

❖ The Keynesian Cross

Some instructors like to develop a more detailed macroeconomic model than is presented in the textbook. This supplemental material provides a concise description of the “Keynesian-cross model,” which underlies the aggregate-demand curve presented in the textbook. The Keynesian cross is based on the condition that the components of aggregate demand (consumption, investment, government purchases, and net exports) must equal total output. In addition to developing the Keynesian cross in this section, we will also look at the behavior of the major sectors of the economy and develop a multiplier that will relate changes in any autonomous (independent of any changes in income) variable, including government spending and taxes, to changes in output.

A Fixed Price Level

In most of his supplement we will assume that the price level is fixed. If the price level is fixed, then changes in nominal income will be equivalent to changes in real income. That is, when assume the price level is fixed, we do not have to distinguish real variable changes from nominal variable changes.

In the very short run, prices are fixed and sellers adjust output to meet the demand for goods and services. That is, the demand for output at a given price is determining how much each firm is producing and selling. The fixed price level assumption has an important implication: if demand determines the quantity of output that each firm sells, then it is aggregate demand that determines the level of real gross domestic product (RGDP) or the aggregate quantities of goods and services sold. In other words, in the Keynesian world, we must study fluctuations in aggregate demand in order to understand changes in real gross domestic product (RGDP).

The Simplest Keynesian-Cross Model: Autonomous Consumption Only

It is useful to begin by considering consumption spending by households. Household spending on goods and services is the largest single component of the demand for final goods, accounting for over 65 percent of GDP.

There are numerous economic variables that influence aggregate demand for consumer goods and services, and thus, aggregate consumption expenditures. Using you or your family as an example, you know that such things as family disposable income (after tax income), credit conditions, the level of debt outstanding, the amount of financial assets, and expectations are important determinants of consumption purchases. Most economists believe that disposable income is one of the dominant factors.

Let's begin by simplifying things quite a bit. Imagine an economy in which only consumption spending exists (no investment, government purchases, or net exports; later, we'll add in these other sectors). To begin with the simplest situation possible, let's suppose that each household has the same level of disposable income. This kind of analysis that relies on averages is called a representative household analysis. On a graph of consumption spending (vertical axis) for our representative household and the household's representative disposable income (horizontal axis) we could represent average consumption of disposable income at point *A* in Figure 1. From point *A*, a horizontal dotted line to the vertical axis permits us to read the value of average consumption spending, C_0 .

Even though income is given for the representative household, other economic factors that influence consumption spending are not. When consumption (or any of the other components of spending, such as investment) does not depend on income, we call it *autonomous* (or independent). Let's look at some of these other autonomous factors and see how they would change consumption spending.

Real wealth

The larger the value of a household's real wealth (the money value of wealth divided by the price level; i.e., the amount of consumption goods that the wealth could buy), the larger the amount of consumption spending, other things equal. Thus, in Figure 1, an increase in real wealth would raise consumption to C_2 , at point *D*, for a given level of current income. Similarly, something that would lower the value of real wealth, such as a decline in property values or a stock market decline would tend to lower the level of consumption to C_1 , at point *B*, in Figure 1.

The interest rate

A higher interest rate tends to make the consumption items that we buy on credit more expensive and thus reduces expenditures on those items. An increase in the interest rate increases the monthly payments made to buy such things as automobiles, furniture and major appliances and reduces our ability to spend out of a given income. This is shown as a decrease in consumption from point *A* to point *B* in Figure 1. Moreover, an increase in the interest rate provides a higher future return from reducing current spending; that is, increasing savings. Thus, a higher interest rate in the current period would likely induce an increase in savings today, permitting households to consume more goods and services at some future date.

Household debt

Remember when that friend of yours ran up his credit card obligations so high that he stopped buying goods except the basic necessities? Well our average household might find itself in the same situation, if its outstanding debt exceed some prudent level relative to its income. So, as debt increases, other things equal, consumption expenditure would fall from point *A* to point *B* in Figure 1.

Expectations

Just as in microeconomics, decisions to spend may be influenced by one's expectations of future disposable income, employment or certain world events. There are monthly surveys conducted that attempt to measure consumer confidence. In general, an increase in consumer confidence would act to increase household spending (a movement from point *A* to point *D* in Figure 1) and

a decrease in consumer confidence would act to decrease spending (a movement from *A* to *B* in Figure 1). For example, a decline in the consumer confidence index after the Iraqi invasion of Kuwait, and a subsequent fall in household spending, has been suggested as a cause of the 1990–91 recession in the United States.

Tastes and Preferences

Of course each household is different. Some are young, beginning a working career, some are without children, others have families, and still others are older and perhaps retired from the workforce. Some households like to save, putting dollars away for later spending, while others spend all their income, or even borrow to spend more than their current disposable income. These saving and spending decisions often vary over a household's life cycle.

As you can see, there are many economic factors that affect consumption expenditures. The above list represents some of the most important, but there can be others. All of these are considered *autonomous determinants of consumption expenditures*; that is, those expenditures that are not dependent on the level of current disposable income. Now let's make our model more complete and evaluate how changes in disposable income affect household consumption expenditures.

A New Model: Consumption Depends on Disposable Income

In our first model, we looked at the economic variables that affected consumption expenditures when disposable income was fixed. This is clearly an unrealistic assumption, but one that allows us to develop some of the basic building blocks of the Keynesian-cross model. You will see why this presentation is called a Keynesian-cross at the end of this section. Now we'll look at a slightly more complicated model in which consumption also depends on disposable income.

If you think about what determines your own current consumption spending, you know that it depends on many factors previously discussed, such as your age, family size, interest rates, expected future disposable income, wealth, and, most importantly, your current disposable income. Your personal consumption spending depends most importantly on your current disposable income. In fact, empirical studies show that most people's consumption spending is closely tied to their disposable income.

Marginal Propensity to Consume and Save

What happens to current consumption spending when a person earns some additional disposable income? Most people will spend some of their extra income and save some of it. The percentage of your extra disposable income that you decide to spend on consumption is what economists call your *marginal propensity to consume* (MPC). That is, MPC is equal to the *change* in consumption spending (ΔC) divided by the *change* in disposable income (ΔY).

$$\text{MPC} = \Delta C / \Delta Y.$$

For example, suppose you won a lottery prize of \$1,000. You might decide to spend \$750 of your winnings today and save \$250. In this example, your marginal propensity to consume is .75 (or 75 percent) because out of the extra \$1,000, you decided to spend 75 percent of it ($0.75 \times \$1,000 = \750).

The term "marginal propensity to consume" has two parts: (1) "marginal" refers to the fact that you received an *extra* amount of disposable income—an addition to your income, not your

total income; and (2) “propensity to consume” refers to how much you tend to spend on consumer goods and services out of your additional income.

Marginal Propensity to Save

The flip side of the marginal propensity to consume is the *marginal propensity to save* (MPS), which is the proportion of an addition to your income that you would save or not spend on goods and services today. That is, MPS is equal to the *change* in savings (ΔS) divided by the change in disposable income (ΔDY).

$$MPS = \Delta S / \Delta DY.$$

In the earlier lottery example, your marginal propensity to save is 0.25, or 25 percent, because you decided to save 25 percent of your additional disposable income ($0.25 \times \$1,000 = \250). Since your additional disposable income must be either consumed or saved, the marginal propensity to consume plus the marginal propensity to save must add up to 1, or 100 percent.

Let’s illustrate the marginal propensity to consume in **Figure 2**. Suppose you estimated that you had to spend \$8,000 a year even if you earned no income for the year, for “necessities” like food, clothing and shelter. And suppose for every \$1,000 of added disposable income you earn, you spend 75 percent of it and save 25 percent of it. So if your disposable income is \$0, you spend \$8,000 (that means you have to borrow or reduce your existing savings just to survive). If your disposable income is \$20,000, you’ll spend \$8,000 plus 75 percent of \$20,000 (which equals \$15,000), for total spending of \$23,000. If your disposable income is \$40,000, you’ll spend \$8,000 plus 75 percent of \$40,000 (which equals \$30,000), for total spending of \$38,000.

What’s your marginal propensity to consume? In this case, since you spend 75 percent of every additional \$1,000 you earn, your marginal propensity to consume is 0.75 or 75 percent. And since you save 25 percent of every additional \$1,000 you earn, your marginal propensity to save is 0.25.

In the figure, the slope of the line represents the marginal propensity to consume. To see this, look at what happens when your disposable income rises from \$18,000 to \$20,000.

