Chapter 4: Short-Run Macroeconomic Equilibrium

4.1: Goals of Macroeconomics

According to Chapter 3, which of the following situations are macroeconomists concerned about?

A

Layoffs in the fast food industry due to automation.

B

A reduction in the overall level of output that causes widespread unemployment.

C

The rising prices of food and health care.

D

The rising prices of luxury cars.

E

An decrease in happiness and well-being of citizens in a country.

F

Sadness because your local professional sports team did not win the championship.

In Chapter 3, we defined the three goals of macroeconomics: achieving a high standard-of-living, maintaining a stable level of prices and reaching full employment. We will use these goals to guide our policy recommendations moving forward, but before that, it is necessary to figure out why an economy is at a particular level of output, price level and employment.

In this chapter we will learn how to model short-run equilibrium in the entire economy. This sounds like a big undertaking, and to some degree it is. In chapter 2, we modeled out the gasoline and housing market using supply and demand. Using a simple model to depict complex markets turned out to provide us with relatively accurate predictions about how prices and quantities in a market change.

Instead of immediately depicting the entire economy with a supply and demand graph, our first step will be to model the level of production and income in the economy. From there, we will be able to show how shocks to particular sectors of the economy can change the overall level of production.

A Quick History of the US Economy

Before we get to modeling the economy, let's take a brief look at the motivation for examining the level of output in the economy. A good resource during this discussion is GapMinder. GapMinder allows you to compare statistics for different countries over time. For example, you can look at the relationship between life expectancy and GDP per capita for every country and see how it changes over time. We can also use GapMinder to see how the US GDP changes over time.

In the early 1800s, the US was primarily an agricultural economy. Many people consumed what they produced and then were able to sell the extra production to others who were producing a different agricultural product. There was a large increase in production during the 1800s and an expansion in total land area that also increased production in the first half of the century.

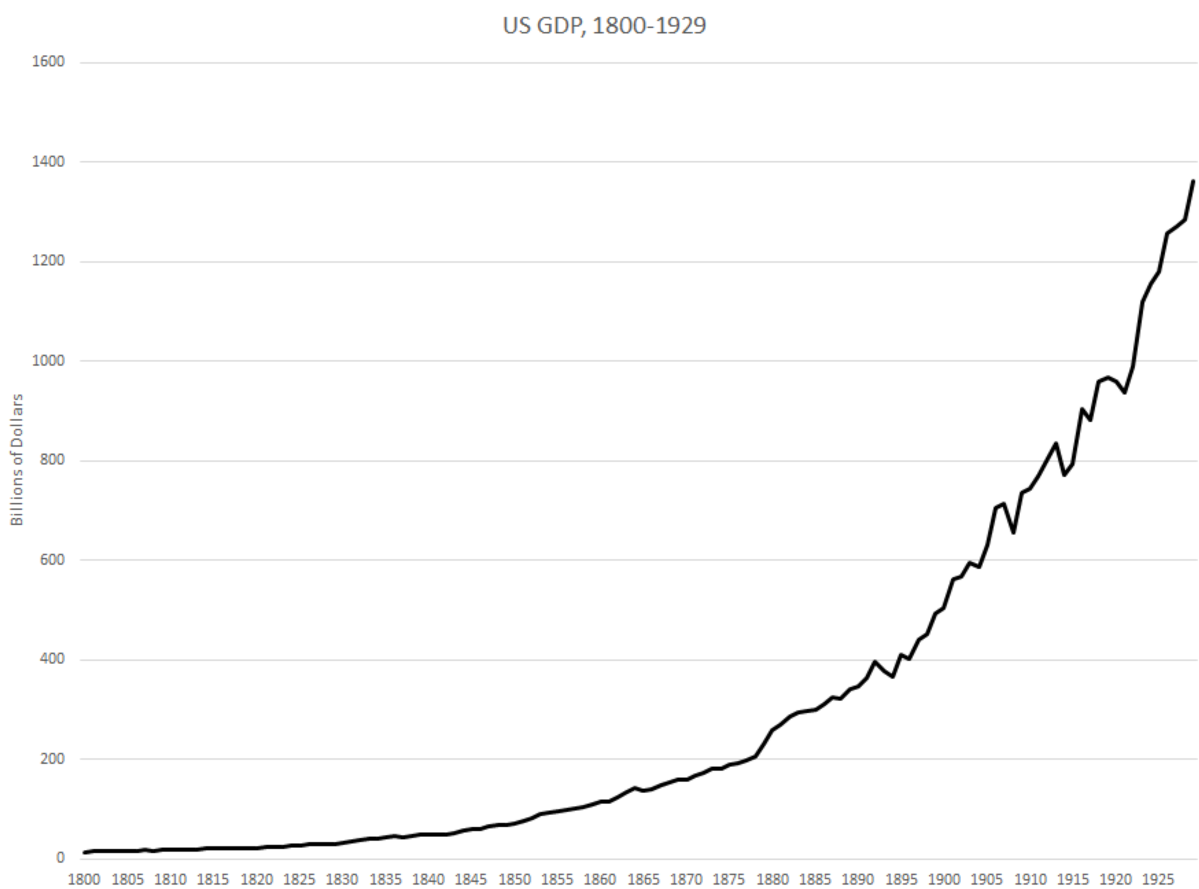


Figure 4.0.01

Towards the middle of the 1800s, the industrial revolution hit the US. The improved technology led to an increase in energy production, textiles and steamships and an overall increase in economic output starting around 1860. In the second half of the 1800s, there were more fluctuations in economic output, which were often driven by financial panics that had large impacts on the price of commodities and agricultural goods.

Part of what made financial panics common at this time was that prior to 1863, most banks in the US issued their own currency. Before the National Banking Act of 1863 established a single currency, there were more than 8,000 banks that had issued currency. Even after 1863, there was not a central bank (the Federal Reserve) until December, 1913, which meant that there was still a significant amount of instability in financial markets after the National Banking Act was signed into law.

Despite the fluctuations in GDP in the latter half of the 1800s, economists and policy makers both believed that the economy was self correcting. If prices of one commodity were too high, prices may crash, but soon enough, the economy would be back to the full-employment level of output. Economists at this time are often referred to as Classical or Long-Run Economists because they were focused on understanding the composition of the economy, under the assumption that it would always return to the full-employment level of output. The big jump in GDP in 1920s, also known as the "Roaring 20s", just confirmed to Classical Economists that the economy would turn out fine in the long-run.

The figure above shows that there was a reduction in GDP between 1920 and 1921, but between 1921 and 1929, the GDP grew by almost 50%. The technological improvements that began in the late 19th century and the first decades of the 20th century were becoming commonplace. This included major changes in the automobile, energy, health and construction industries.

In the early 1920s, many investors had made money investing in the stock market. Other individuals saw the stock market as an opportunity to make money themselves. For many, it did not matter how well-run a company was. The only thing that mattered was that they would be able to sell the company's stock for a profit at a later date. What does this sound like? It should be reminiscent of the speculation we saw in the housing market as recently as the mid-2000s.

Between the 1926 and 1929, the value of the average company on the stock market doubled. This would have been reasonable, had every company doubled their production and maintained their profit margins. Unsurprisingly, the market value of the stocks far surpassed the actual value of the companies. Once people realized that their stocks were not as valuable as what they paid for it, they panicked and sold as quickly as possible. The stock market index fell by 75%! This meant that individuals with their wealth tied to the stock market saw a 75% reduction in wealth.

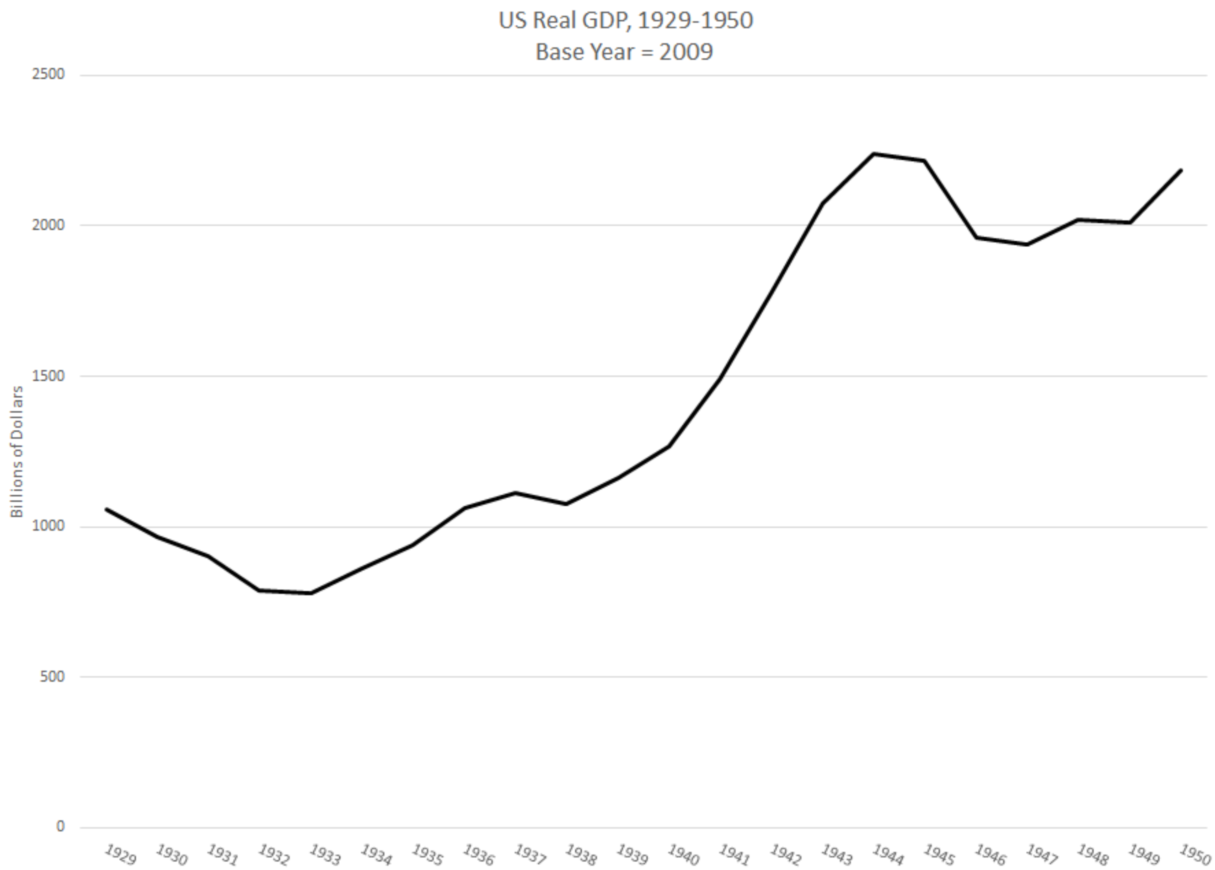


Figure 4.0.02

By the end of 1929, the US had began what became known as the Great Depression. It was not until the US began increasing military spending significantly in the 1940s that the economy finally recovered from the Great Recession. During this long time period in which unemployment was as high as 25% and the overall level of output was well below the potential level, waiting for the economy to correct itself was not a reasonable solution.

At the time John Maynard Keynes, a British economist, is believed to have said, "In the long run, we're all dead." What was the use of long run economic theory if the quality-of-life was so low waiting for the long run to come? Keynes began to focus on short run fluctuations in the economy with the hope that being able to explain why the economy is not producing at full-potential would help guide policy makers.

Some of you may be saying, "I do not believe in Keynesian Economics", as you associate it with some political ideology. You may not agree with the recommendations made by Keynes (which largely involved increasing government spending), but that is not important for our purposes. Keynes provided a clear and concise way to explain the macroeconomy. We will discuss the limitations of Keynes' analysis, but just like the supply and demand model helps explains changes in individual markets, Keynes' work helps us understand the movements in the entire economy.

The Great Depression officially ended as World War II began. Since the end of the war, there has been significant growth in production in the US. The figure below shows that between 1950 and 1990, the real GDP in the US grew around 3.7 percent per year. There were multiple recessions during that time period, with particularly deep recessions in the early 1970s and early 1980s, but in general, there has been a consistent upward trend in economic production since World War II.

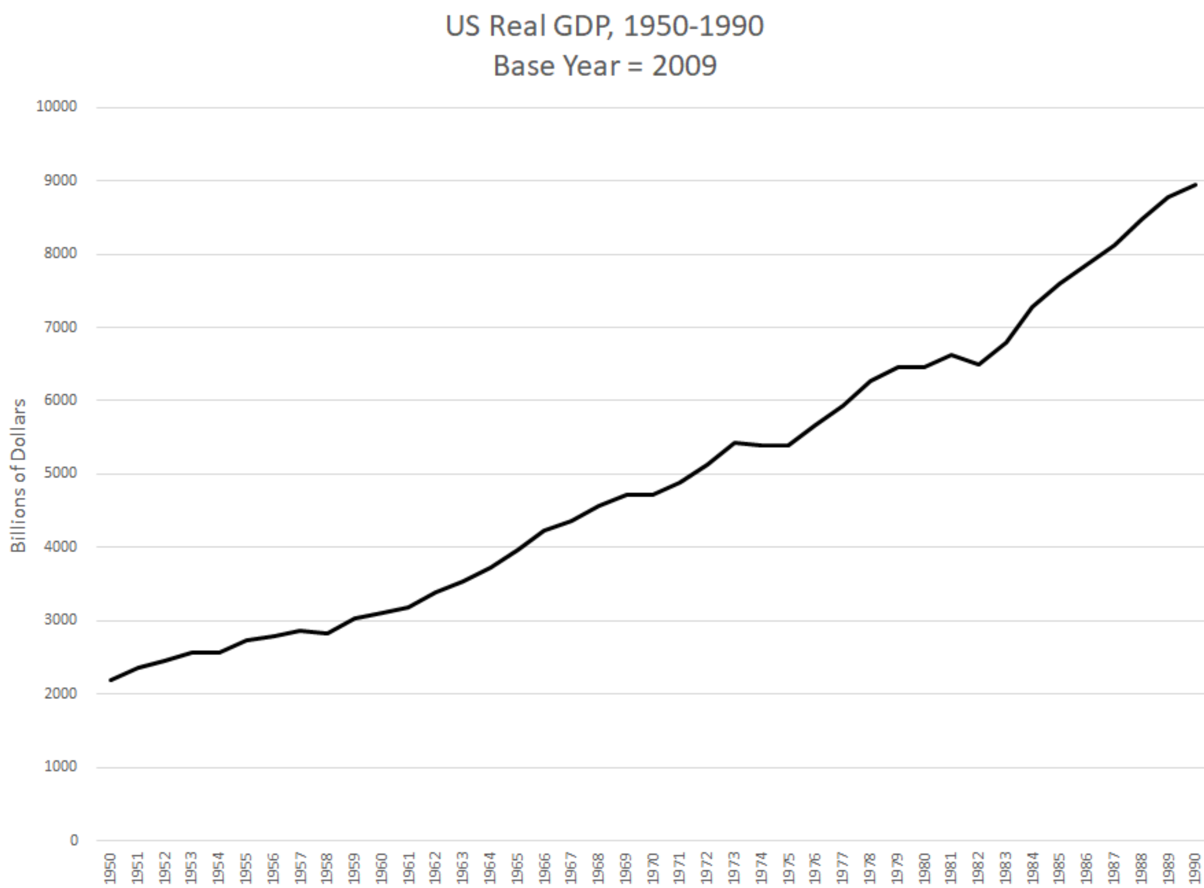


Figure 4.0.03

Although growth in real GDP continued after 1990, the Great Recession in 2008 was the largest recession in the US since the Great Depression in the 1930s. Much of our analysis moving forward will use the Great Recession to test whether the models we are create match the real world. It may be worth revisiting the discussion about the housing market at the end of chapter 2, as that was a primary catalyst for the Great Recession in 2008.

