciation in the U.S. dollar induces a 0.75% increase in exports and a 0.25% decrease in imports. If initially exports equals imports, what will be the impact on the trade balance?
   b) Suppose the U.S. experiences the exchange rate depreciation in Part (a) while running a large trade deficit. What will happen to the trade balance?
   c) Suppose that instead of the elasticities being constant, they are smaller in the short run and larger in the long run. What happens to the trade balance over time, assuming it starts at zero?

9) Consider the Keynesian model, where exports and imports are partly determined by real exchange rates.
   a) Using the solution for income, show algebraically what the impact of an increase in lump sum taxes on the trade balance.
   b) Using the solution for income, show algebraically what is the impact of a devaluation of the real exchange rate on the trade balance.
   c) Can one say which policy would have the effect of shrinking a trade deficit? Is it possible to say which policy has a bigger impact (in absolute value) than the other?
   d) Suppose the level of output is already deemed “too low”. Which policy would you recommend, if either, in order to shrink the trade deficit.

10) In the Keynesian model used in Problem 9, how does the increasing ability of other countries to make goods similar to those made in the United States show up in the parameters in the model?

11) In the Keynesian model used in Problem 9:
   a) If the marginal propensity to import rises, then what is true about the relative effectiveness of expenditure switching versus expenditure reducing as a means of reducing a trade deficit?
   b) If the sensitivity of trade flows to the real exchange rate increases, then what is true about the relative effectiveness of expenditure switching versus expenditure reducing as a means of reducing a trade deficit?

12) Consider a world with only two economies, of equal size, called Home and Foreign. Explain why a dollar’s increase in government spending results in a larger increase in GDP than it would in an economy much smaller than the world economy.

13) Again consider a world with only two economies, of equal size, called Home and Foreign.
   a) If Home increases government spending, what happens to output in Foreign? Why? What happens to the Home trade balance?

b) If Home keeps government spending constant, but Foreign increases its government spending, what happens to Home output? Why? What happens to the *Home* trade balance?
c) Suppose Home and Foreign are the same size, and behave in the same way (i.e., the marginal propensity to consume, the marginal propensity to import, and the tax rate are all the same across both countries). Then when both economies increase government spending by the same, amount, what happens to each economy's trade balance?

Worked Exercise

6. If autonomous exports increase by $1 billion, then what happens to output? What happens to the trade balance? (Does it also increase by $1 billion?)

Consider the system of equations:

$$Y = AD$$

$$AD = C + I + G + X - IM$$

$$C = \overline{C} + c(Y - T)$$

$$I = \bar{I}$$

$$G = \bar{G}$$

$$IM = \overline{IM} + mY$$

$$X = \bar{X}$$

Substitute in all the equations to obtain:

$$Y = AD = \bar{C} + c(Y - \bar{T}) + \bar{I} + \bar{G} + \bar{X} - \overline{IM} - mY + (n + v)\bar{q}$$

Bringing all the Y terms to the left hand side:

$$Y - cY + mY = \bar{C} + c(Y - \bar{T}) + \bar{I} + \bar{G} + \bar{X} - \overline{IM} - mY + (n + v)\bar{q}$$

Factoring and dividing by (1-c+m) yields:

$$Y_0 = \left(\frac{1}{1-c+m}\right) \times [\bar{C} - c\bar{T} + \bar{I} + \bar{G} + \bar{X} - \overline{IM} + (n + v)\bar{q}]$$

Which is the same as:

$$Y_0 = \bar{\alpha}[\bar{A} + (n + v)\bar{q}]$$

For $\bar{A} \equiv [\bar{C} - c\bar{T} + \bar{I} + \bar{G} + \bar{X} - \overline{IM}]$ and $\bar{\alpha} \equiv \left(\frac{1}{1-c+m}\right)$

To determine the impact of an increase in GDP arising from a $1 billion increase in autonomous exports, take the total differential:

$\Delta Y = \left(\frac{1}{1-c+m}\right) \times [\Delta C - c\Delta T + \Delta I + \Delta G + \Delta X - \Delta IM + (n+v)\Delta q]$

Since the only component of autonomous spending that is changing is exports, then:

$\Delta Y = \left(\frac{1}{1-c+m}\right) \times \Delta X$

Because:

$\Delta C = \Delta T = \Delta I = \Delta G = \Delta IM = \Delta q = 0$

So, income increases by \$ $\left(\frac{1}{1-c+m}\right)$ billion for a \$1 billion increase in autonomous exports.