At disposable income of \$18,000, you spend \$8,000 plus 75 percent of \$18,000 (which is \$13,500), for total spending of \$21,500. If your disposable income rises to \$20,000, you spend \$8,000 plus 75 percent of \$20,000 (which is \$15,000), for total spending of \$23,000. So when your disposable income rises by \$2,000 (from \$18,000 to \$20,000), your spending goes up by \$1,500 (from \$21,500 to \$23,000). Your marginal propensity to consume is \$1,500 (the increase in spending) divided by \$2,000 (the increase in disposable income), which equals 0.75 or 75 percent. But notice that this calculation is also the calculation of the slope of the line from point *A* to point *B* in the figure. Recall that the slope of the line is the rise (the change on the vertical axis) over the run (the change on the horizontal axis). In this case, that’s \$1,500 divided by \$2,000, which makes 0.75 the marginal propensity to consume. So the marginal propensity to consume is the same as the slope of the line in our graph of consumption and disposable income.

Now, let’s take this same logic and apply it to the economy as a whole. If we add up, or aggregate, everyone’s consumption and everyone’s income, we’ll get a line that looks like the one in Figure 2, but which will apply to the entire economy. This line or functional relationship is called a “consumption function.” Let’s suppose consumption spending in the economy is something like \$1 trillion plus 75 percent of income.

Now, with consumption equal to \$1 trillion plus 75 percent of income, consumption is partly autonomous (the \$1 trillion part, which people would spend no matter what their income, which depends on the current interest rate, real wealth, debt and expectations), and partly *induced*, which

means it depends on income. The induced consumption is the portion that's equal to 75 percent of income.

What is the total amount of expenditure in this economy? Since we've assumed that investment, government purchases, and net exports are zero, aggregate expenditure is just equal to the amount of consumption spending represented by our consumption function.

Equilibrium in the Keynesian Model

The next part of the Keynesian-cross model is to examine what conditions are needed for the economy to be in equilibrium. This discussion also tells us why it is called a Keynesian-cross model. There are two parts to determining equilibrium: (1) we need to show that income equals output in the economy; and (2) we need to show that in equilibrium, aggregate expenditure (or consumption in this example) equals output. First, income equals output because people earn income by producing goods and services. For example, workers earn wages because they produce some product that is then sold on the market, and owners of firms earn profits because the products they sell provide more income than the cost of producing them. So any income that is earned by anyone in the economy arises from the production of output in the economy. So, from now on, we'll use this idea and say that income equals output; we'll use the terms income and output interchangeably. Another way to remember this is to refer to the circular flow diagram. The top half (output) is always equal to the bottom half (income- the sum of wages, rents, interest payments, and profits).

The second condition needed for equilibrium (aggregate expenditure in the economy equals output) is the distinctive feature of the Keynesian-cross model. Just as income must equal output (since income comes from selling goods and services), expenditure equals output because people can't earn income until the products they produce are sold to someone. Every good or service that is produced in the economy must be purchased by someone or added to inventories. This gives rise to our next graph, **Figure 3**, which plots aggregate expenditure against output.

As you can see, it's a 45-degree line (slope = 1). The 45-degree line shows that the number on the horizontal axis, representing the amount of output in the economy, is equal to the number on the vertical axis, representing the amount of aggregate expenditure in the economy. If output is \$5 trillion, then in equilibrium, aggregate expenditure must equal \$5 trillion.

What would happen if, for some reason, output were lower than its equilibrium level, as would be the case if output were Y_1 in **Figure 4**?

Looking at the vertical dotted line, we see that when output is Y_1 , aggregate expenditure (shown by the consumption function) is greater than output (shown by the 45-degree line). This amount is labeled the distance AB on the graph. So people would be trying to buy more goods and services (A) than were being produced (B). This would cause producers to increase the amount of production, which would increase output in the economy. This process would continue until output reached its equilibrium level, where the two lines intersect. Another way to think about this disequilibrium is that consumers would be buying more than is currently produced. This would mean inventories on shelves and in warehouses would be decreasing from their desired levels. Clearly, profit-seeking business people would increase production to bring their inventory stocks back up to the desired levels. In doing so they would move production to the equilibrium level.

Similarly, if output were above its equilibrium level, as would occur if output were Y_2 in **Figure 4**, economic forces would act to reduce output. At this point, as you can see by looking at the graph above point Y_2 on the horizontal axis, aggregate expenditure (D) is less than output (C). This means people wouldn't want to buy all the output that is being produced, so producers would want to reduce their production. They would keep reducing their output until the equilibrium level

of output was reached. Using the inventory adjustment process, inventories would be bulging from shelves and warehouses and rational firms would reduce output and production until inventory stocks return to the desired level. There is more discussion of this inventory adjustment process later in the chapter when the complete model has been developed.

This basic model, in which we've assumed that consumption spending is the only component of aggregate expenditure (that is, we've ignored investment, government spending, and net exports) and in which we've assumed that some consumption spending is autonomous, is quite simple, yet this is the essence of the Keynesian-cross model. From Figure 3, you can see where the "cross" part of its name comes from. Equilibrium in this model, and in more complicated versions of the model, always occurs where one line representing aggregate expenditure crosses another line representing the equilibrium condition where aggregate expenditure equals output (the 45-degree line). The "Keynesian" part of the name reflects the fact that the model is a simple version of John Maynard Keynes's description of the economy from 60 years ago.

Now let's put Figures 2 and 3 together to find the equilibrium in the economy, shown in Figure 4. As you might guess, the point where the two lines cross is the equilibrium point. Why? Because it is only at this point that aggregate expenditure is equal to output. Aggregate expenditure is shown by the flatter line (labeled "Aggregate expenditure = Consumption"). The equilibrium condition is shown by the 45-degree line (labeled "Output = Aggregate expenditure"). The only point for which consumption spending equals aggregate expenditure equals output is the point where those two lines intersect, which is labeled "Equilibrium output" on the horizontal axis and "Equilibrium aggregate expenditure" on the vertical axis. Because these points are on the 45-degree line, equilibrium output equals equilibrium aggregate expenditure.

Not only can we find the equilibrium point graphically, but since we have an equation that describes the aggregate-expenditure line (remember it equals consumption, which in turn equals \$1 trillion plus 75 percent of output), we can use some algebra to find the dollar value of equilibrium output. Let Y represent the amount of output. The intersection of the two lines in the figure means that aggregate expenditure, $\$1 \text{ trillion} + (0.75 \times Y)$, equals output, Y . So we have $\$1 \text{ trillion} + (0.75 \times Y) = Y$. Subtracting $0.75 \times Y$ from both sides of the equation yields $\$1 \text{ trillion} = .25Y$ and then multiplying each side of the equation by 4 yields $Y = \$4 \text{ trillion}$.

Adding Investment, Government Purchases, and Net Exports

Now we can complicate our model in another important way, adding in the other three major components of expenditure in the economy—investment, government purchases, and net exports. As a first step, we'll add these components to the model but assume that they are autonomous, that is, they don't depend on the level of income or output in the economy. Later, we'll relax that assumption.

Suppose that consumption depends on the level of income or output in the economy, but investment, government purchases, and net exports don't; instead, they depend on other things in the economy like interest rates, political considerations, or the condition of foreign economies (we'll discuss these things in more detail later). Now, aggregate expenditure (AE) consists of consumption (C) plus investment (I) plus government purchases (G) plus net exports (NX):

$$AE \equiv C + I + G + NX.$$

This equation is nothing more than a definition (indicated by the \equiv rather than $=$): aggregate expenditure equals the sum of its components.

When we add up all the components of aggregate expenditure, we'll get an upward sloping line, as we did in Figure 4, because consumption increases as income increases. But since we're

now allowing for investment, government purchases, and net exports, the autonomous portion of aggregate expenditure is larger. Thus, the intercept of the aggregate expenditure line is higher, as shown in **Figure 5**. In particular, let's suppose that investment plus government purchases plus net exports total \$1 trillion. As before, consumption equals \$1 trillion plus 0.75 times output. So aggregate expenditure equals \$2 trillion plus 0.75 times output. Since consumption is the only component of aggregate expenditure that depends on income, the slope of the line in **Figure 5** is the same as the slope of the line (= MPC) in **Figure 4**, which was 0.75. The only difference between the two figures is that the aggregate-expenditure line in **Figure 5** is higher by the amount $I + G + NX$, which equals \$1 trillion.