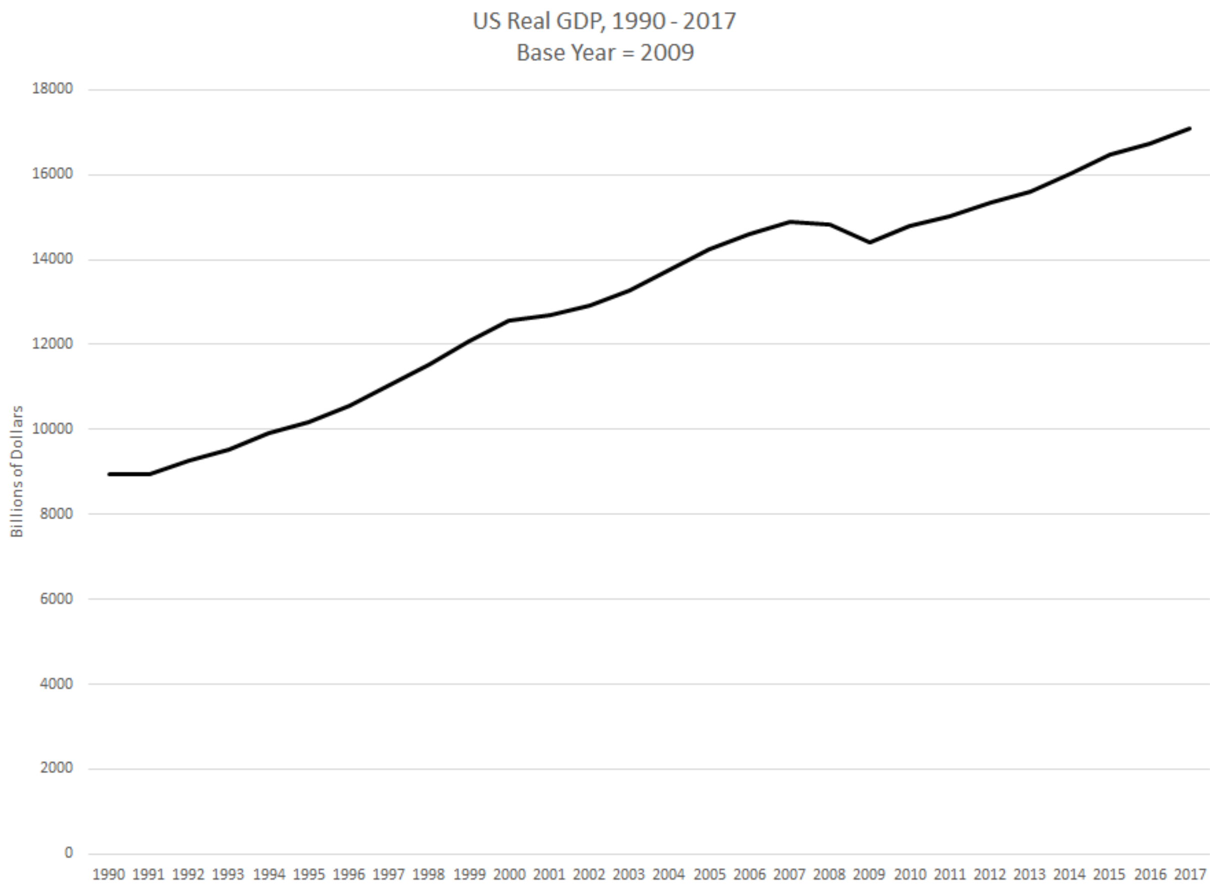


Figure 4.0.04

Business Cycles

Although we are not formally addressing long run economic thought, it does not mean that long run economics is not without merit. In fact, the natural tendency of the economy is to consistently move towards the full-employment level of output. In other words, the GDP naturally follows the business cycle.

In a business cycle, firms and consumers may be operating at the full-employment level of output, but believe the future is going to be even better. This increases production above the full-employment level as the economy expands. Operating above the potential GDP eventually burns out workers and consumers and after peaking, the economy begins to revert back towards the potential level of output.

The GDP may decrease to below the full-employment level of output. As the GDP decreases, it is in a recession. The National Bureau of Economic Research defines a recession as "a significant decline in economy activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production and wholesale-retail sales."

If a recession lasts 3 or more years and GDP decreases by 10 percent or more, it is defined as a depression. The Great Recession of 2008-2009 lasted 18 months, which is noticeably more than the average recession since World War II in the US of 10 months. Even the worst recessions will hit a trough and begin to recover and move back towards the full-employment level of output.

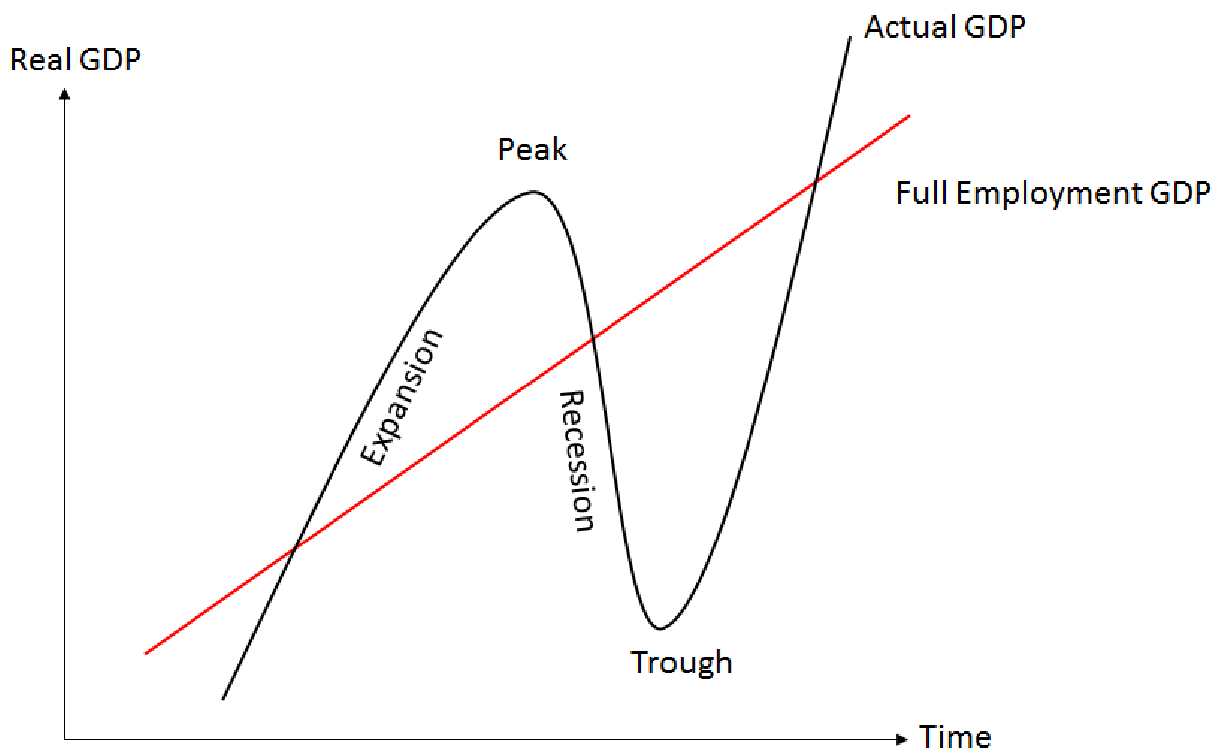


Figure 4.0.05

The figure above visually shows the business cycle of a generic economy. It will be our job as macroeconomists to explore whether there are any policies that will bring us back to the full-employment level of output quicker and more efficiently than waiting for long run forces to spur our recovery.

Short-Run Macroeconomics

4.1: Income or Spending

Imagine that the following transactions take place: Tim purchases an iPhone from Sarah for $1000. Sarah uses that money to buy a computer for $500 from Chris. Chris uses that money to buy a guitar for $250 from Dan. Assuming these are the only purchases in the economy, what is the total level of spending in this economy?

A

250

B

500

C

1000

D

1750

4.2: Output or Income

Imagine that the following transactions take place: Tim purchases an iPhone from Sarah for $1000. Sarah uses that money to buy a computer for $500 from Chris. Chris uses that money to buy a guitar for $250 from Dan. Assuming these are the only members of the economy and anytime a person sells something, they consider the amount they sold the good for as income, what is the income of Sarah, Chris and Dan?

A

250

B

500

C

1000

D

1750

How can we start thinking about the entire economy in a simple model? Start by imagining that in 2016, the economy was at a full employment level of output. In 2017, there is evidence that consumers will not spend as much as they did in 2016. Firms respond to this news by reducing the amount they produce, which means that fewer workers are needed.

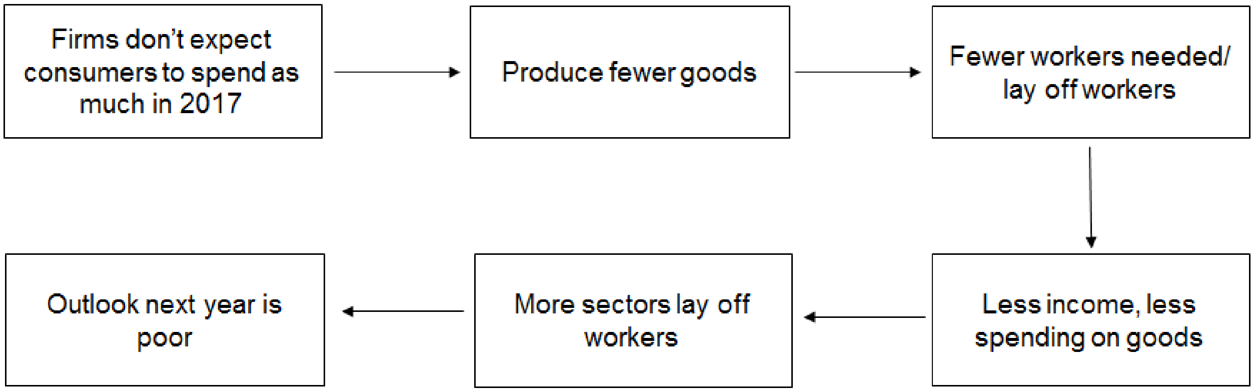


Figure 4.0.06

The reduction in employment means that consumers are spending less on most goods and services, which means that the more sectors lay off workers. Consequently the outlook next year is poor because of the decrease in output and employment. In some ways this is a self-fulfilling prophecy, as firms believe that the next year will be bad and in this example, that leads to a lower level of production.

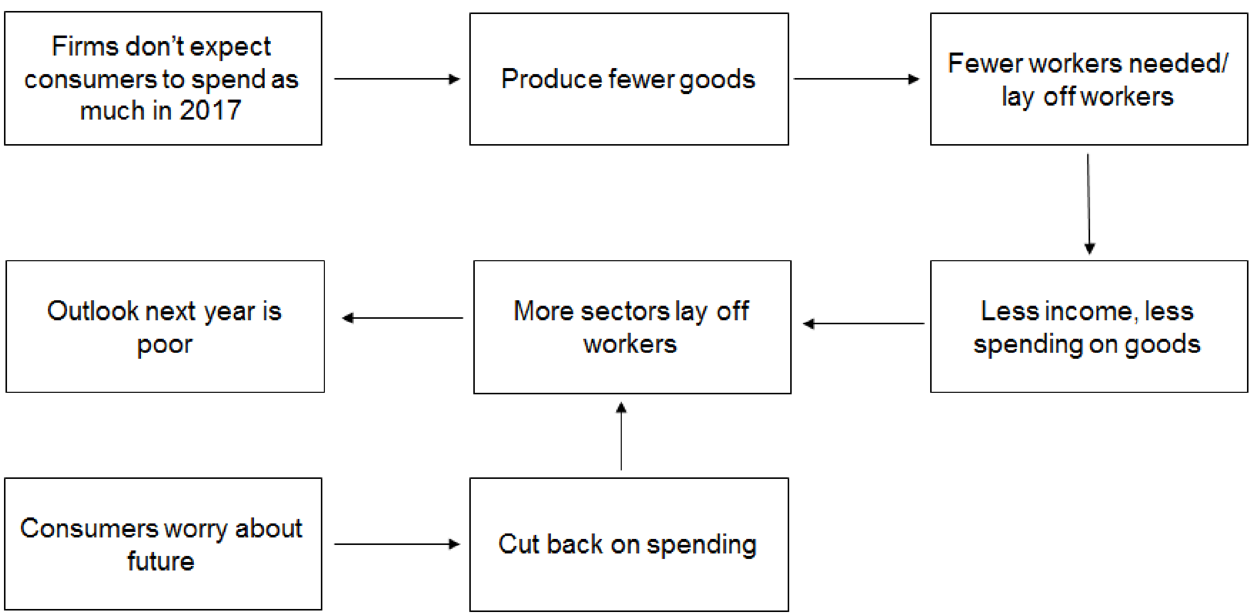


Figure 4.0.07

But if the reason firms are concerned about consumer spending next year is because the value of homes have fallen or the stock market has reduced the wealth of individuals, the firms may have good reason to believe spending will decrease. If consumers are worried about the future (because they have less wealth), they will cut back on spending, causing firms to produce less and increasing the level of unemployment.

The general idea behind our simple economy above is that when people spend more, output increases. When people spend less, output decreases. Firms are constantly adjusting their production to match the amount of spending in an economy.

This is exactly what the two questions at the start of the section are getting at. In question 4.1, the total amount of spending in the economy is just the value of the purchases made on the iPhone, computer and guitar.

How does this spending turn into income in question 4.2? When Tim bought the iPhone from Sarah, her income increased by $1000. When Sarah bought the computer from Chris, his income increased by $500. Dan's income increased by $250 when he sold the guitar to Chris. The total spending in the previous question is exactly equal to income (or output or GDP) in this economy.