The real trade balance is the difference between exports and imports:

(13.9') $$TB = \underbrace{(\bar{X} + v\bar{q})}_{exports} - \underbrace{(\overline{IM} + mY - n\bar{q})}_{imports}$$

The total differential is given by:

$$\Delta TB = (\Delta X + v\Delta q) - (\Delta IM + m\Delta Y - n\Delta q)$$

Holding all else constant,

$$\Delta IM = \Delta q = 0$$

And substituting in the solution for the change in income:

$$\Delta TB = (\Delta X) - (m\bar{\alpha}\Delta X) = (1 - m\bar{\alpha})\Delta X$$

So for a \$1 billion increase in autonomous exports, the trade balance increases by less than \$1 billion. That occurs because the increase in GDP arising from the exogenous increase in exports draws in more imports.

Appendix: Solving the Two-Country Model

In Section 13.7, the workings of the two-country model were described generally. However, we did not show how equilibrium was determined algebraically, nor did we formally demonstrate that the multipliers for government spending are larger in this setting. Here we work through the math.

Let the exports of Home include an autonomous term, as in Section 13.2, but add a term that is dependent on Foreign's income:

(A13.1) $$X = \bar{X} + m^*Y^*$$

Then the equation for Home's income becomes:

(A13.2) $$Y = \left(\frac{1}{1-c+m}\right)[\bar{A} + \bar{X} - \overline{IM} + m^*Y^*]$$

For convenience, let $1 - c = s$:

(A13.3) $$Y = \left(\frac{1}{s+m}\right)[\bar{A} + \bar{X} - \overline{IM} + m^*Y^*]$$

Foreign's economy works just like Home's:

(A13.4) $$Y^* = \left(\frac{1}{s^*+m^*}\right)[\bar{A}^* + \bar{X}^* - \overline{IM}^* + mY]$$

In this two-country setup, each country's exports are the other country's imports, so $\bar{X}^* = \overline{IM}$ and $\overline{IM}^* = \bar{X}$.

(A13.5) $$Y^* = \left(\frac{1}{s^*+m^*}\right)[\bar{A}^* + \overline{IM} - \bar{X} + mY]$$

Equilibrium income is found by substituting (A13.5) into (A13.3):

(A13.6) $$Y = \left(\frac{1}{s+m}\right)\left[\bar{A} + \bar{X} - \overline{IM} + m^*\left(\frac{1}{s^*+m^*}\right)(\bar{A}^* + \overline{IM} - \bar{X} + mY)\right]$$

Rearranging:

(A13.7) $$Y(s+m) = \left[\breve{A} + \left(\frac{m^*m}{s^*+m^*}\right)Y\right],$$

$$\text{where } \breve{A} \equiv \left[\bar{A} + \bar{X} - \overline{IM} + \left(\frac{m^*}{s^*+m^*}\right)(\bar{A}^* + \overline{IM} - \bar{X})\right]$$

Solving for Home's income:

(A13.8) $$Y\left[s + m - \left(\frac{m^*m}{s^*+m^*}\right)\right] = \breve{A}$$

(A13.9) $Y_0 = \breve{\alpha}\breve{A}_0$, where $\breve{\alpha} \equiv \frac{1}{s+m-\left(\frac{m^*m}{s^*+m^*}\right)} \geq \bar{\alpha} = \frac{1}{s+m}$

Notice that setting $m*$ to zero leads to $\breve{A} = \bar{A} + \bar{X} - \overline{IM}$ and $\breve{\alpha} = \bar{\alpha}$. If Foreign's imports from Home are entirely autonomous, the two-country model reduces to the one-country model as far as Home is concerned.