What is the new equilibrium? As before, the equilibrium occurs where the two lines cross, that is, where the aggregate-expenditure line, which has a slope of 0.75, intersects the equilibrium line, which is the 45-degree line.

Again, we can find the numerical value of output using some algebra, just as we did before. The intersection of the two lines in the figure means that aggregate expenditure, \$2 trillion + $(0.75 \times Y)$, equals output, Y . So we have $\$2 \text{ trillion} + (0.75 \times Y) = Y$. Subtracting $0.75 \times Y$ from both sides of the equation yields $\$2 \text{ trillion} = .25Y$ and then multiplying each side of the equation by 4 yields $Y = \$8 \text{ trillion}$.

Now that we've added in the other components of spending, especially investment spending, we can begin to discuss some of the more realistic factors related to the business cycle. This discussion of what happens to the economy during business cycles is a major element of Keynesian theory, which was designed to explain what happens in recessions.

If you look at historical economic data, you'll see that investment spending fluctuates much more than overall output in the economy. In recessions, output declines, and a major portion of the decline occurs because investment falls very sharply. In expansions, investment is the major contributor to economic growth. There are two major explanations for the volatile movement of investment over the business cycle, one involving planned investment and the other concerning unplanned investment.

The first explanation for investment's strong business cycle movement is that *planned* investment responds dramatically to perceptions of future changes in economic activity. If business firms think that the economy will be good in the future, they'll build new factories, buy more computers, and hire more workers today, in anticipation of being able to sell more goods in the future. On the other hand, if firms think the economy will be weak in the future, they'll cut back on both investment and hiring. Economists have found that planned investment is extremely sensitive to firms' perceptions about the future. And if firms desire to invest more today, it generates ripple effects that make the economy grow even faster.

The second explanation for investment's movement over the business cycle is that businesses encounter *unplanned* changes in investment as well. The idea here is that recessions, to some extent, occur as the economy is making a transition, before it has reached equilibrium. We'll use **Figure 6** to illustrate this idea. In the figure, equilibrium occurs at output of Y_1 . Now, consider what would happen if, for some reason, firms produced too many goods, bringing the economy to output level Y_2 . At output level Y_2 , aggregate expenditure is less than output since the aggregate expenditure line is below the 45-degree line at that point. When this happens, people aren't buying all the products that firms are producing, and unsold goods begin piling up. In the national income accounts, unsold goods in firms' inventories are counted in a subcategory of investment—inventory investment. The firms didn't plan for this to happen, so the piling up of inventories reflects *unplanned inventory investment*. Of course, once firms realize that inventories are rising because they've produced too much, they cut back on production, reducing output below Y_2 . This process continues until firms' inventories are restored to normal levels and output returns to Y_1 .

Now let's look at what would happen if firms produced too few goods, as occurs when output is at Y_3 . At output level Y_3 , aggregate expenditure is greater than output since the aggregate expenditure line is above the 45-degree line at that point. People want to buy more goods than firms are producing, so firms' inventories begin to decline or become depleted. Again, this change in inventories shows up in the national income accounts, this time as a decline in firms' inventories and thus a decline in investment. Again, the firms didn't plan for this to happen, so once they realize that inventories are declining because they haven't produced enough, they'll increase production beyond Y_3 . Equilibrium is reached when firms' inventories are restored to normal levels and output returns to Y_1 .

So, our Keynesian-cross model helps to explain the process of the business cycle, working through investment. Next, let's see how other economic events can act to affect the equilibrium level of output in the economy. We'll begin by looking at how changes in autonomous spending (consumption, investment, government purchases, and net exports) can influence output.

Shifts in Aggregate Expenditure and the Multiplier

What happens if one of the components of aggregate expenditure increases for reasons other than an increase in income? Remember that we called these components or parts "autonomous." Households expectations might become more optimistic, or households may find credit conditions easier as interest rates decline, or their real wealth might increase as the stock market rises, all increasing autonomous consumption and thus total consumption at every level of income. Firms might increase their investment, especially if their productivity rises or the interest rate declines), government might increase its spending, or net exports could rise as foreign economies improve their economic health. Any of these things would increase aggregate expenditure for any given level of income, shifting the aggregate-expenditure curve up, as shown in [Figure 7](#).

Continuing with our earlier numerical example, suppose government purchases increased by \$500 billion because the government undertook a large spending project, such as deciding to rebuild a major portion of the interstate highway system. The increase in government purchases of \$500 billion increases the autonomous portion of aggregate expenditure from \$2 trillion to \$2.5 trillion. As the figure shows, the upward shift in the aggregate-expenditure curve (from AE_1 to AE_2) leads to an equilibrium with a higher level of output. Again, using algebra, we can find out exactly how much the new equilibrium output will be.

Setting aggregate expenditure [$\$2.5 \text{ trillion} + (0.75 \times \text{output})$] equal to output, we find that output is \$10 trillion. So output rose from \$8 trillion to \$10 trillion. This might seem amazing—that an increase in government spending of \$500 billion can lead to a \$2 trillion increase in output—but it merely reflects a well-understood process, known as the *multiplier*.

A caution here: Do not assume that the multiplier applies only to changes in government spending. Multipliers apply to any increase in autonomous expenditure. As an example, if the stock market went up to increase the amount of autonomous household spending by \$500 billion, the level of output would go up the same \$2 trillion as found in the above example.

The idea of the multiplier is that permanent increases in spending in one part of the economy lead to increased spending by others in the economy as well. When the government (or other autonomous components of aggregate expenditures) spends more, private citizens earn more wages, interest, rents, and profits, so they spend more. The higher level of economic activity encourages even more spending, until a new equilibrium with higher output is reached. In this example, the increase in output is four times as big as the initial increase in government spending that started the cycle. Let's see how this works in more detail.

Suppose, as in Figure 7, that we are initially in equilibrium at point A, with output of \$8 trillion. Just as in the example above, let's suppose that the government increases spending by \$500 billion, so we know that we'll eventually get to a new equilibrium at point Z in the figure, with output of \$10 trillion. Now let's see how we get from point A to point Z, with just induced consumer spending propelling the economy along.

Figure 8 shows what happens along the way. We begin at point A, with output of \$8 trillion. The increase in government purchases of \$500 billion directly increases aggregate expenditure by that amount, represented by point B. Firms observe the increase in aggregate expenditure (perhaps because they see their inventories declining), so over the next few months they produce more output, moving the economy to point C, with output of \$8.5 trillion. But now consumers have an extra \$500 billion in income and they wish to spend $3/4$ of it (since the marginal propensity to consume is $.75$). Since $3/4$ of \$500 billion is \$375 billion, consumers now spend an additional \$375 billion, increasing aggregate expenditure to \$8.875 trillion at point D. Again, firms observe the increase in expenditure, so over the next few months they increase output, bringing the economy to point E. This process continues until the economy eventually reaches point Z, at which output is \$10 trillion. Notice that the process is not accomplished immediately, but over several quarters of time.

You can see on the graph how the economy reaches its new equilibrium at point Z. We can also calculate it numerically by adding up an infinite series of numbers in the following way. The first increase in output was \$500 billion, which comes directly from the increase in government purchases. Then consumers, with higher incomes of \$500 billion, want to spend $3/4$ of it, so they increase spending by $\$500 \text{ billion} \times 3/4$ equals \$375 billion. Now, with incomes higher by \$375 billion, consumers want to spend an additional $3/4$ of it, which is $\$375 \text{ billion} \times 3/4$ equals \$281.25 billion. Again, incomes are higher, so consumers will spend more, this time in the amount $\$281.25 \times 3/4$ equals \$210.94 billion. The process continues indefinitely. To find the total increase in output (or income) we simply need to add up all these amounts. They total \$500 billion + \$375 billion + \$281.25 billion + \$210.94 billion + The process goes on infinitely, but fortunately, the sum of the numbers is finite, as we can see using algebra. Notice that to get these numbers, we started with \$500 billion, then took $3/4 \times \$500 \text{ billion}$ (to get \$375 billion), then took $3/4$ times that (to get \$281.25 billion), and so on. So the increase in output is equal to $\$500 \text{ billion} + (3/4 \times \$500 \text{ billion}) + (3/4 \times 3/4 \times \$500 \text{ billion}) + (3/4 \times 3/4 \times 3/4 \times \$500 \text{ billion}) + \dots$. It turns out that an infinite sum with this pattern is equal to exactly $\$500 \text{ billion} / (1 - 3/4) = \2 trillion . So output increases by \$2 trillion, from \$8 trillion to \$10 trillion.