The idea that that income/GDP in an economy is equal to spending is where we can ground ourselves. If we are interested in figuring out what the level of output is, we just need to figure out what the level of spending is. Technically, this means that we will be in a short-run equilibrium when spending and output are equal to one another. We will better understand why we define equilibrium where spending equals output, but before we get into the details, it is important to reiterate what we is meant by both spending and output.

Total spending in the economy in our analysis will be defined by the term aggregate expenditures (AE). The level of aggregate expenditures in the question above was $1750 ($1000 for the iPhone, $500 for the computer, $250 for the guitar). In equilibrium, *AE* is equal to output (Y).

In the previous chapter, we learned that output is the same thing as GDP, which is defined by *Y*, and is the same thing as production, income and value-added by the firm. With the variety of meanings of output, the following situations all depict equilibrium:

- AE = Y
- spending equals income
- aggregate expenditures equals production

Right now, it may not seem like there is ever a situation where spending does not equal output. Think back to chapter 2 and the supply and demand model. We motivated equilibrium by looking at how a market adjusts to equilibrium when the price of a good is not equal to the equilibrium price. The same concept will apply here. If AE is not equal to Y, how and why will the economy adjust towards the equilibrium level of output?

Chapter 4.1: Aggregate Expenditures Part 1, The Consumption Function

Our goal this chapter is to figure out when output is equal to aggregate expenditures. At this point, we are in a short-run macroeconomic equilibrium.

We will start by calculating aggregate expenditures in the economy. Aggregate expenditures (AE) will eventually be represented by a single number, but unsurprisingly, there are many spenders in the economy and it is useful to understand the different groups of spenders. Attempting to create categories of spenders in the economy may sound like a big undertaking, but fortunately, the categories will look very familiar to our GDP discussion last chapter.

Which group is responsible for the most spending in the economy?

A

Households and individuals

B

Producers and Firms

C

Government

D

Foreign investors and firms

Consumption Spending (C)

Although you may not feel like you contribute very much to overall spending in the economy, it turns out that households as a group are by far the biggest spenders in the economy. In our GDP analysis last chapter, we defined the GDP that comes from final goods and services bought by households and individuals, **consumption (C)**. When talking about spending by households and individuals, we can think of consumption from our GDP discussion and consumption spending as the same thing.

Consumption Spending

What factors determine the amount a household or individual spends?

Responses

Reply

Ordered by

Newest Responses

There are many things that can determine how much a household or individual spends. A lot of people may have said something about the number of people in a household. Kids in particular can play a big role in spending patterns.

A lot of what causes us to want something is seeing an advertisement that makes a product seem useful. In 2018, a 30-second commercial during the Super Bowl cost $5 million dollars. This seems like a lot of money, but considering over 100 million people watched the Super Bowl in the US, $5 million dollar may end up being a pretty good deal for an advertiser.

While marketing must be considered when thinking about consumption spending, the most relevant determinant of consumption is income. This is helpful because we are attempting to find the short-run equilibrium where total spending in the economy (AE) is equal to income/output/production (Y). With income a driving force behind the amount that households spend, we will be one step closer to determining the equilibrium level of output.

Before we directly model consumption in the economy, it is important to categorize all the determinants of consumption.

Income/Disposable Income

Income (Y) is the biggest determinant of how much households spend in the economy. We want to make the distinction between income and take-home income. When individuals are paid, in most cases, taxes are automatically taken out of their pay. In states like Washington and Florida, there is no state income tax, so someone making $50,000 in Washington takes home more than someone making $50,000 in Oregon because state taxes are paid by households in Oregon.

The take-home of income of households is defined as **Disposable Income (DI)** where DI in the economy is equal to the amount of income in the economy (Y) minus the total amount of taxes in the economy (T). The tax amount is set by the Federal Government and changes to the level of taxes will be a primary policy lever that will be discussed later.

Disposable Income = Income - Taxes = Y - T

To keep things simple, we will assume that taxes (T) are constant and not responsive to changes in income. This is a bit of a stretch, but it makes our analysis below easier. A way to convince yourself that this assumption is not too far-fetched is to imagine that the Federal Government decides how much tax revenue they will collect, regardless of household income (or any other factor). We will discuss relaxing this assumption below, but keeping taxes unresponsive to changes in income saves us a few steps when we are finding equilibrium in the economy.

It has not been directly said yet, but it is hopefully clear that an increase in disposable income leads to an increase in consumption (C). The increase in disposable income can come from an increase in total income (Y) or a decrease in taxes (T). Decreasing Y or increasing T would then lead to a decrease in DI and decrease C.

Wealth

Another very important factor in how much households and individuals spend is their level of wealth. Wealth is a term that is used often in news and politics, so it is important to define it clearly.

Wealth is the total value of your assets minus the total value of your liabilities.

Assets are the things that households own that have value. This includes the money in your bank account that you readily have access to, but it also includes the value of your investments. Stocks, bonds, homes and land are all assets that are included in the calculation of wealth.

4.5: Wealth Shocks

The housing market crashed in the mid-2000s. How would we expect the level of consumption to change?

A

Consumption is expected to rise because the value of assets increased.

B

Consumption is expected to fall because value of assets increased.

C

Consumption is expected to rise because value of assets decreased.

D

Consumption is expected to fall because value of assets decreased.

When the housing market crashed around 2008, homeowners experienced a significant decrease in the value of their assets. Very often, the amount that a house could be sold for was less than the amount owed on the mortgage (this is what is meant by the term "*underwater on your mortgage*"). Because the average household had less wealth, their consumption decreased.

Since the Great Recession, the value of stocks have increased significantly. Owners of stocks have experienced growth in their wealth. They have access to more money for spending, even though their income has not necessarily increased. As the value of stocks rise, the value of assets increase, leading to an increase in consumption.

Liabilities are what households owe money on. Mortgages are often the largest liability that households have, but there are many others things on the list. Credit cards, car loans, health care bills and student loans are all included under liabilities. As a households liabilities rise, their wealth decreases and the level of consumption decreases.

During the Democratic Primaries in 2016, Bernie Sanders ran on a platform that included making [education free at all state colleges and universities](). If this were to ever come to fruition, there would be a significant reduction in student loan debt, leading to an increase in consumption. There are definite costs to this type of policy, but one large benefit for households is a reduction in the value of liabilities.

Interest Rate (r)

An often overlooked determinant of household spending at this point in a macroeconomics course is the interest rate, which we will define as *r*. The interest rate (r) will become increasingly important as we talk about national debt and monetary policy, but for now, the interest rate can be thought of as the cost of borrowing money or the benefit of saving money.

4.6: Interest Rates and Consumption

Policy makers decide to decrease the interest rate. What is the most likely outcome of the decrease in the interest rate?

A

Consumption increases because borrowing for big-ticket items becomes less expensive

B

Consumption increases because borrowing for big-ticket items becomes more expensive

C

Consumption decreases because saving for a home is more necessary

D

Consumption increases because saving for a home is less necessary

"The interest dropped today! Kids we're going out for ice cream!" said no parent ever.

When the interest rate changes, households and individuals do not change how much food they buy or whether or not they fill up their car with gas. The interest rate is only relevant to spending on big-ticket items. The big-ticket items can be thought of as durable goods.

A low interest rate makes purchasing a car cheaper if the car is being financed with a loan. Furniture and appliances also have options that allow buyers to borrow money in order to buy the product. A lower interest rate makes these goods "cheaper" since the interest payments are reduced. Higher interest rates work in the opposite direction, with borrowing becoming more expensive as the interest rate increases.

Expectations

Expectations about future streams of income can play a significant role in the amount of spending by households. This applied directly to my wife and I after we received our first job offer. We were in our fifth year of graduate school and our income very low, especially given we were in an expensive city (Santa Barbara, CA). When we signed the contract for our first job, we could not believe how much our income was going to increase, starting in six months. Although we did not have an immediate increase in income, our income was guaranteed to rise in the near future. Where did we go to celebrate the expectation of more income? The correct answer is Hawaii!

This is an extreme example of a change in expectations leading to an increase in spending, but you may have went out to a celebratory dinner when a family member got a big promotion. An acceptance letter to college also has implications for future income and can potentially increase spending today.

Negative expectations of the future can have the opposite impact on current spending. During the late 2000s when home values were falling, gas prices were rising and jobs were being lost, the average household did not look to the future with confidence. Consequently, spending on many unnecessary goods and services fell as households saved for the future.

Confidence in the economy is often measured by the University of Michigan's Consumer Sentiment index. The index is created in a very similar way to the CPI, where the base year is 1966 and the feelings about the direction of the economy in the near future is relative to the base year. In 2007 and 2008, the consumer sentiment index was below 60. This means that the average household felt 60% as confident about the economy in 2008 than in 1966. After the Great Recession, it was not until 2014 that confidence levels starting approaching 1966 levels.

Preferences and Tastes

Many of the entertaining answers to the discussion question earlier, such as the ShamWow commercial, fall under the general consumption category of preferences and tastes. When a new product comes out that everyone wants to purchase, spending will rise, no matter what happens to income. If there is a movement towards a more frugal lifestyle for the average household, spending will decrease. Just like our supply and demand shocks, preferences and tastes cover a lot of the interesting, but hard to categorize events that change household consumption.

The Consumption Function

We could talk about the reasons that consumption changes for many more pages, but that does not get us closer to learning when spending is equal to output (equilibrium) in the economy. Consumption is the largest component of spending in the economy and from our discussion above, disposable income is the largest determinant of how much households spend. What exactly is the relationship between disposable income and consumption?

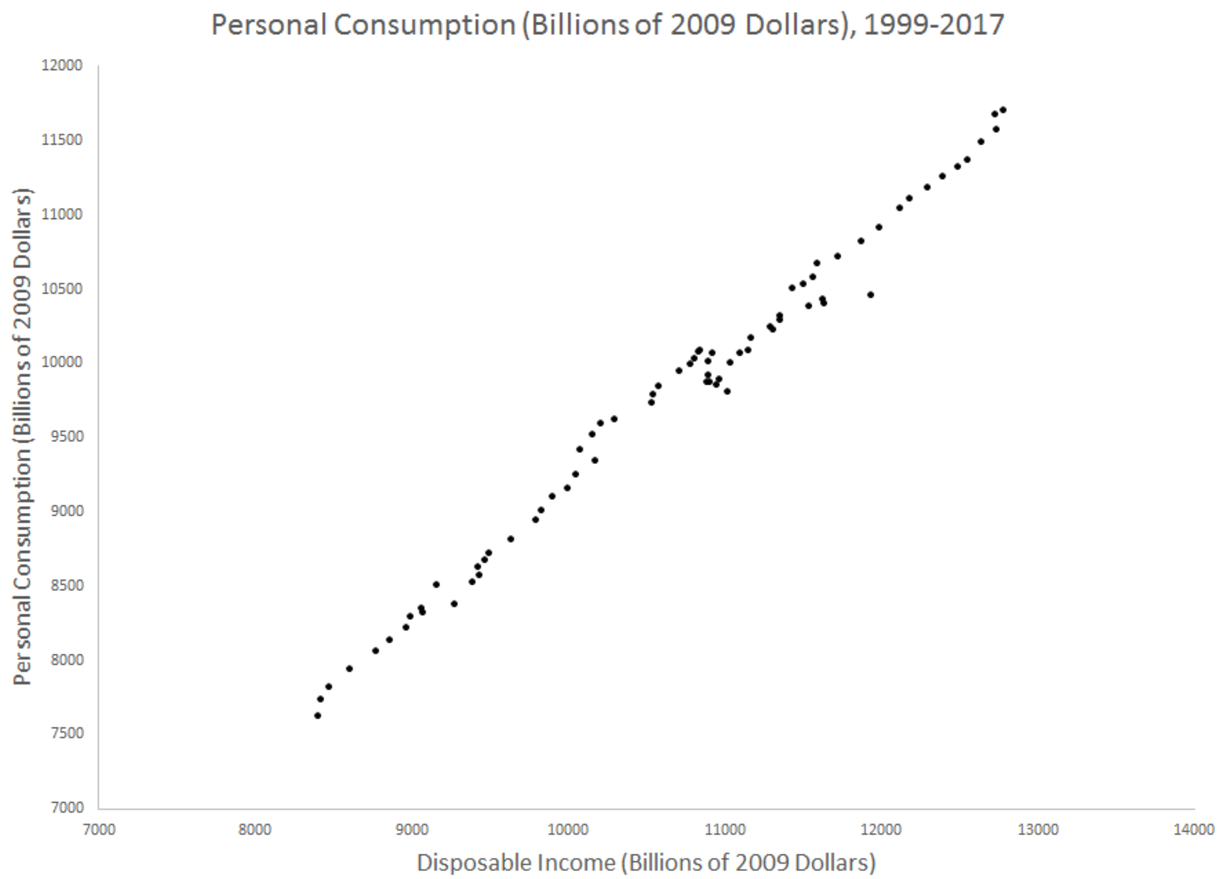


Figure 4.1.01

The figure above plots the relationship between real disposable income (DI = Y - T) on the horizontal axis and real personal consumption (C) on the vertical axis for every quarter between 1999 and 2017. Lower levels of DI tend to have lower levels of C and it is not a stretch to argue that the relationship between DI and C is linear. This means that every $1 increase in disposable income leads to the same increase in consumption and the increase is roughly the same whether the DI is low or high.

For those of you planning to take Econometrics, you will learn how to draw a "line-of-best fit" for a plot like this. In this particular plot, we can use econometric techniques to predict that for every $1 increase in DI, C will increase by 87 cents and the line gets close to most of the points on the plot. Over 98% of the variation in consumption between 1999 and 2017 can be explained by the changes in disposable income.

The figure above makes it safe to assume that the relationship between disposable income and consumption is linear. Not only is this assumption supported by the figure above, but it also helps us characterize (describe) the relationship between C and DI in a concise way.

A linear function is that straight line that you learned about in your algebra class: $y = mx + b$. In a generic linear function, y is the value of the outcome variable, m is the slope of the line, x is the value of the independent variable and b is the y-intercept. For some of you, the linear function is second nature, for others, the linear function was a black hole of unhappiness that you hoped to never see again.

Fortunately, the linear function is easier to understand (and maybe even fun to work with) if it is attached to a real world situation, such as consumption (C) and disposable income (DI). In our plot, DI = Y - T, is the independent variable. Changes in the value of Y - T will impact the level of C.

This means that a linear function that explains the plot above can be written as:

C = fixed intercept + slope × DI = fixed intercept + slope × (Y - T)

Consumption Function 1

In the function relating consumption and disposable income, what does the intercept represent?

Responses

Reply

Ordered by

Newest Responses

The fixed intercept term is the level of consumption that does not depend on disposable income. Even when the level of disposable income is zero, there is still going to be consumption by households, whether that is because the households borrow money or use savings from the past.