This calculation of the sum of all the increases to output can be written in a very convenient way. Following the same process we used above, whenever an autonomous element of spending increases by some amount, output in the economy rises by that amount times a number called the *multiplier*. As you saw in this example, the multiplier depends on how much consumers spend out of any additions to their income. So in this model in which consumption spending is the only component of aggregate expenditure that depends on income, the multiplier is equal to $1 / (1 - MPC)$, where *MPC* is the marginal propensity to consume. In the example above, $MPC = 3/4$, so the multiplier is $1 / (1 - 3/4) = 4$. The same multiplier holds whether the increase in aggregate expenditures arises from an increase in government purchases, as in the example above, or from an increase in other autonomous elements of spending, such as investment, net exports, or the autonomous portion of consumption spending. The multiplier just developed was designed to provide insights into the process of how it works. The actual multiplier for the United States economy is thought to be about half this size, around 2. We will see why shortly.

A Complete Model

In developing the Keynesian-cross model, we simplified many elements of the economy. We assumed that the only element of aggregate expenditure that depended on income was consumption, and that all the other components were autonomous. Now that this simpler model has been presented, we can complicate the model in many ways, but the intuition underlying equilibrium and the calculation of the multiplier remains the same.

First, consider investment spending. Economists studying investment spending have found that it depends on people's expectations of future economic conditions, taxes, interest rates, and the size of the current capital stock compared to the desired capital stock. Could investment spending also depend on current income? It might, especially if firms view the change in current income as an indicator of future changes in income. Furthermore, given a firm's cost structure, an increase in current income may generate profits or cash flows that can be used for financing investment expenditures. In this case, an increase in income would increase their ability to invest, so investment would rise.

Government purchases also might be directly affected by current income in the economy. While the process for determining the federal government budget is very slow and deliberate and constitutes what is known as fiscal policy, state and local governments often have balanced-budget requirements. To balance their budgets, state and local governments often reduce their spending in recessions as tax revenues fall, and can afford to increase their spending in expansions as tax revenue rises. So to some extent, part of government purchases may be affected by current income.

Finally, net exports are strongly dependent on a country's income, as well as other factors, such as exchange rates between the currencies and price levels in different countries. Holding the rest of the world constant, when an economy is growing strongly, with rising income, it imports more goods from other countries. When an economy is in recession, with falling income, it imports less. As a result, an economy with high income has lower net exports, while an economy with low income has higher net exports. So net exports are also influenced by the economy's current income. But notice that the direction is the opposite of the relationship between the other components of aggregate expenditure and income. Consumption, investment, and government purchases are all positively related with income (when income rises, they rise) but net exports are negatively related to income.

Why is the relationship of all these elements of aggregate expenditure with income so important? The relationship affects the multiplier. Remember that the multiplier in the earlier example (in which consumption was the only component that depended on income) was equal to $1 / (1 - MPC)$, where MPC is the marginal propensity to consume. When we allow the other components of aggregate expenditure to depend on income, as described here, the same logic behind the multiplier holds, but the formula changes slightly. The multiplier is now $1 / (1 - MPAE)$, where $MPAE$ is the marginal propensity of aggregate expenditure, which in turn is equal to the marginal propensity to consume disposable income, the change in disposable income as total income changes, plus the marginal propensity to invest (which is the amount that investment increases when income rises) plus the marginal propensity of government purchases (which is the amount that government purchases increase when income rises) minus the marginal propensity to import (which is the amount that imports increase when income rises). Notice that the marginal propensity to import enters with a minus sign because imports are goods that aren't produced within the country. The final result of this modification is to make the $MPAE$ approximately equal to 0.5. Placing this value in our multiplier formula results in a multiplier no larger than 2.

Now we have a more complicated model, but we don't always need to use the more complicated approach. Economists have found that it's often best to use the simplest model possible, the

one that gets at the essentials and ignores the less-important elements, when solving an economic problem.

Government Purchases, Taxes, and the Balanced-Budget Multiplier

The Keynesian-cross model is often used to provide insight into changes in fiscal policy, the counter-cyclical expenditure and tax policy of the federal government. Earlier, we developed the multiplier based on a change in autonomous government purchases. Now, we want to see what happens when taxes change. Finally, we want to examine balanced-budget changes, which occur when the government changes both spending and taxes by the same amount. (Since the possibility that government purchases might depend on income doesn't matter for what we're going to do, we'll return to the simple model in which only consumption depends on income.)

First, let's see what happens if the government increases taxes by some amount, say \$100 billion. We are thinking of taxes, a lump of dollars paid that is often called "lump sum" taxes or fixed taxes. In other words, taxes which do not depend on the level of income. We'll assume that consumers pay the taxes, so the effect of the tax increase is just like a reduction in consumers' incomes. How much will consumers reduce their spending? Since the tax increase is like a reduction in income, consumers will reduce their spending by the amount of the tax increase times the marginal propensity to consume. If the marginal propensity to consume is $3/4$, as in the example we discussed earlier, then consumers will reduce their spending by \$75 billion. Thus aggregate expenditure will decline by \$75 billion because of the direct impact of the higher taxes. And what will happen in equilibrium? As Figure 9 shows, with aggregate expenditure \$75 billion less, the new equilibrium level of output is lower by the multiplier (4) times the change in aggregate expenditure (\$75 billion), which equals \$300 billion. So output in the economy declines from \$8 trillion to \$7.7 trillion.

So, just as there's a multiplier effect on government purchases, there's also one on taxes. But there's an important difference between the two cases. When we looked at an increase in government purchases, we found that output changed in the same direction by the multiplier times the change in government purchases. But in the case of an increase in taxes, output changes in the opposite direction by the multiplier times an amount equal to the marginal propensity to consume times the change in taxes. In the example, the tax increase of \$100 billion caused aggregate expenditure to decline by $3/4 \times \$100$ billion, which equals \$75 billion. So a change in taxes of a given amount affects aggregate expenditure by less than that amount, because the marginal propensity to consume is less than one.

This fact means that when the government changes both government purchases and taxes by the same amount, an event that some economists call a *balanced-budget change in fiscal policy*, there's still an effect on output. We use the term balanced budget to call attention to the fact that both taxes and government expenditures change by the same amount. For example, if the government increases its purchases by \$100 billion and pays for the increased purchases by raising \$100 billion of additional taxes, the increase in government purchases increases aggregate expenditure by \$100 billion, but the increase in taxes reduces aggregate expenditure by only $3/4 \times \$100$ billion, which equals \$75 billion. So the net effect is an increase in aggregate expenditure of \$25 billion. With a marginal propensity to consume of $3/4$, the multiplier is 4, so the total impact on output is $4 \times \$25$ billion = \$100 billion. Similarly, a balanced-budget decrease in government purchases and an equivalent decrease in taxes of \$100 billion would lead to a reduction in aggregate expenditure of \$25 billion, which would lead to a decline in output of \$100 billion.

Because the change in government purchases increases output by the multiplier times the change in purchases, while a change in taxes decreases output by the multiplier times the change

in taxes times the marginal propensity to consume, the *balanced-budget multiplier* is less than the multiplier we used before (which we'll call the *basic expenditure multiplier* from now on). In fact, since the basic expenditure multiplier is equal to $1 / (1 - MPC)$, the balanced-budget multiplier is $1 / (1 - MPC)$ [reflecting the effect of government purchases on aggregate expenditure] minus $MPC / (1 - MPC)$ [reflecting the effect of taxes on aggregate expenditure], which equals exactly one. So the balanced-budget multiplier is equal to one, no matter what the marginal propensity to consume. Thus, as we saw in our example, a balanced-budget increase in government purchases (and taxes) of \$100 billion increases output by \$100 billion, while a balanced-budget decrease in government purchases (and taxes) of \$100 billion decreases output by \$100 billion.

We've now developed the Keynesian-cross model in complete detail. It's a useful model for examining what happens to output in the economy when there are changes in the autonomous components of aggregate expenditure. But the Keynesian-cross model is not a complete macroeconomic model, as we'll now see.

The Paradox of Thrift

Suppose all households in aggregate decide to save an extra \$5 billion this year, instead of spending it. This kind of change would be an autonomous change in tastes or it could be triggered by a change in autonomous expectations as discussed earlier. Returning to our numerical example above, assuming the marginal propensity to consume is $3/4$, the multiplier is 4. Under these assumptions the increased saving of \$5 billion leads to a decrease in consumption spending of \$5 billion, which in turn leads to a decrease of $\$5 \text{ billion} \times 4 = \20 billion in the nation's output. This seems very strange, doesn't it? People often believe that saving is a virtue, yet in this model, saving reduces the economy's output. The paradox is that thrift is desirable for any individual or family, but it might cause problems for the economy as a whole.

What the Keynesian-Cross Model Is Missing

The paradox of thrift helps point out a key, missing ingredient of the Keynesian cross as a model of the economy. There should be some benefit to the economy if saving rises, yet the model suggests that the only result is a decline in output. The Keynesian-cross model clearly shows that when people make decisions about spending, they influence the amount of demand in the economy. But what's missing is the notion of supply and what economists call *general equilibrium*.

To see the importance of adding the idea of supply to the model, again suppose the multiplier is 4. Then if the government (or households or business firms) increased its spending by \$1 trillion, the economy's output would rise by \$4 trillion. But why doesn't the government then increase spending by \$2 trillion, so the economy's output would rise by \$8 trillion? Why doesn't the government simply raise output infinitely? There is some constraint on government revenue (or the size of the deficit), where eventually all taxes or deficits have to be approved by Congress and ultimately the citizens of the country. But the essential reason the government (or any other sector, households or firms) can't do this in reality is that scarce resources limit output. The government can raise aggregate expenditure by increasing its spending, but for output to go up, something must cause an increase in aggregate supply. For this reason, the Keynesian-cross model is best seen as a model of aggregate demand and not a complete model of the economy.

From the Keynesian Cross to Aggregate Demand

To go from the Keynesian cross to aggregate demand, all we need add is the how the price level affects the components of aggregate demand. In everything we've done so far, we've implicitly

assumed that the price level was constant, along with other financial variables (like the money supply) that we didn't discuss. But now we need to complicate the model in yet another dimension, allowing the components of aggregate expenditure to depend on the price level. The textbook provides three main reasons for this. Consumption rises when the price level falls, because people's real wealth rises (Pigou's wealth effect). Return and reread the section on autonomous consumption. Investment rises when the price level falls because interest rates decline (Keynes's interest-rate effect). Net exports rise when the price level falls because now domestic goods are cheaper than foreign goods and interest rates decline and the real exchange rate declines (Mundell-Fleming's exchange-rate effect).

The effect of different price levels can be seen in **Figure 10**. Let's consider three different price levels, $P = 90$, $P = 100$, and $P = 110$, where P is a price index like the GDP deflator. Suppose the price level is 100, and suppose at that level of prices, the aggregate expenditure curve is given as the curve labeled $AE(P = 100)$, shown in the top diagram. The equilibrium in the Keynesian-cross model occurs at point A . Now we plot point A in the bottom diagram, corresponding to a price level of 100 and output of \$8 trillion.

What happens if the price level falls from 100 to 90? The lower price level means higher aggregate expenditure, so the aggregate-expenditure curve shifts up to $AE(P = 90)$, and the equilibrium in the Keynesian-cross diagram is at point B . So we plot point B in the bottom diagram, corresponding to price level 90 and output \$9 trillion.

Finally, what happens if the price level rises to 110? The higher price level means lower aggregate expenditure, so the aggregate-expenditure curve shifts down to $AE(P = 110)$, and the equilibrium in the Keynesian-cross diagram is at point C . We plot point C in the bottom diagram, corresponding to a price level of 110 and output of \$7 trillion.

Notice that the higher the price level, the lower is aggregate demand. Imagine carrying out this same experiment for every possible price level. Then the points like A , B , and C in the lower diagram would trace out the entire aggregate-demand curve, as shown.

Shifts in Aggregate Demand

In the previous section, we used the relationship between aggregate expenditure and the price level to derive the aggregate-demand curve. Now we'll show that changes in any of the components of aggregate expenditure that occur for any reason other than a change in the price level or output lead to a shift of the aggregate-demand curve. To do this, we'll combine Figures 7 and 10. That is, we'll start with Figure 10 (but to keep things readable we'll only draw in one of the aggregate-expenditure lines in the top half of the figure), then consider what happens when the autonomous parts of consumption, investment, government purchases, or net exports change, as we did in Figure 7. Such a change would shift the aggregate-expenditure curve upwards, as shown in **Figure 11**, where we denote the original aggregate-expenditure curve AE_1 and the new aggregate-expenditure curve AE_2 . (You can visualize a similar shift in the other aggregate-expenditure curves, corresponding to $P = 90$ and $P = 110$, drawn in Figure 10.)

Originally we had equilibrium at point A with output of \$8 trillion when the price level was 100. After the increase in government spending, the aggregate-expenditure curve shifts up, and we get equilibrium at point D with output of \$8.5 trillion when the price level is 100. Similarly, for any other given price level, equilibrium output would be higher. So, the new aggregate-demand curve on the lower diagram has shifted to the right.

The aggregate-demand curve can now be combined with a model of aggregate supply in the economy, as discussed in greater detail in the textbook. As an example, suppose the aggregate-supply curve is vertical, as it must be in the long run, since the price level has no long-lasting effect on output. Now, consider our example of an increase in government purchases (or any other

autonomous change). As shown in **Figure 12**, the original aggregate demand curve is AD_1 and the increase in government purchases shifts the aggregate demand curve to AD_2 . What happens to output? It is unchanged from its original level. The price level rises from 100 to 105, but that's the only effect of the higher level of government expenditures. In this case, the expenditure multiplier effect on real output (RGDP) is zero. Changes in aggregate expenditure lead to no increase in output. Try this exercise with a different autonomous change such as wealth or expectations.

As the textbook explains in more detail, in the short run the aggregate-supply curve slopes upward, so an increase in aggregate expenditure will lead to some increase in output in the short run. In that case, the effect on real output in the short run will be greater than zero, but not as large as the basic expenditure multiplier we derived above ($1 / (1 - MPC)$), which we derived without considering the effects of aggregate supply.

So the important point is that supply considerations are important in constraining the impact of a change in aggregate expenditure on output.