The fixed intercept also represents any change in consumption that does not depend on income. This means that the housing market crash that reduced wealth is wrapped into the intercept term. An increase in the value of the stock market or improving confidence in the economy will increase the value of the intercept. In these situations, consumption will increase, regardless of what the income level is.

Because the consumption that is captured by the intercept is somewhat "automatic" and not directly dependent on income, it is called autonomous consumption (AC). What exactly goes into AC? All of the categories we discussed last section other than income. Changes in wealth, the interest rate, expectations and preferences will all have a direct impact on AC.

Consumption Function 2

What does the value of the slope mean in the linear function comparing disposable income to consumption?

Responses

Reply

Ordered by

Newest Responses

The last part of the function we need to understand is the slope. How is the slope of a line calculated? I always remembered the phrase "rise over run". The slope is telling you how much your line rises (or falls) when it moves left-to-right. In the case of consumption and disposable income, the slope is telling us how much consumption changes when disposable income increases by one dollar.

Slope of C vs DI Line: Change in C/Change in DI

In the plot above, the estimate slope of a linear curve is 0.87. This means that a $1 increase in disposable income will increase consumption by 0.87. Another way to think of the slope is that it is the fraction of income that an individual spends on consumption. The rest of the $1 is put into savings or investments. Because the slope tells us the proportion of income that is dedicated to consumption, it is called the marginal propensity to consume(mpc).

Technically, the slope of our function can be calculated by dividing a change in consumption by a change in disposable income. If disposable income increases by $1000 and consumption increases by $870, then the slope is calculated as: $870/$1000 = 0.87.

How will the relationship between C and DI be depicted in this book? Let's use a simple example. The table below provides a number of different combinations of disposable income and consumption for a hypothetical economy.

What is the level of autonomous consumption in this hypothetical economy?

A

0

B

2000

C

3200

D

4000

The first thing to notice is that when the level of disposable income is 0, the level of consumption is 2000. This means that autonomous consumption (AC) in this economy is 2000. Even if there is no income, there will still be 2000 worth of spending. The money for this spending will come from savings, borrowing, retirement or investments. Because it is unlikely that an economy is ever in a situation where there is no income, the level of AC also represents how much consumption is driven by things other than income.

4.8: Marginal Propensity to Consume

What is the marginal propensity to consume (mpc) in this hypothetical economy?

A

0

B

0.6

C

600

D

1200

To find the marginal propensity consume (mpc) in the economy, we need to find the slope of the relationship between DI and C. All the relationships in this book related DI and C will be linear. This means that we can calculate the slope by taking any two combinations of DI and C and following the slope equation above.

Use the first two combinations of DI = 0 and C = 2000 and DI = 2000 and C = 3200.

The change in consumption between these two points is $1200 ($3200-$2000) and the change in disposable income is $2000 ($2000-0).

The slope is then $1200/$2000 = 0.6.

An alternative way to think about this exercise is to ask, how much of every $1 dollar taken home is put towards consumption spending? When disposable income increased by $2000, consumption increased by $1200. If the disposable income only increased by $1000, then consumption would only have increased by $600. A $100 increase in DI leads to a $60 increase in C. A $10 DI increase causes a $6 C increase. Increasing DI by $1 increases C by $0.60.

The marginal propensity to consume is equal to the slope, which is 0.6. Because the mpc tells us the fraction of income put towards consumption, it is bounded between 0 and 1. It does not make sense in the long-run for the mpc to be negative, meaning that increasing income reduces consumption. It is unsustainable for mpc to be greater than 1 and for households to spend more than their take-home income.

After finding the intercept and slope of the function relating DI and C, we can write out the linear curve representing the relationship between the two variables as: $C = 2000 + 0.6 \times (Y - T)$

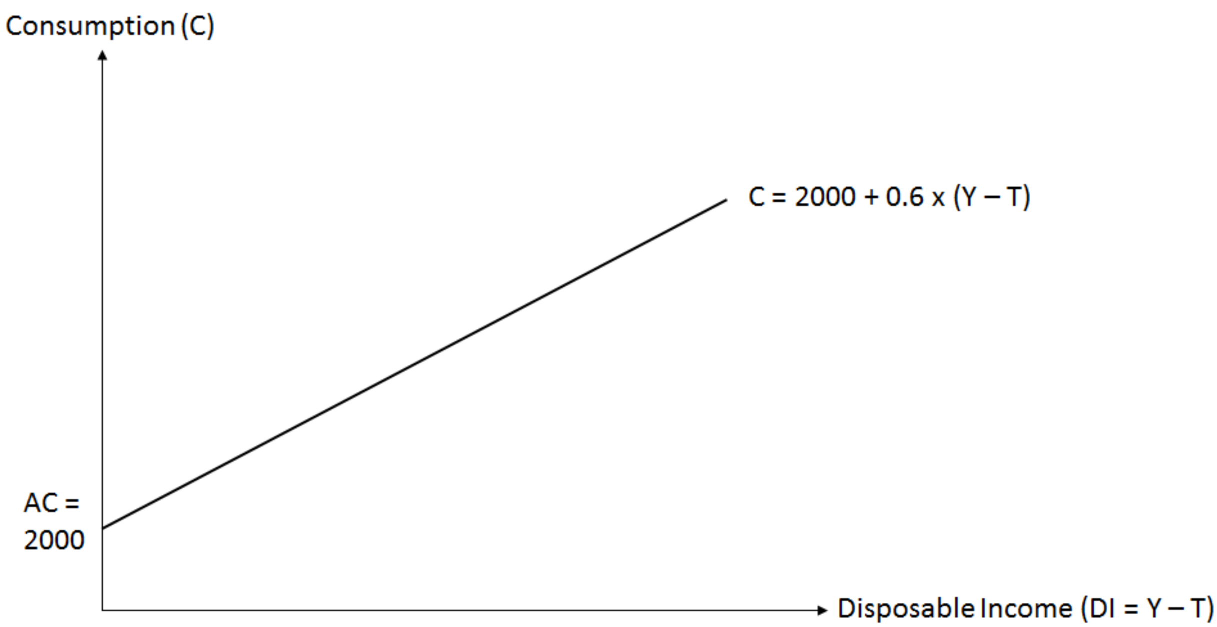


Figure 4.1.02

The linear curve relating DI and C is drawn above. The intercept is where DI is equal to zero and on the graph, the intercept is at 2000. For every $1 increase in DI, C increases by 0.6, which is captured by the upward sloping line.

The linear relationship between DI and C allows us to quickly depict the relationship on a graph, but we are missing something. Remember, we are trying to calculate aggregate expenditures (AE), which includes consumption and want to compare AE to output (Y), not disposable income (Y - T).

Fortunately, we can relate output to consumption without much hassle if we assume that taxes (T) are fixed. Again, this means taxes (T) do not change when income (Y) changes. We are assuming that the Federal Government sets the level of tax revenue they want regardless of the level of income. They can change the tax level (T), but it will apply in the same way to all income levels.

In our example above we will assume that the level of taxes are equal to 2000. This alters our table from above.

When taxes (T) are equal to 2000 and disposable income (DI) is equal to zero, it must be that output (Y) is equal to 2000 since 2000 - 2000 = 0. When output/income is equal to 2000, consumption is equal to 2000, even though take-home income is 0.

In order to accurately graph the relationship between output (Y) and consumption (C), the intercept of the line needs to be calculated. This is technically done by simply adding the level of taxes into the linear function above:

$C = 2000 + 0.6 \times (Y - 2000)$
$C = 2000 + 0.6 \times Y - 0.6 \times 2000$
$C = (2000 - 1200) + 0.6 \times Y$
$C = (AC - mpc \times T) + mpc \times Y$
$C = 800 + 0.6 \times Y$

The function, $C = 800 + 0.6 \times Y$, is what we will define as the consumption function. The intercept of the consumption function tells us how much consumption there will be when income (Y) is zero. This intercept is a combination of the autonomous consumption and a fraction of the tax amount. A more practical way to think about the intercept is that changes to autonomous consumption (AC) or taxes (T) will change the intercept of the consumption function.

The fraction of additional income that is put towards consumption (mpc) is captured by the slope of the consumption function, which is the same interpretation of the slope as above. The graph below depicts the consumption function. Notice that is very similar to the previous graph, with the only difference being that the horizontal axis is GDP (Y) and the intercept is 800 since it captures both AC and T.

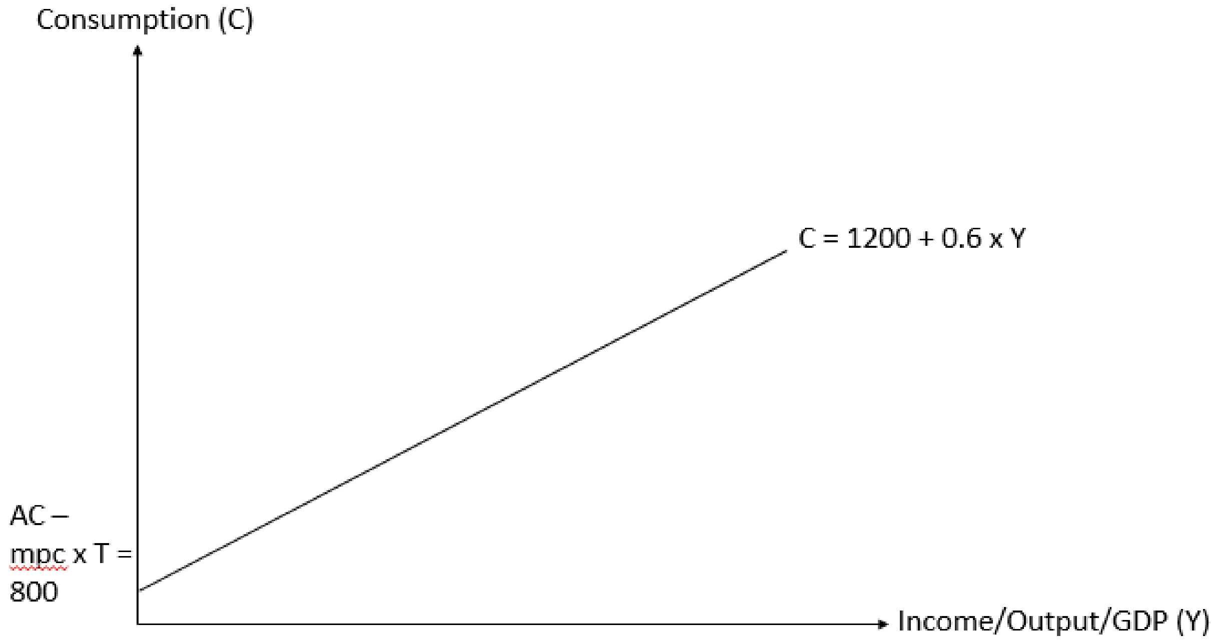
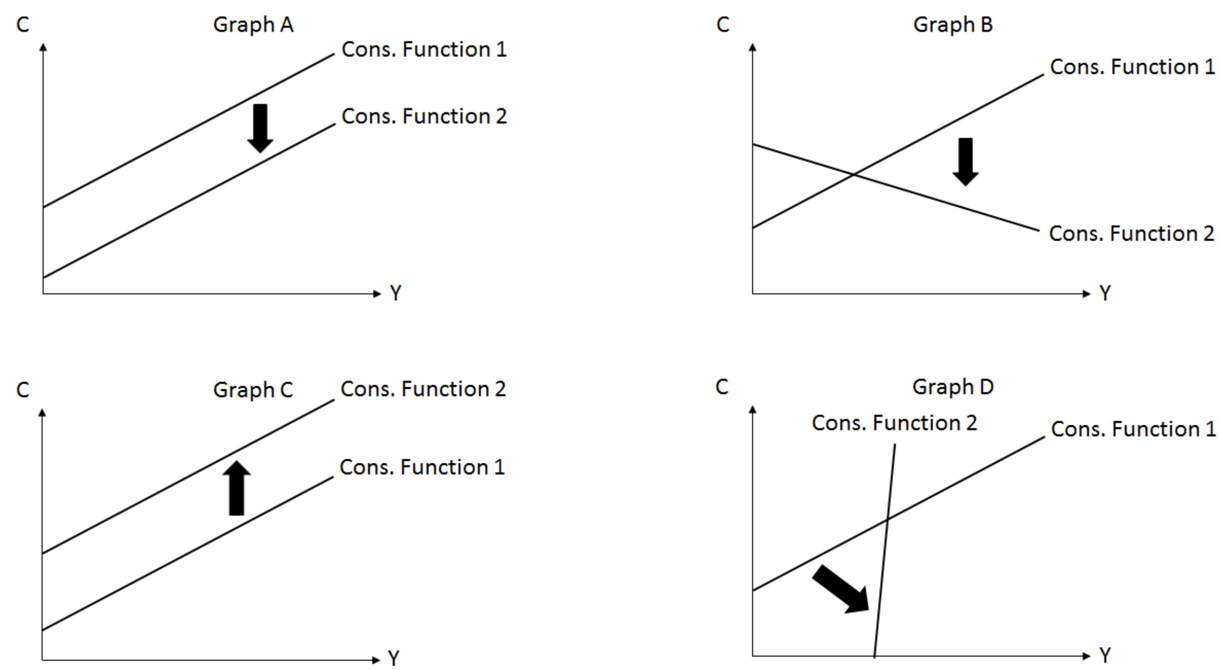


Figure 4.1.03

Shifts in the Consumption Function

4.9: Consumption Function Shift

Consumption function 1 depicts the initial relationship between income (Y) and consumption (C). There is a stock market crash that causes the value of stocks to decrease. Which of the following graphs shows the consequence of the stock market crash on consumption?