Figure 1

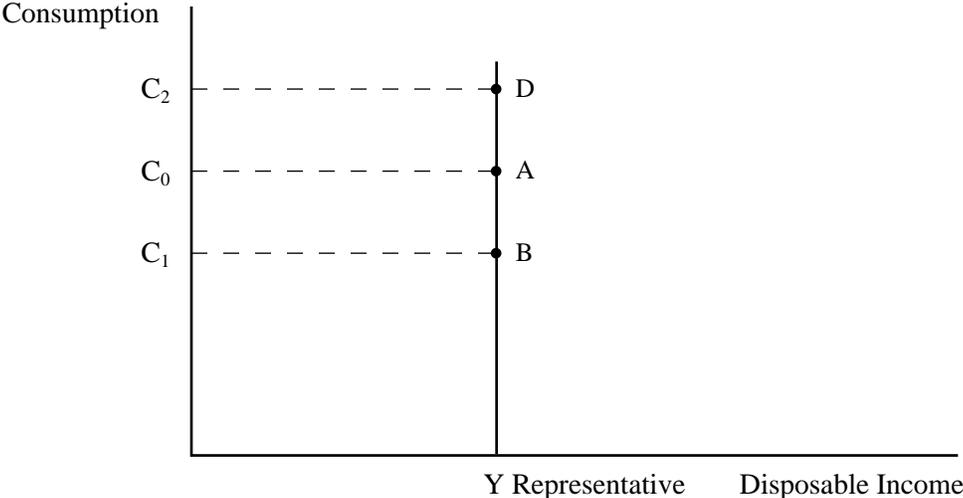


Figure 2

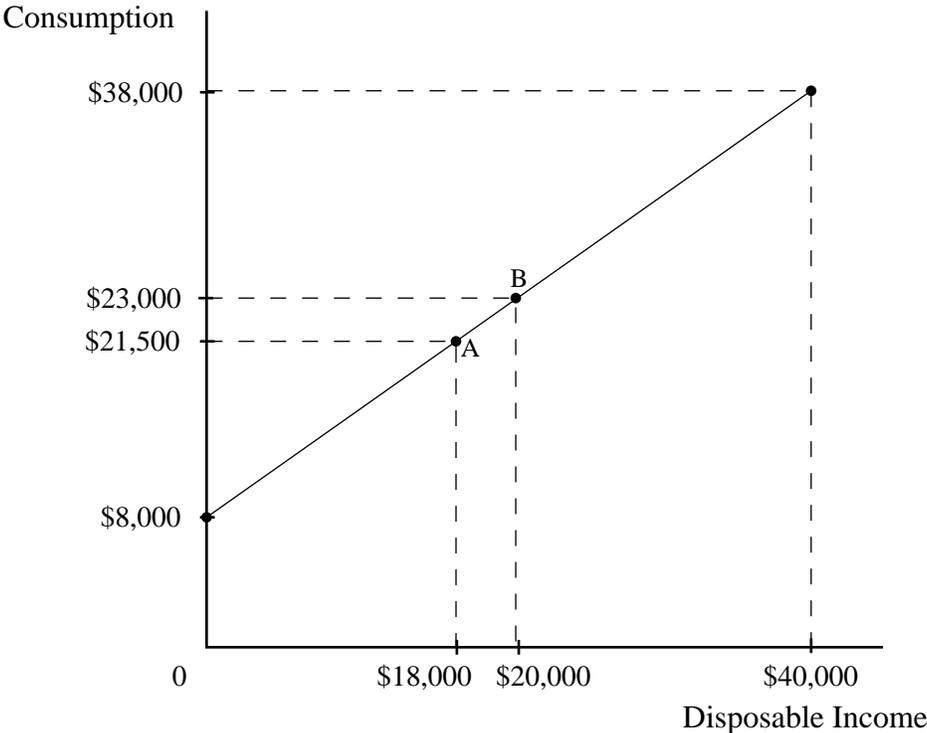


Figure 3

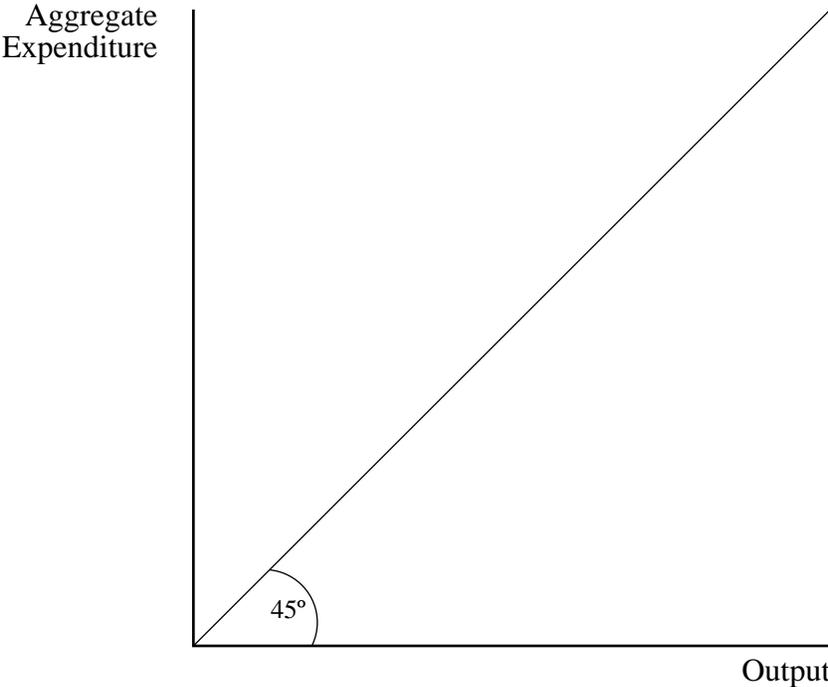


Figure 4

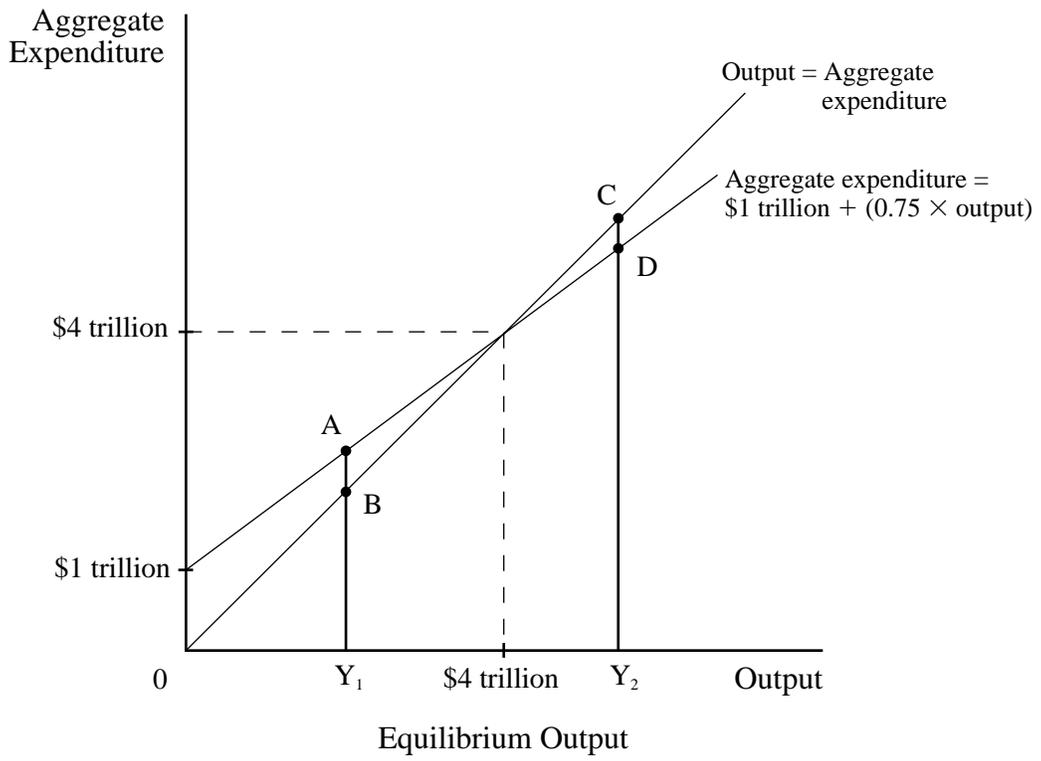