A

Graph A

B

Graph B

C

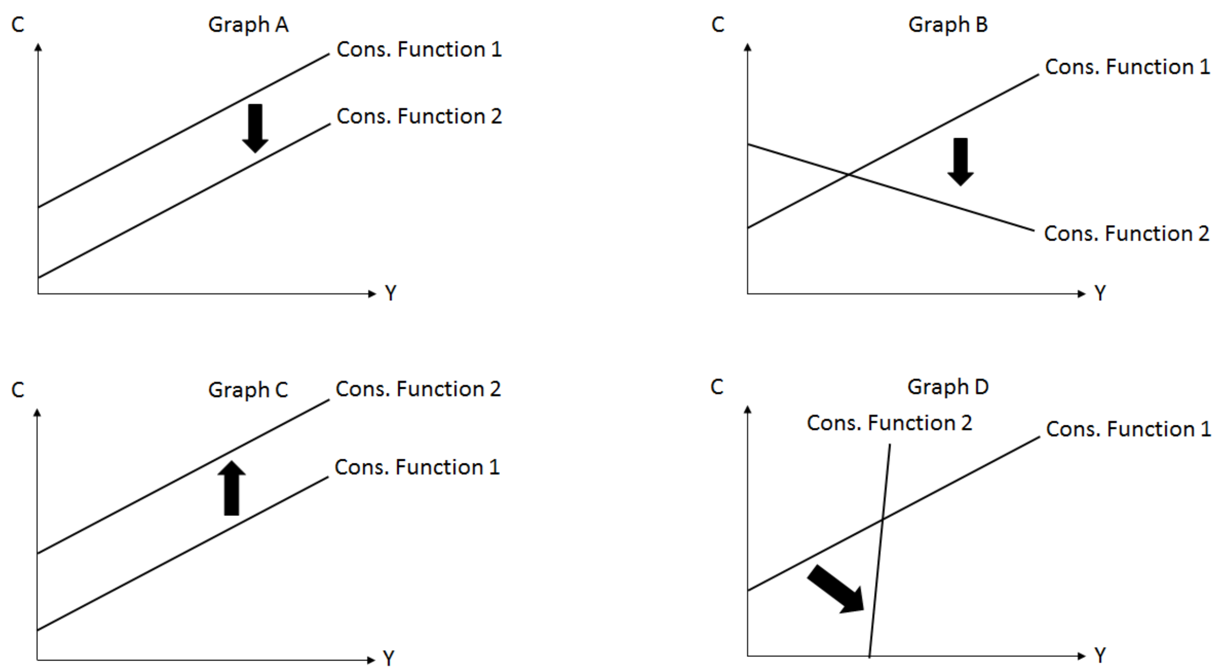
Graph C

D

Graph D

4.10: Consumption Function Shift

Consumption function 1 depicts the initial relationship between income (Y) and consumption (C). There is a decrease in the interest rate. Which of the following graphs shows the consequence of the decrease in the interest rate on consumption?



A

Graph A

B

Graph B

C

Graph C

D

Graph D

In questions 4.9 and 4.10, you are asked to graphically show what happens to the consumption function when there is a shock to the economy. In the question 4.9, the stock market crashed. This will cause a reduction in wealth, which means that autonomous consumption (AC) will decrease. The intercept of the consumption function then decreases and the entire curve shifts down. There is no change in the slope, so the two consumption functions are parallel. The consequence of the stock market crash is captured by graph A.

In question 4.10, you have to remember how interest rates and consumption are related. As the interest rate decreases, consumption of durable goods increases at all levels of Y. This will increase consumption, but again, because the change in consumption is not driven by a change in income, it will be captured by an increase in autonomous consumption. Graph C shows that the intercept of the consumption function rises, but the slope (mpc) has not changed.

Anytime there is a change to autonomous consumption (AC) or taxes (T), the intercept of the consumption will change, causing a shift in the consumption function. As we discussed above, there are many different scenarios that can cause a change in AC. The questions above focused on the stock market and interest rates. Consumer confidence, expectations, preferences and tastes will also shift the consumption function.

Changes in taxes will also shift the consumption function. Mathematically, a reduction in taxes will lead to an increase in the intercept of the consumption function, causing the function to shift up.

Practically, a decrease in taxes will lead to an increase in disposable income (Y - T) and household will bring home more money from working, even though their income is not changed. This will cause an increase in consumption at all income levels.

In the graph below, the shift in the consumption function from C1 to C2 is shown, where the consumption amount for any given income on C2 is greater than the consumption amount for any given income on C1. The cause of the shift from C1 to C2 is caused by either an increase in AC or a decrease in T.

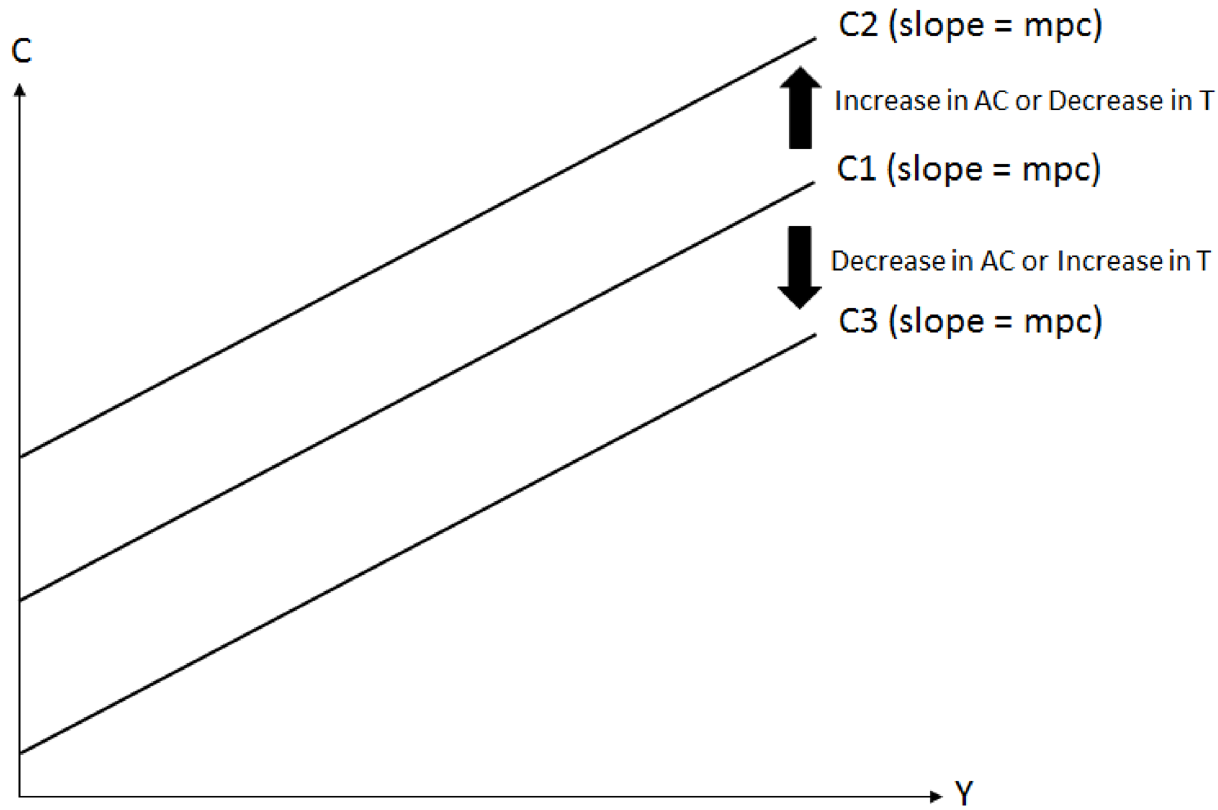


Figure 4.1.04

When AC decreases or T increases, the consumption function will shift down. This is seen in the movement from C1 to C3. As discussed above, when there is a reduction in AC, the intercept of the consumption function is less, shifting the entire consumption function down. As we saw in the questions above, the slope of the consumption functions do not change, as we will assume that the mpc is constant in our analysis of the short run.

We have laid the foundation for the consumption function. Now let's try a few questions to make sure you feel comfortable with the concept.

4.11: Marginal Propensity to Consume

Consider the following table. What is the marginal propensity to consume?

Real GDP (Y)	Taxes (T)	Disposable Income (Y - T)	Consumption (C)
200	100	100	175
300	100	200	250
400	100	300	325
500	100	400	400
600	100	500	475
700	100	600	550
800	100	700	625
900	100	800	700
1000	100	900	775

A

0.5

B

0.75

C

0.8

D

0.9

In this question, you should recognize that the increase in income (and disposable income) is $100 every row. For every $100 increase in income, the consumption level increases by $75. The change in consumption divided by the change in income is 0.75. This is the slope of the consumption function, which is the marginal propensity to consume.

As you calculate the mpc, make sure to remind yourself that you are figuring out the fraction of every dollar earned that is put towards consumption.

4.12: Autonomous Consumption

Consider the following table. What is the level of autonomous consumption?

Real GDP (Y)	Taxes (T)	Disposable Income (Y - T)	Consumption (C)
200	100	100	175
300	100	200	250
400	100	300	325
500	100	400	400
600	100	500	475
700	100	600	550
800	100	700	625
900	100	800	700
1000	100	900	775

A

0

B

100

C

190

D

280

Question 4.12 is a bit more difficult, but there are a number of ways to answer the question. Start by recalling that autonomous consumption is the level of consumption when disposable income is equal to zero. From question 4.11, we found that the mpc is 0.75 and that for every $100 change in disposable income, there is a $75 change in consumption.

One way to answer question 4.12 is to extend the table to include real GDP equal to 100. When Y is 100, T is still 100 and disposable income becomes 0. The $100 reduction in income reduces consumption by $75, moving it from $175 to $100. The level of consumption when disposable income is zero is $100, which is the value of autonomous consumption (AC).

The autonomous consumption can also be calculated mathematically. Even if you felt more comfortable extending the table, understanding the mathematics behind question will be helpful as we move forward in the course.

From question 4.11, we learned that the slope is 0.75 and already know that taxes are equal to 100. With just this information, we could write the consumption function as:

$C = AC + 0.75 \times (Y - 100)$

We want to solve for the level of AC, but we only have one equation and three unknown variables (AC, C and Y). However, the table above gives us many combinations of Y and C that lie on the consumption function. You can pick any one of these combinations and put them into the equation, leaving you with only one unknown variable to solve for, AC.

Let's pick the first combination of Y and C in the table where Y is 200 and C is 175. Place these values into the consumption function:

$175 = AC + 0.75 \times (200 - 100)$
$175 = AC + 0.75 \times (100)$
$175 = AC + 75$
$AC = 175 - 75 = 100$

Now we have one equation and one unknown. In order for consumption to equal 175 when income is equal to 200, taxes are 100 and mpc is 0.75, the autonomous consumption (AC) must be equal to 100. This is the same answer we arrived at by extending the table to include a disposable income of zero.

Instead of using the first combination in the table, lets use the last combination where Y is 500 and C is 400. Plugging these values into the consumption gives us:

$400 = AC + 0.75 \times (500\text{-}100)$
$400 = AC + 0.75 \times (400)$
$400 = AC + 300$
$AC = 400 - 300 = 100$

The same value of AC will be found no matter what combination of Y and C that is plugged into the consumption function. Once we find AC, we can step back and rewrite our consumption function allowing for Y and C to change:

$C = 100 + 0.75 \times (Y - T)$,

because $T = 100$,

$C = 100 + 0.75 \times (Y - 100) = 100 - (0.75 \times 100) + 0.75 \times Y$

and,

$C = 25 + 0.75 \times Y$.

The intercept value of 25 is capturing both the AC (100) and T (100).

The consumption function is a very important and detailed component of aggregate expenditures. This is why the entire section has been dedicated to consumption. Additional components of aggregate expenditures are also important, but will be introduced into our analysis is a slightly easier way. Make sure you feel good about the consumption function: what it is capturing, how it is created and when it shifts. The next section will cover the remaining components contained in aggregate expenditures and get us closer to short-run macroeconomic equilibrium.

Chapter 4.2: Aggregate Expenditures Part 2, Finding Equilibrium

Our goal this chapter is to determine the total level of spending in the economy (aggregate expenditures, AE) and find out what level of output (Y) makes income and spending equal. Consumption (C) is our first component of spending and households account for the largest proportion of spending. It was a process to create and understand the consumption function and if the remaining categories of spending take just as long, you will be reading this book for years!

Fortunately, we will be able to make a couple of assumptions in the remaining categories of spending that will allow us to depict aggregate expenditures (AE) relatively soon. After finding AE, we will be able to determine short-run macroeconomic equilibrium: the point where AE equals Y.

Planned Investment Spending (I^P)

The next category of spenders in our model are businesses, firms and producers. These are the same agents that drove investment (I) in the previous chapter on GDP. However, we do not want to simply use investment (I) in our calculation of spending in the economy. Instead, we will use planned investment spending (I^P) to capture the amount that firms spend.

Planned investment spending (I^P) consists of two familiar components:
1. Spending by firms on capital (materials, machines, software, hardware, etc.)
2. New homes

After recalling the discussion on investment in chapter 3, it should not be a surprise that we want to include spending by firms in planned investment spending. New homes were a bit of a surprise component of investment earlier, but when thinking about how much is spent in an economy, new homes need to be included and they are defined as an investment. Consequently, they are part of planned investment spending, I^P.

How is planned investment spending, I^P, different from investment (I), that was defined last chapter? The third category of I is missing from I^P. Remember that this category was the change in private inventories. Inventories are unsold goods. When firms produced too much, their inventories increase. When there is not enough production, firms match the excess demand by reducing their existing inventory. It may be the case that the change in inventory is zero in a given year. In this case, the level of investment (I) will be equal to the level of planned investment spending (I^P).

The change in inventory is part of investment (I), but it is not planned and it does not directly change overall spending, which is what we are trying to calculate. The change in inventory will play an important role in defining short run equilibrium, but it is not appropriate in our calculation of aggregate expenditures (AE).

Determinants of Planned Investment Spending

What determines the level of planned investment spending for a firm?

Responses

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-

In the discussion above, we need to put ourselves in the mindset of a firm and ask what will increase spending? This is a harder concept to imagine, but it is good to start thinking about it, as you will soon be working at a firm and having to make decisions about spending.

Similar to previous discussions, there are many things that can influence how much a firm spends. We will again simplify our analysis and categorize the determinants of planned investment spending (I^P) in a few important groups.

Expectations

Firms, possibly more than households, respond to expectations about the future by altering their level of spending. Right now, there is a lot of interest in self-driving cars. Traditional car companies such as GM, Ford, Audi, Toyota, Volvo and many others, have recently dedicated a lot of money to creating a vehicle that operates itself.

Newer companies have also joined the race to create a self-driving car, including Tesla, Uber, Lyft and Google. Each of these companies are trying to become the leader of a revolution in the automobile industry. Self-driving cars are difficult to find today, but because firms expect there to be significant profit opportunities from creating a self-driving car in the future, they are increasing their spending today. This is equivalent to increasing planned investment spending, I^P.

Self-driving cars are a very interesting example of how firms respond to expectations, but all firms are looking towards the future. As we implicitly discussed earlier in the chapter, firms that expect the sale of their product to decrease in the upcoming year will respond by spending less today and planned investment spending (I^P) will decrease.

Cash Flow and Profitability

Many of the answers to the discussion question above likely had something to do with the amount of money a firm has. More specifically, firms with a positive cash flow and higher profits are able to increase planned investment spending. Without cash around, firms will be required to borrow in order to spend on capital.

Interestingly, in the summer of 2017, Amazon's sales were higher than ever (more than $38 billion over the past year), but profits were surprisingly low. The reason for this discrepancy was not poor management or low profit margins. In 2017, Amazon significantly increased spending on new technology and video content. Although this temporarily reduced profits, Amazon believes that spending their profit on investments today will lead to increased profits in the future.