Figure 5

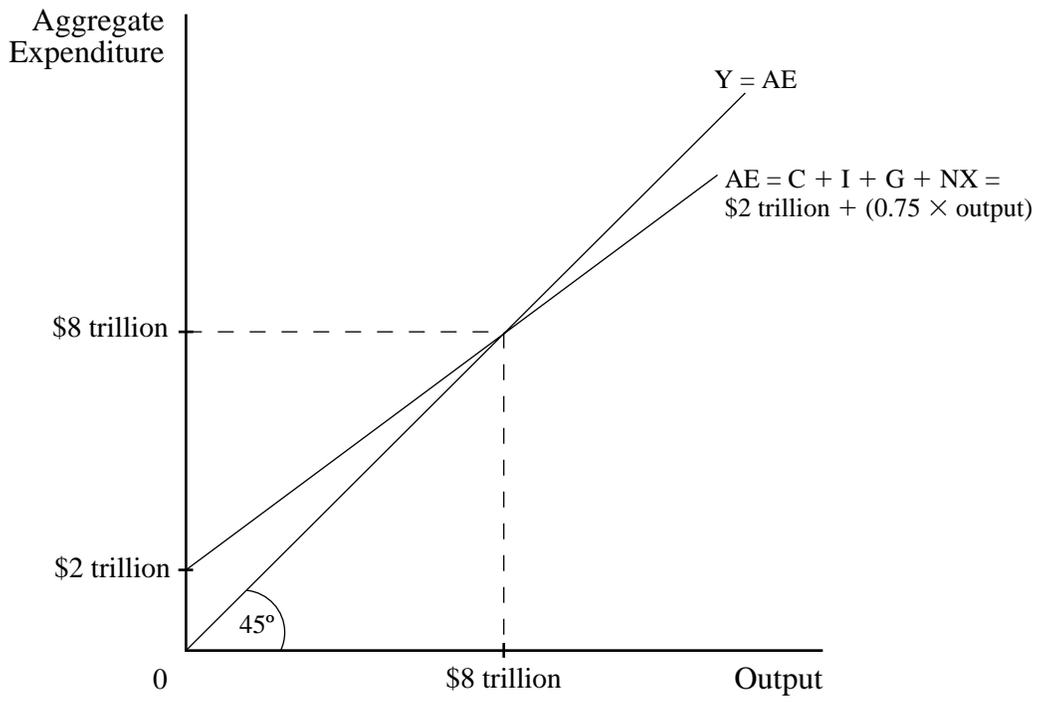


Figure 6

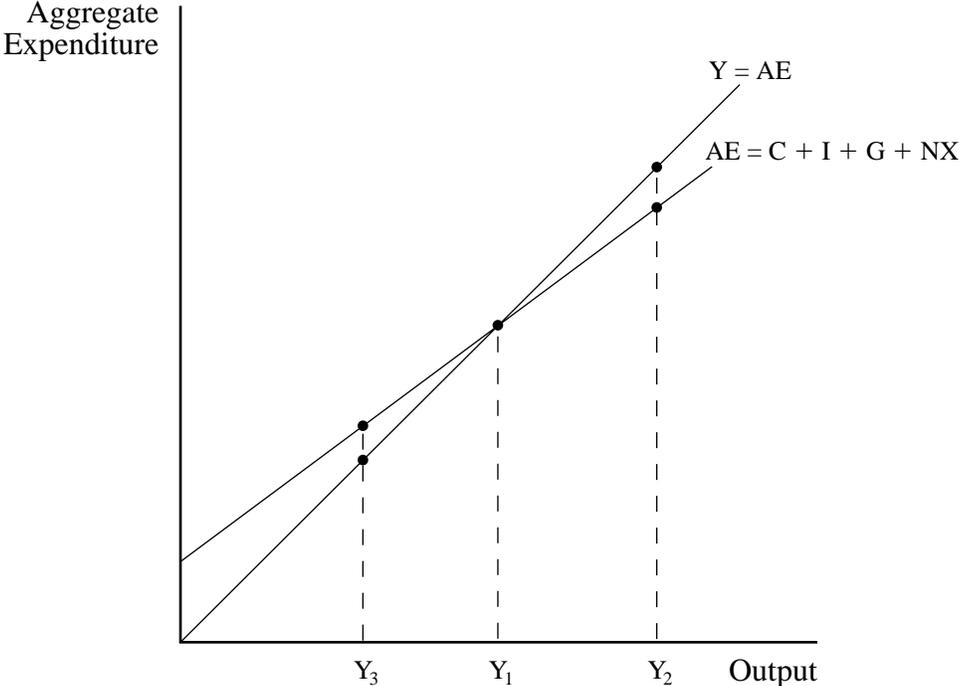


Figure 7

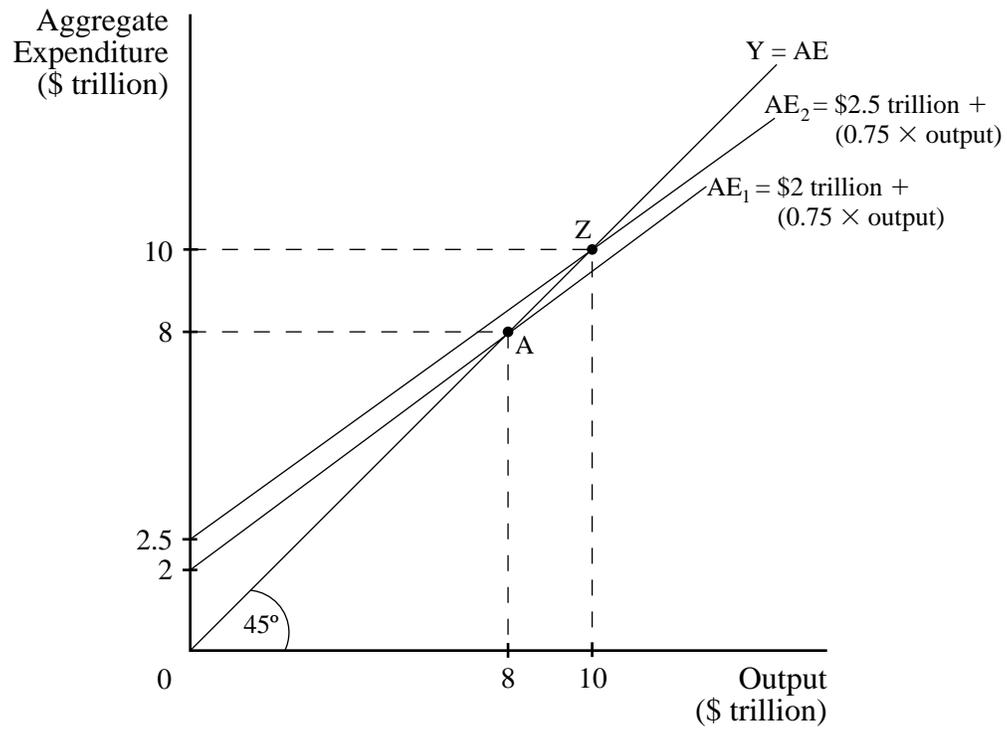


Figure 8