As cash flow and profitability decrease in a company, they will be more reluctant to spend on new capital, if for no other reason than they cannot afford to lose more money. When looking at the all firms in the economy, the less profitable firms are as a whole, the lower the level of I^P.

Interest Rate

Just as the interest rate played an important role in the spending of some consumer goods and services, it also plays a role in the amount of planned investment spending (I^P). Companies that decide to borrow money in order to purchase capital will need to increase their revenue by at least as much as the interest rate in order for the purchase to make sense.

If the interest rate is 5%, the firm must increase their revenue by 5% so that they can pay the interest on the loan. As the interest rate increases, the likelihood that an investment will be able to overcome the interest payment decreases. Conversely, lower interest rates will make borrowing cheaper and firms will not need as big of a production increase in order to make profit on the investment.

Adding Planned Investment Spending to Consumption

It is possible that an increase in income (Y) will eventually lead to an increase in spending by firms (I^P), but this relationship takes time to come to fruition. We will make our analysis simple by assuming that firms set the level of I^P and do not respond to changes in Y in the short run. In other words, the planned investment spending will be fixed in our model, similar to AC and T.

What does this look like in practice? In the table below, planned investment spending is added to our consumption table from above. The level of planned investment spending, I^P, is equal to 35 at all levels of income.

Real GDP (Y)	Taxes (T)	Disposable Income (Y - T)	Consumption (C)	Planned Investment Spending (IP)	C + IP
200	100	100	175	35	210
300	100	200	250	35	285
400	100	300	325	35	360
500	100	400	400	35	435
600	100	500	475	35	510
700	100	600	550	35	585
800	100	700	625	35	660
900	100	800	700	35	735
1000	100	900	775	35	810

The final column of the table shows that if we want to graphically depict the level of consumption and planned investment spending, 35 is added to the level of consumption. At a real GDP of 200, consumption is 175 and planned investment spending is 35, for a total of 210. When real GDP increases by 100, consumption rises by 75 (mpc = 0.75), but planned investment spending remains 35. The level of consumption and planned investment spending then rises to 285, of which 250 comes from consumption and 35 comes from planned investment spending.

The graph below shows the addition of planned investment spending (I^P) to the consumption function from above.

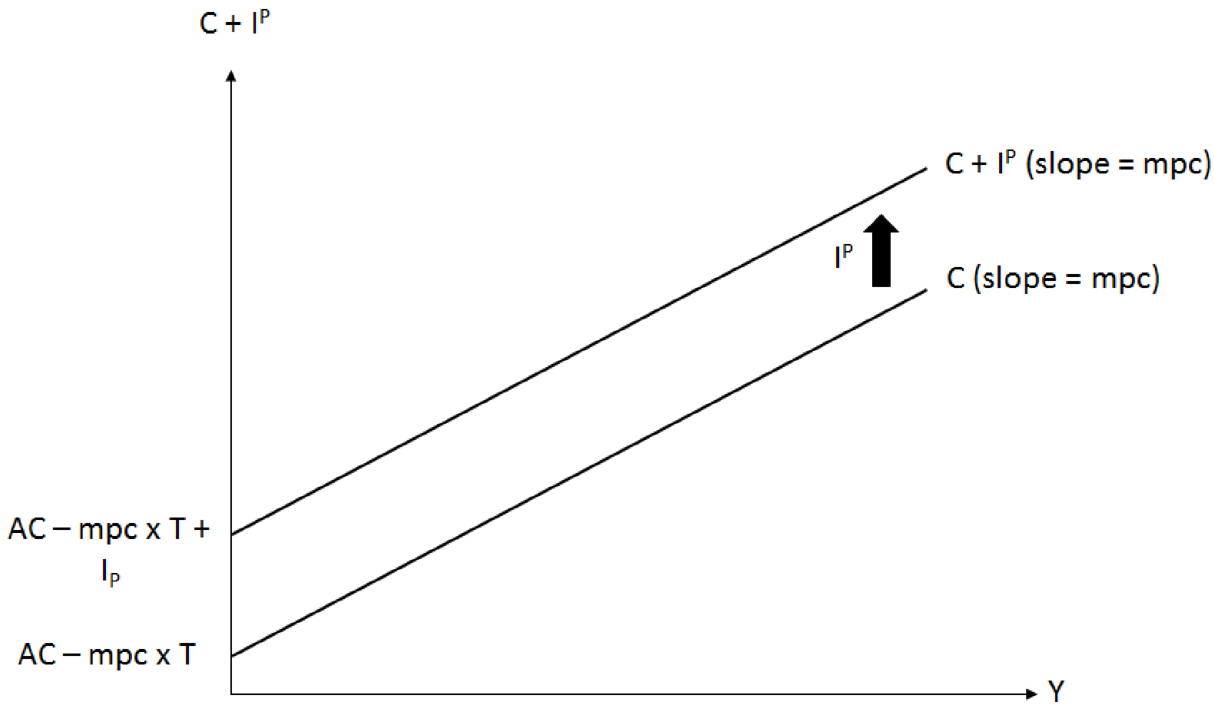

Figure 4.2.01

Notice that adding I^P to the consumption function simply shifts the consumption function up by the amount of I^P. This is what is meant by the saying planned investment is fixed. The increase in I^P is the same whether Y is equal to 0 or 1000. The slope of the function remains the mpc of the consumption function, but now the intercept is determined by AC, T and I^P. There is a lot of information and situations that can be captured by the term, I^P. Any of those situations will change the height of $C + I^P$, but not the slope, simplifying our analysis as we get closer to defining aggregate expenditures.

Government Purchases (G)

In our journey towards defining aggregate expenditures and finding equilibrium, we had to dig deep into what consumption is, which led to the construction of the consumption function. Planned investment spending is similar to investment from chapter 3, but does not include changes in inventory. Assuming that I^P is constant simplified our analysis as it allowed us to just add I^P to the existing consumption function. The remaining groups of spenders in the economy will mirror our GDP analysis from last chapter.

Despite what many people believe, the government does not account for the largest fraction of spending in the economy (that title belongs to consumers). Having said that, the largest single spender in the economy is the Federal Government, with over $3 trillion in spending every year in the US.

As discussed in the previous chapter, the government spends on many goods and services, such as national defense, transportation infrastructure, education, police and fire protection and parks. Remember that government purchases do not include transfer payments such as welfare and social security. These programs do not directly add to production as they primarily transfer income from one group of individuals to another. The costs of these programs, as well as other costs that the government bares will be considered when we discuss fiscal policy next chapter.

If you are wondering whether government purchases (G) is the same thing as government purchases we discussed in the previous chapter, the answer is yes. This will be useful as we move closer towards equilibrium. Another assumption we will make about G is that it is fixed, meaning that it is constant for all levels of Y.

The table below adds government purchases to our previous example. For simplicity, we assume that government purchases are equal to 40.

Real GDP (Y)	Taxes (T)	Disposable Income (Y - T)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	C + IP + G
200	100	100	175	35	40	250
300	100	200	250	35	40	325
400	100	300	325	35	40	400
500	100	400	400	35	40	475
600	100	500	475	35	40	550
700	100	600	550	35	40	625
800	100	700	625	35	40	700
900	100	800	700	35	40	775
1000	100	900	775	35	40	850

The final column of the table reports the total amount of spending from consumers (C), firms (I^P) and the government (G). When the real GDP is 500, for example, the level of consumption (C) is 400, planned investment spending (I^P) is 35 and government purchases (G) is 40. Total spending is then 400 + 35 + 40, which is equal to 475.

Graphically, the additional 40 in G shifts the C + I^P curve up by 40 at all levels of Y.

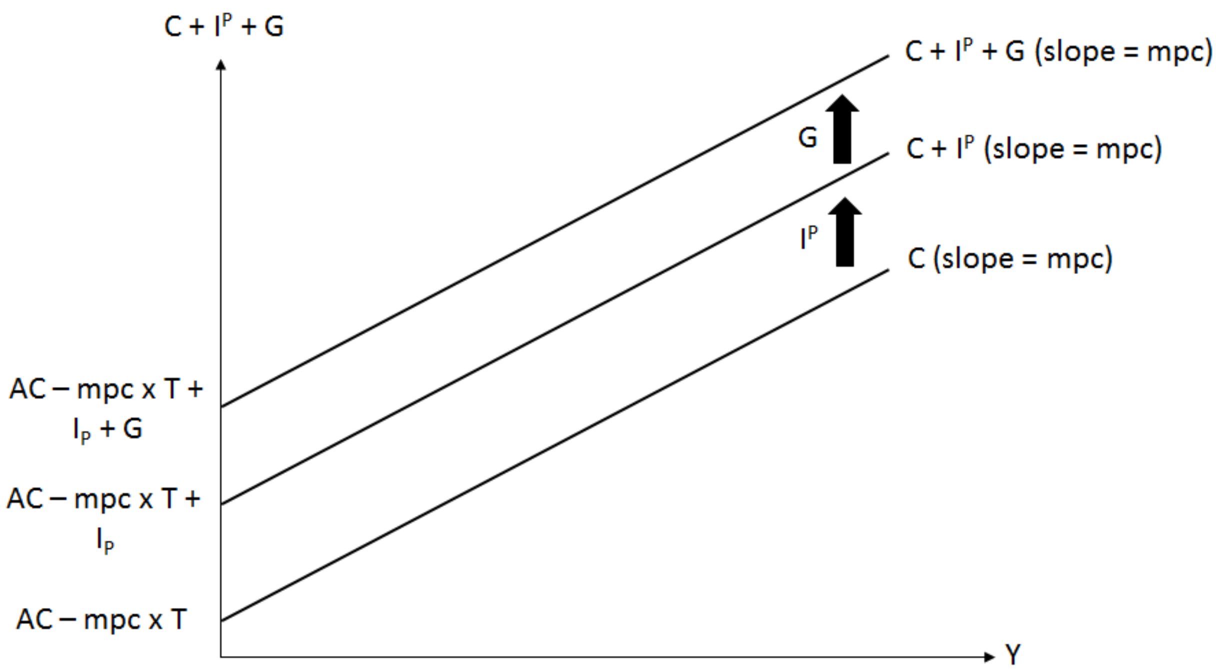

Figure 4.2.02

Adding G to the level of spending by consumers and firms (C + I^P) increases the intercept by the G. The level of G is the difference between the C + I^P curve and the C + I^P + G curve. Notice again that because G impacts the level of total spending in the same way no matter what the value of Y, there is no change in the slope, as it remains equal to the mpc.

Net Exports (NX)

Our final category of spenders mirrors our GDP analysis: foreign investors. We will define net exports (NX) in the same way that we did earlier: exports (X) minus imports (M). As exports (X) increase, the value of net exports (NX) rise. When imports (M) increases, the level of NX decreases.

Unsurprisingly, we will assume that NX is fixed and remains constant as Y changes. This means that we can add it to our existing table in the same way as we did before. In the table, net exports are set at 25, but it is possible for net exports to be negative if imports are greater than exports.

Real GDP (Y)	Taxes (T)	Disposable Income (Y - T)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Net Exports (NX)	AE = C + IP + G + NX
200	100	100	175	35	40	25	275
300	100	200	250	35	40	25	350
400	100	300	325	35	40	25	425
500	100	400	400	35	40	25	500
600	100	500	475	35	40	25	575
700	100	600	550	35	40	25	650
800	100	700	625	35	40	25	725
900	100	800	700	35	40	25	800
1000	100	900	775	35	40	25	875

The final column shows the value of consumption, planned investment spending, government purchases and net exports. The only value that changes with income (Y) is consumption (C). The rest of the groups of spenders have the same value for all values of Y. Specifically, the last column is the value of consumption plus 100, which is sum of I^P + G + NX.

Graphically, adding the net exports to C + I^P + G looks the same as our previous additions. The value of NX Is added to the intercept and moves the existing curve up by NX. The difference between the line, C + I^P + G and the line, C + I^P + G + NX, is NX. The slope of the line remains the mpc that we found when deriving the consumption function.

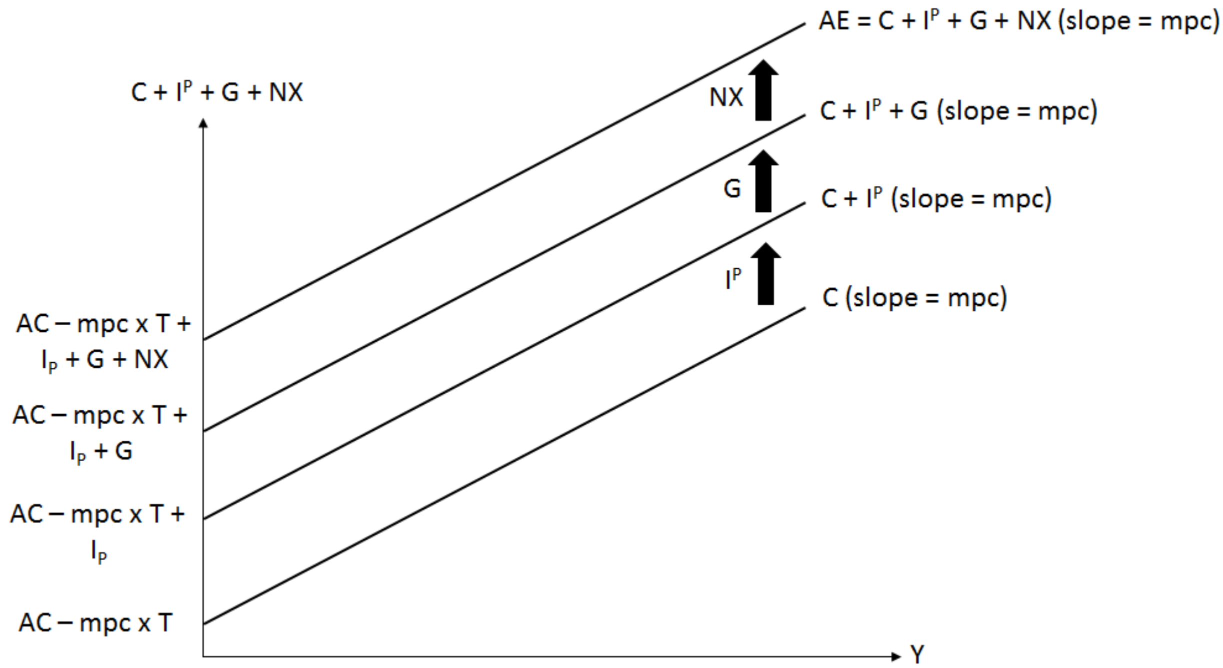

Figure 4.2.03

Aggregate Expenditures (AE) and Equilibrium

Hopefully by the time we added NX to our existing line, you were accurately predicting the next step of shifting the $C + I^P + G$ line up by the value of NX. Although there may be a few spenders that do not fall into the four categories we defined, we will move forward with the assumption that total spending in the economy is equal to the spending by consumers, business, government and foreigners. This means we derived total spending in the economy, also known as aggregate expenditures (AE)!

You probably noticed that AE was placed on the last graph and table. This was done because:
$AE = C + I^P + G + NX$.

The AE-curve is the level of consumption, which changes with income, plus the fixed values of I^P, G and NX. Instead of drawing four lines every time we depict AE, we will instead draw one single curve, but we need to recognize all the information held in the AE curve. Specifically, any change in I^P, G, NX, AC or T will lead to a shift in AE.

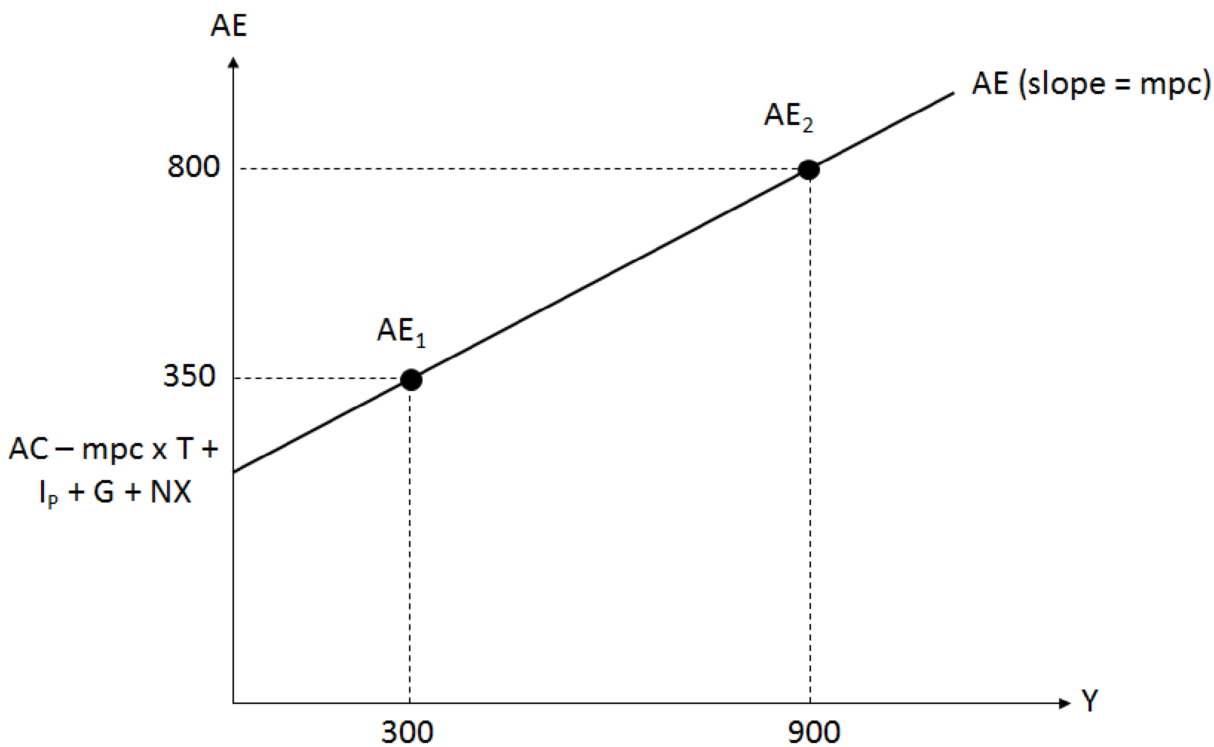

Figure 4.2.04

Following along with the most recent table above, when GDP/production/income (Y) is 300, the level of spending, AE, will be 350 (Point AE_1). As the level of production increases, AE also increases and the level of spending is 800 when production is 900 (point AE_2). Each specific point on the table could be plotted, but because the AE curve will be a straight line that has a slope of mpc, drawing a line through any two points captures all the possible combinations of Y and AE.

4.13: Short Run Equilibrium

What is the equilibrium level of output (Y) in this economy?

Real GDP (Y)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Exports (NX)	Aggregate Expenditures (AE) C + IP + G + NX
200	175	35	40	25	275
300	250	35	40	25	350
400	325	35	40	25	425
500	400	35	40	25	500
600	475	35	40	25	575
700	550	35	40	25	650
800	625	35	40	25	725
900	700	35	40	25	800
1000	775	35	40	25	875

A

300

B

400

C

500

D

600

Now that we have AE, we can determine the short run equilibrium level of Y. This was defined earlier in the chapter, but let's bring it up again now that we are so close to finding equilibrium. The short run equilibrium level of output occurs where output (Y) is equal to spending (AE). When we find the point where Y = AE, we are in equilibrium.

Many of you may have looked at the question above and noticed that when Y is equal to 500, C is 400 and I^P + G + NX is equal to 100, making AE equal to 500. At an output level of 500, output is exactly equal to spending. This is our short run equilibrium.

But why exactly is the point where Y = AE equilibrium? Let's follow our analysis from supply and demand and look at what happens when are not in equilibrium.

Begin at a level of Y equal to 300 (Point AE_1). At this point, the economy would be in an equilibrium if spending was equal to 300. Instead, the level of spending is 350.

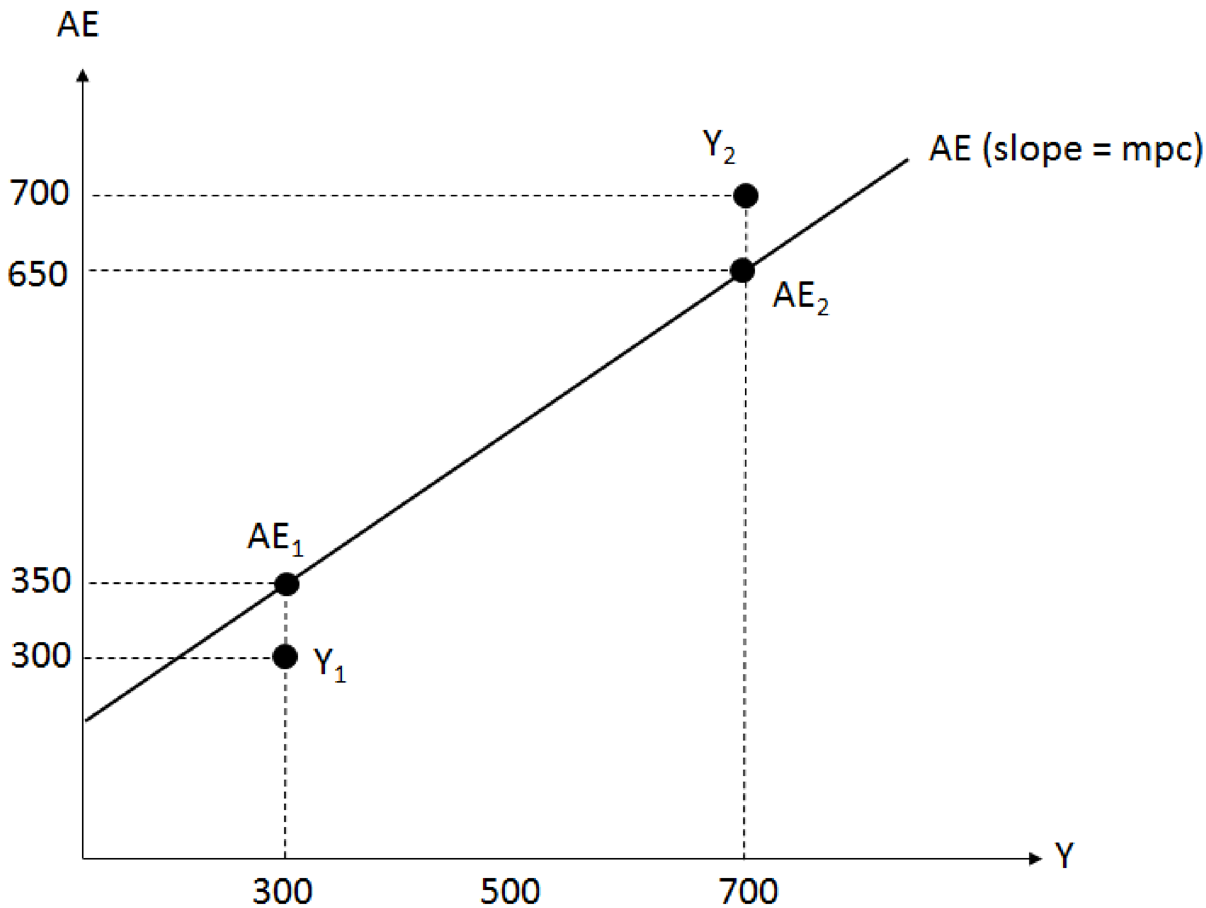

Figure 4.2.05

More Spending than Producing

When the level of output is 300 and spending is 350, where do firms get the additional 50 units to sell?

Responses

Reply

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-
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If there are 50 units that are sold, but not produced this year, they have to come from somewhere. Had they magically appeared, we would have considered them part of production. The additional 50 units that are sold come from existing inventory. After selling 350 units, but only producing 300 units, firms will have decreased their inventory by 50 units. Firms recognize that it is not ideal to rely on inventory to match demand, so they have an incentive to increase production the following year. Because the firms have an incentive to change their behavior, the output level of Y equal to 300 cannot be an equilibrium.

A similar story can be told when output is 700 and AE is 650 at point AE_2. This is a more natural way to think about changes in inventory. After the year, the firm has 50 units of production laying around. This is added to the investment portion of GDP (I) as an increase in inventory, but it is not part of planned investment spending. The following year, the firm remembers that they produced too many units and it does not make sense to continue adding to inventory year-after-year. Consequently, the firm reduces output (Y) after they see inventory increasing. Because the firms have an incentive to deviate from their level of production, the output level of Y equal to 700 cannot be an equilibrium.

The exact amount of the change in inventory can be quickly calculated using the values of AE and Y. Specifically,

Change in Inventory = Y - AE = Production - Spending.

When production is greater than spending, then change in inventory is positive and inventory for firms grow. In the case where spending is greater than production, the change in inventory is negative and inventory is removed.

What happens at equilibrium? We discussed above that the table shows that when production (Y) is 500, spending (AE) is 500.

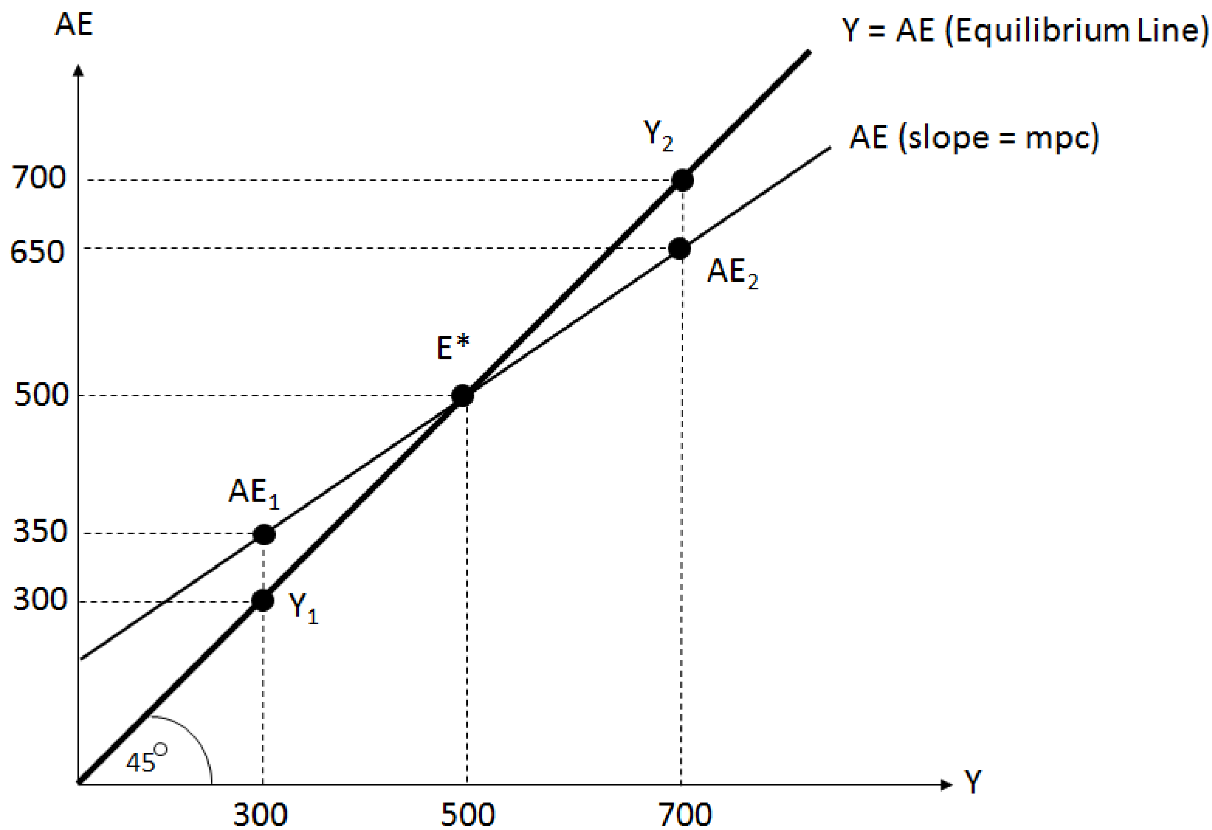

Figure 4.2.06

At E*, firms produce 500 units of output and spenders purchase 500 units of goods and services. There is no change in inventory because production exactly matches spending. We just defined the change in inventory as Y - AE. If **Y - AE =0**, it must be that **Y = AE**, which is where we begin our discussion about equilibrium early in this chapter!

An alternative way to motivate equilibrium would have been to ask, if a firm expects there to be 500 units of goods sold in a year, how many units should be produced? The answer would have again been 500, because firms want to produce (Y) as much as they will sell (AE).

A helpful feature that comes from our graph above has to do with the levels of potential equilibrium, Y_1 and Y_2. The level of aggregate expenditures in the table could have worked out so that equilibrium ended up being at 300 or 700. Any level of Y is a possible equilibrium, so long as it satisfies our equilibrium condition that Y = AE. The points Y_1, Y_2 and E* are all possible equilibrium, as are the point where Y is $1 and AE is $1 or Y is $1000 and AE is $1000.

Drawing a line through all of these points is equivalent to graphing out an equilibrium line where all values of Y = AE are mapped out. Some resources call the Y = AE line a 45-degree line, since a 45-degree angle is made at the origin. This is a feature of the line, but I have found that calling Y = AE the equilibrium line is more informative and applicable to solving for equilibrium.