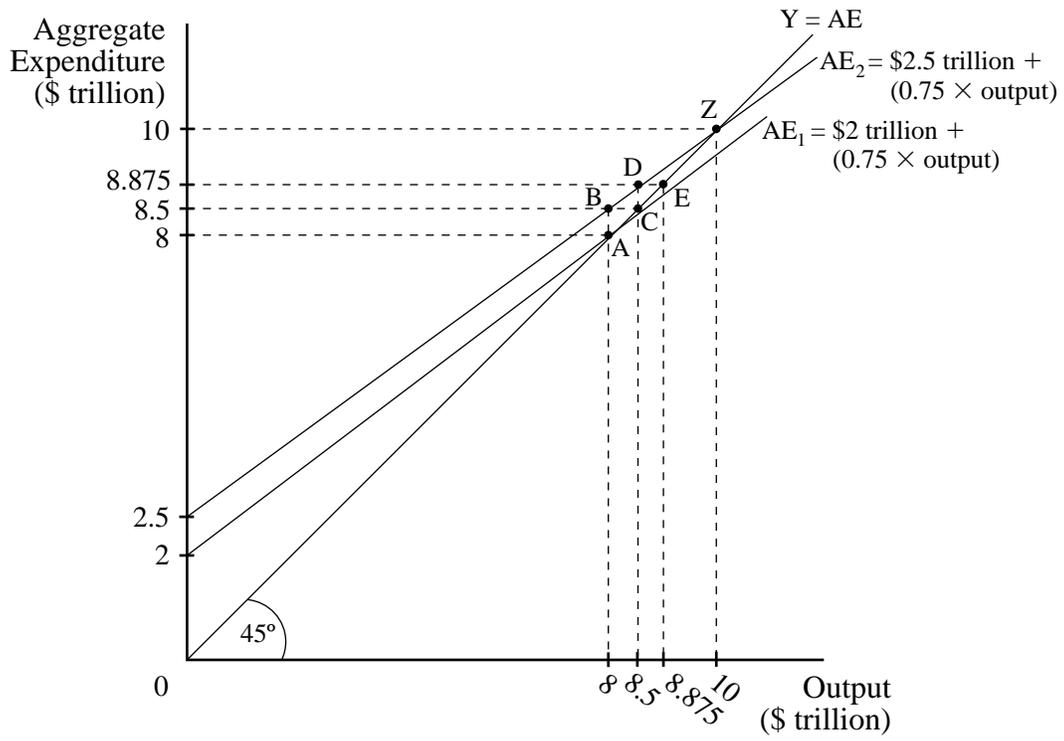


Figure 9

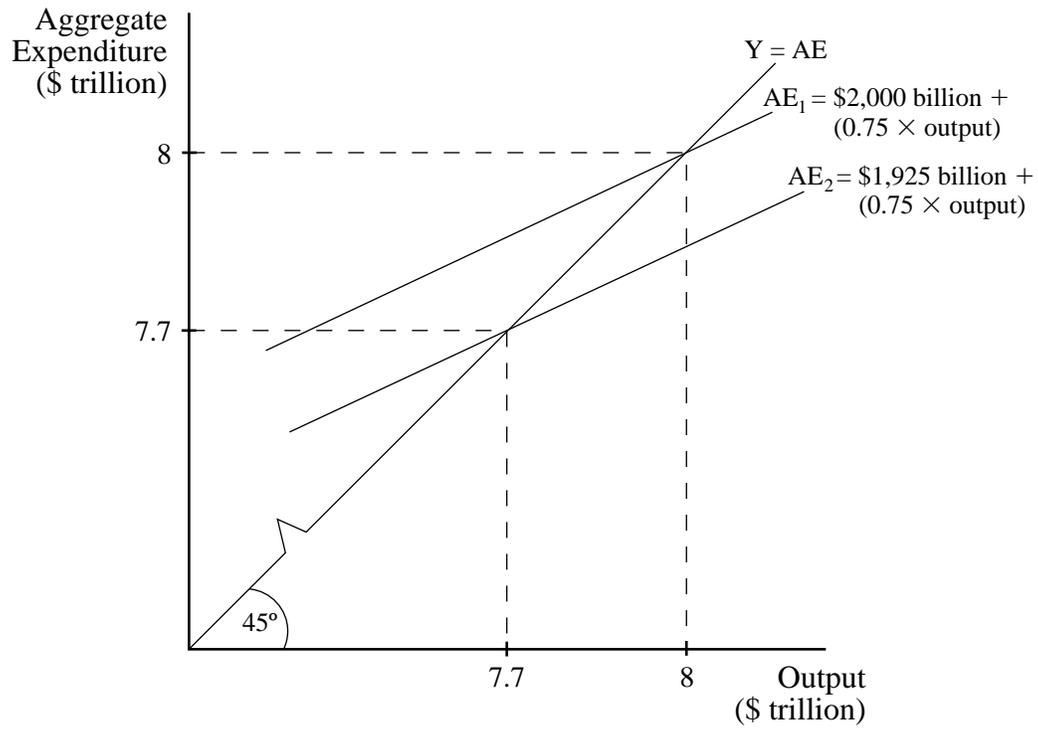


Figure 10

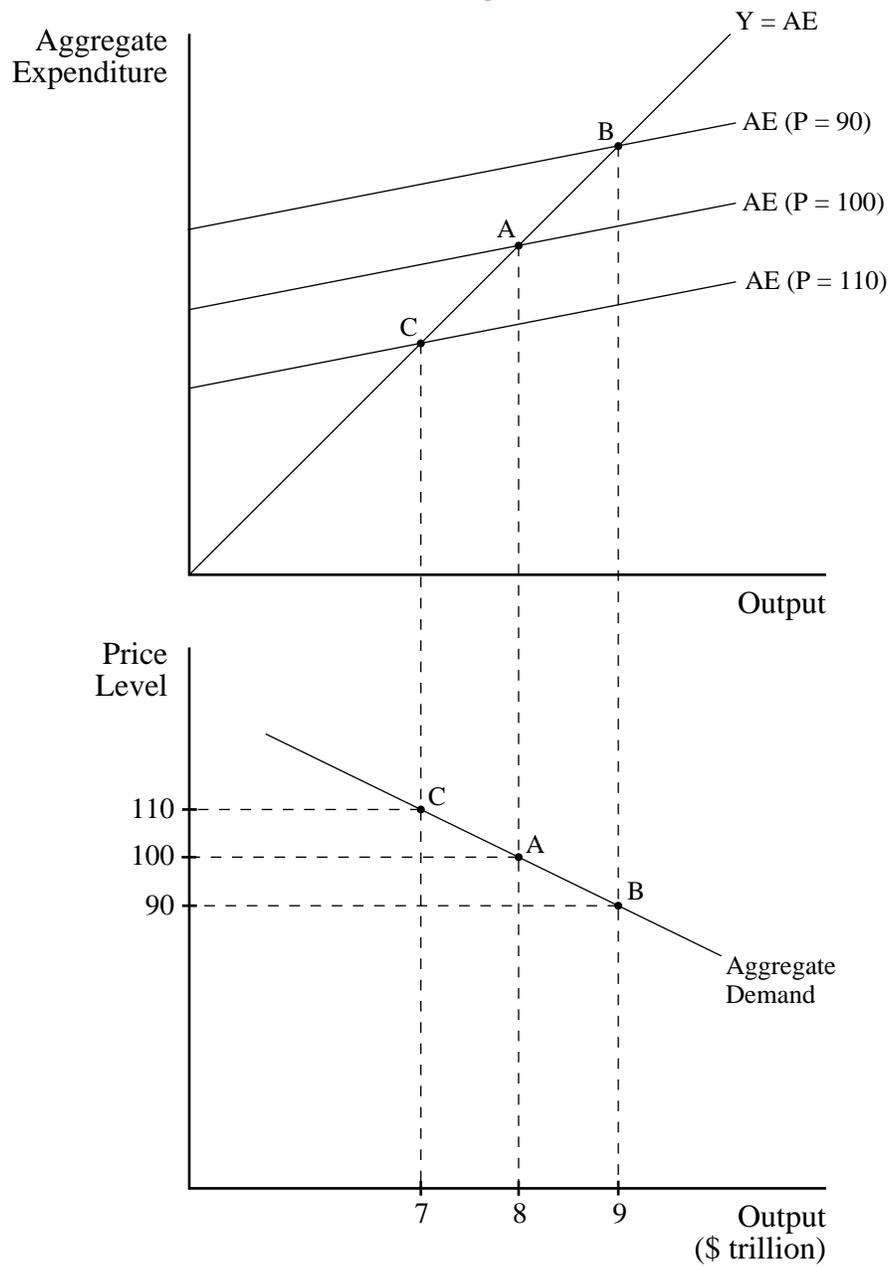


Figure 11

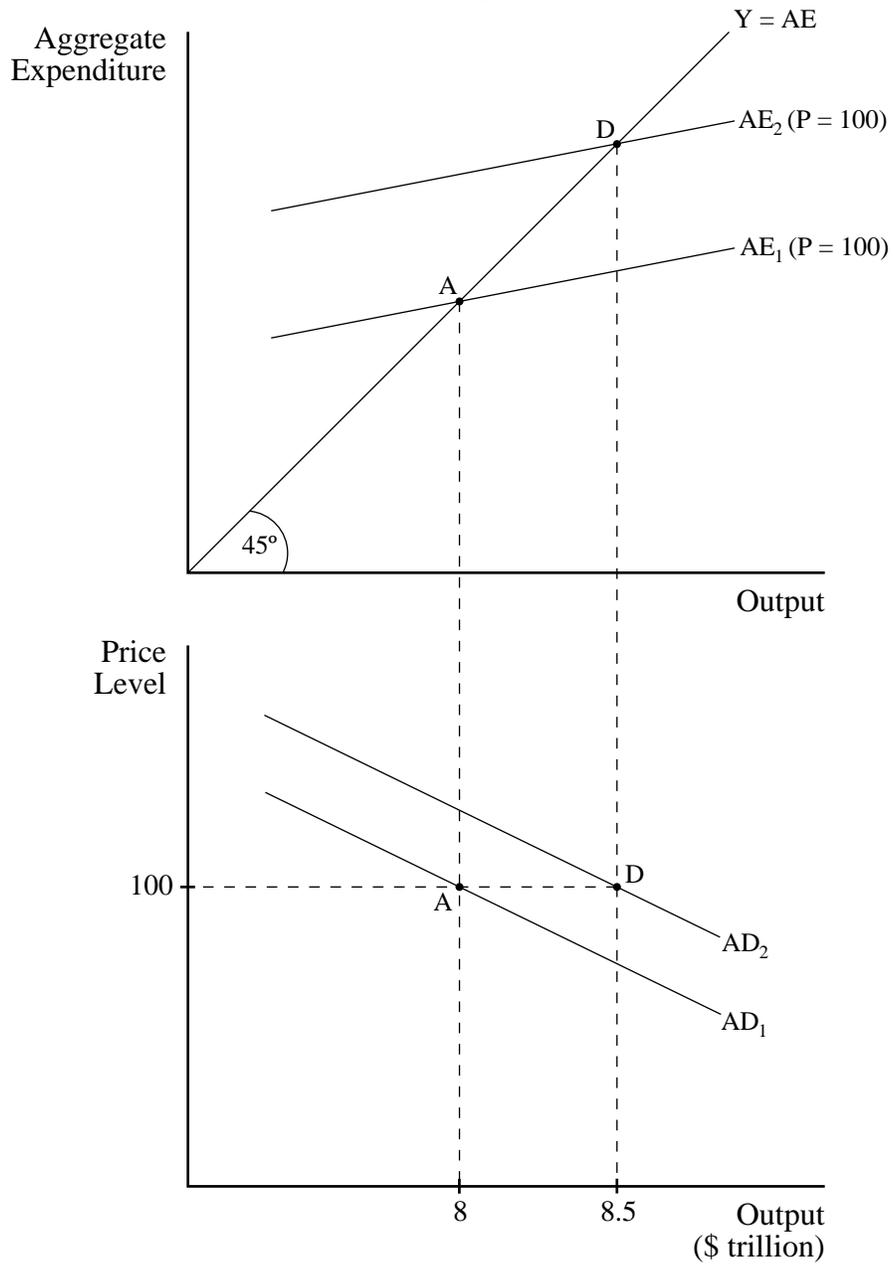


Figure 12