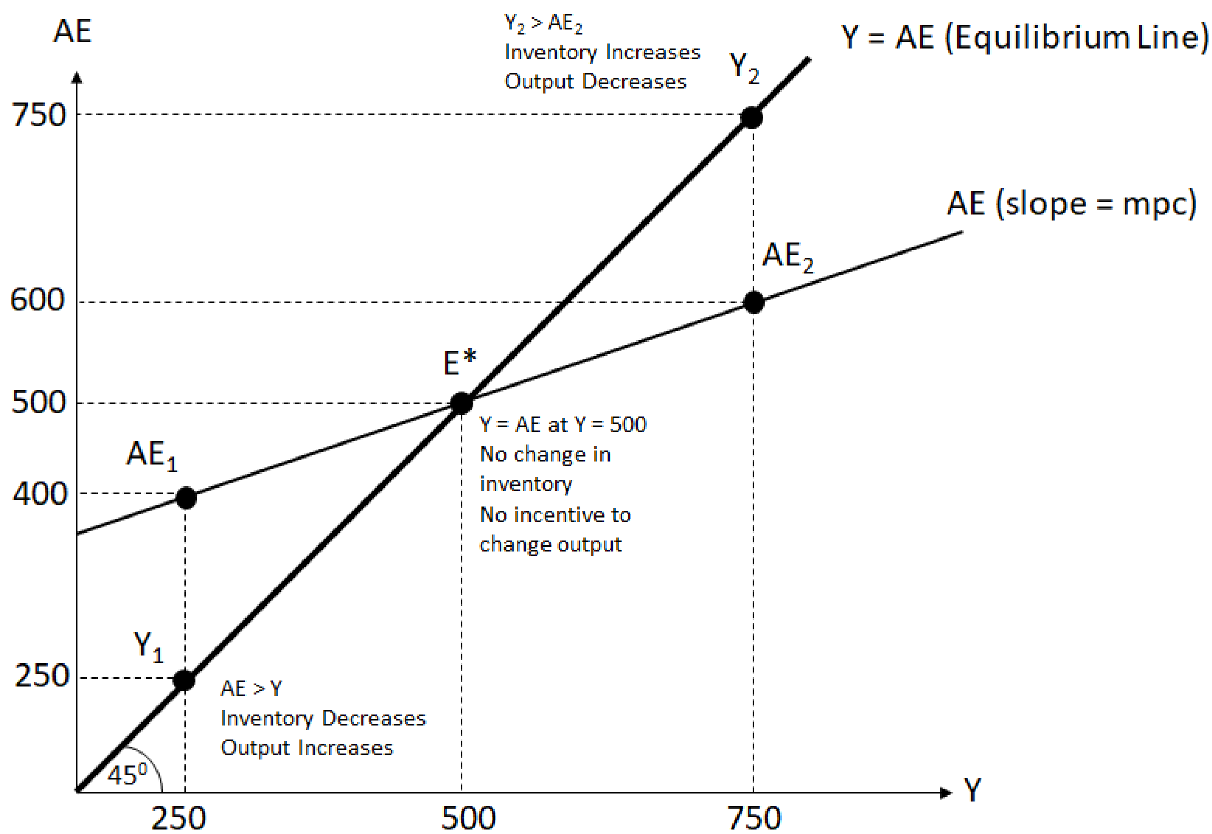

Figure 4.2.07

After plotting the equilibrium line, we just need to find when our particular AE curve intersects with the equilibrium line. At the intersection, the level of output (Y) will be equal to spending (AE) and also a point along the AE curve.

As we move forward and draw more short run equilibrium graphs, it will become less necessary to look at all the possible outcomes in an economy and focus on equilibrium. The graph below plots a generic AE curve and the equilibrium line, Y = AE.

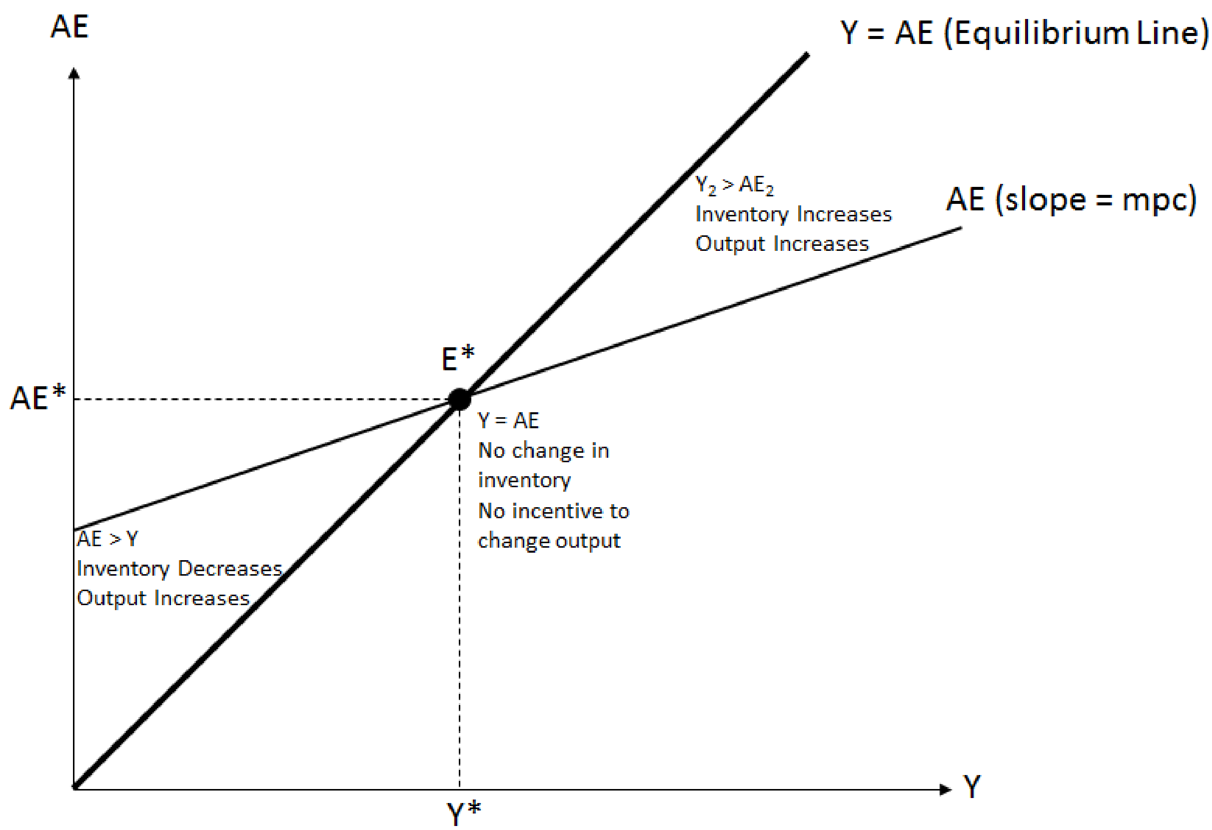

Figure 4.2.08

In this simplified graph, the equilibrium is quickly identified at point E* and Y* and AE* is where Y = AE. When output (Y) is too low, AE > Y and output adjusts towards E*. Output levels that are too high, Y > Y*, cause an increase in inventory and output will move towards E*. At E*, there is no change in inventory and no incentive to deviate. We are in a short run equilibrium at E*.

After defining equilibrium as Y = AE, and then after learning how to calculate AE, there may have been points where you wondered how GDP (Y) is ever different than AE. In our calculation of GDP last chapter:

GDP = Y = C + I + G + NX

Aggregate expenditures AE are:

$AE = C + I^P + G + NX$

Y = AE, is equivalent to saying:

$C + I + G + NX = C + I^P + G + NX$

All the components of GDP (Y) and AE are always the same except investment (I) and planned investment spending (I^P). When Y and AE are equal, it must be that investment (I) is equal to planned investment spending (I^P). If we think back to the definitions of I and I^P, this is just saying that the change in inventory must be equal to 0. In other words, production (Y) must equal spending (AE) and equilibrium is where Y = AE.

4.14: Short Run Equilibrium

Consider the following table. What is the marginal propensity to consume?

Real GDP (Y)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Net Exports (NX)	Aggregate Expenditures (AE)
1000			400		
2000			400		
3000					
4000					
5000	4000			-100	
6000	4800				
7000	5600				
8000	6400	500			

A

0.50

B

0.75

C

0.80

D

0.90

4.15: Short Run Equilibrium

Consider the following table. What is the value of spending on the economy that does not depend on the level of Y?

Real GDP (Y)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Net Exports (NX)	Aggregate Expenditures (AE)
1000			400		
2000			400		
3000					
4000					
5000	4000			-100	
6000	4800				
7000	5600				
8000	6400	500			

A

-100

B

400

C

500

D

800

4.16: Short Run Equilibrium

Real GDP (Y)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Net Exports (NX)	Aggregate Expenditures (AE)
1000			400		
2000			400		
3000					
4000					
5000	4000			-100	
6000	4800				
7000	5600				
8000	6400	500			

Consider the following table. What is the equilibrium level of output?

A

4000

B

5000

C

6000

D

7000

4.17: Short Run Equilibrium

Consider the following table. You learn that the change in inventory is -400. What is the level of output when the change in inventory is -400?

Real GDP (Y)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Net Exports (NX)	Aggregate Expenditures (AE)	Change in Inventory (Y - AE)
1000			400			
2000			400			
3000						
4000						
5000	4000			-100		
6000	4800					
7000	5600					
8000	6400	500				

A

1000

B

2000

C

3000

D

4000

Hopefully the first few review questions came naturally. The things to remember to answer the questions are first, the marginal propensity to consume (mpc) is the change in consumption divided by the change in output. When output increases from 5000 to 6000, consumption increases by 800, from 4000 to 4800. The mpc is then 0.80 and every decrease of 1000 in Y leads to a reduction of 800 in consumption.

To figure out AE, remember that I^P, G and NX are fixed. This means that if you are given one value in the table, you are given all the values in the table. I^P + G + NX adds up to 800. Add 800 to each of the levels of consumption to get AE and you will find that equilibrium is at Y = 4000. At this point, consumption is 3200 and the fixed spending by firms, government and foreigners is 800 and AE is 800.

The last question is a bit tricky. The change in inventory can be calculated at each point in the table by subtracting AE from Y. When Y is 5000, for example, AE is 4800. The change in inventory is the discrepancy between output and spending. There is 200 more units produced than sold, so inventory rises by 200, which is Y - AE. Fill out the rest of the final column in the final question and you will see that the change in inventory is -400 when output is 2000.

The Aggregate Expenditure Model in the Real World

One of the goals in this course is find policies that move the economy towards the full-employment level of output, Y-bar. Assume that the economy we are interested in is currently at a full-employment level of output at Y-bar equal to 10,000.

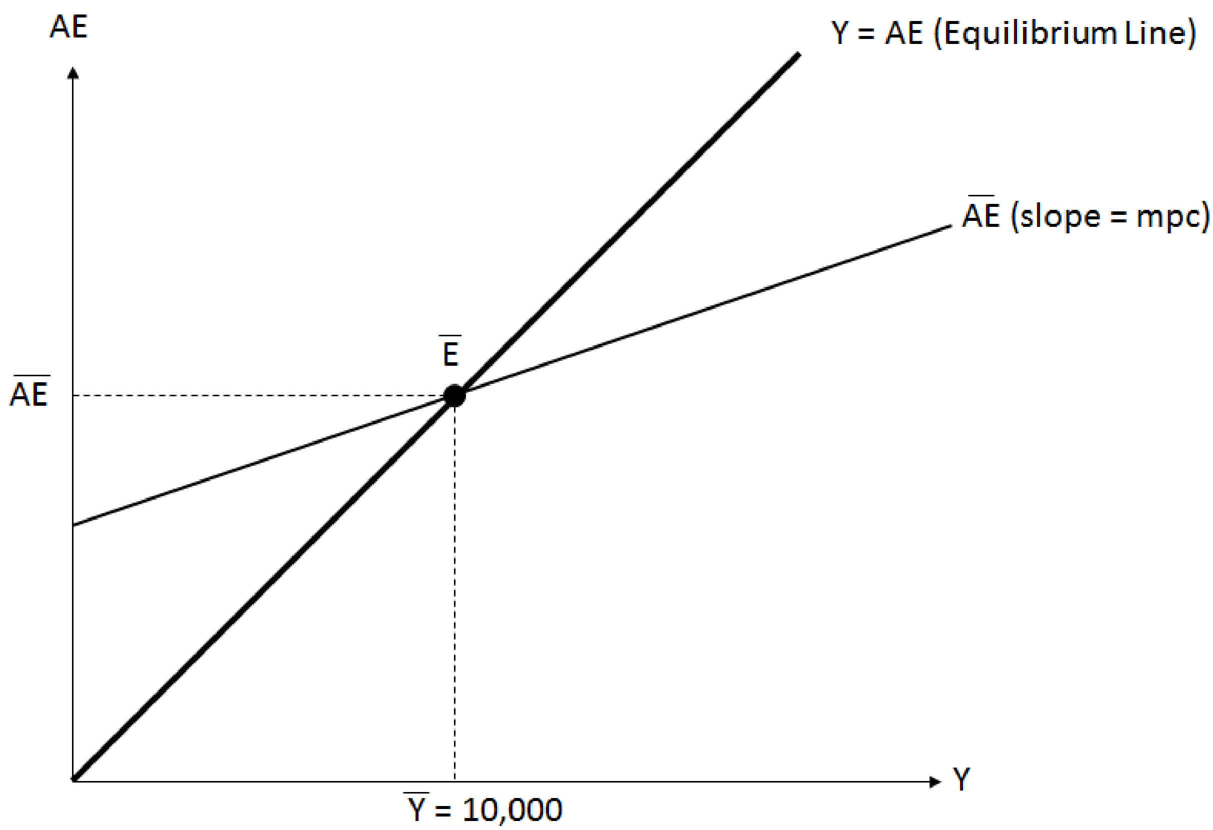

Figure 4.2.09

Graphically, the full employment equilibrium is shown above. The equilibrium line (Y = AE) intersects with the AE line at a value of 10,000. This happens to be the full-employment level of output. At 10,000 in output, there is no cyclical unemployment. If there were to be no changes to any component of AE into the future, there would be no reason to worry about policy changes.

It turns out that the components of AE are always changing. Return to the situation where there is a housing market crash. This has two implications for the AE curve. First, there is a reduction in wealth, as we saw earlier, which decreases autonomous consumption (AC). Second, lower home prices reduces the building of new homes, since they are less profitable than before. Fewer homes being built will be reflected by a reduction in planned investment spending (I^P).

How can we show a decrease in AC and I^P in our graph above? In the same way the consumption function was shifted earlier in this chapter. Lower levels of AC and I^P cause a decrease in the intercept of the AE curve. The entire AE curve moves down to the new AE_2. The slope of AE curve remains equal to the original mpc, and the original and new AE curves are parallel.

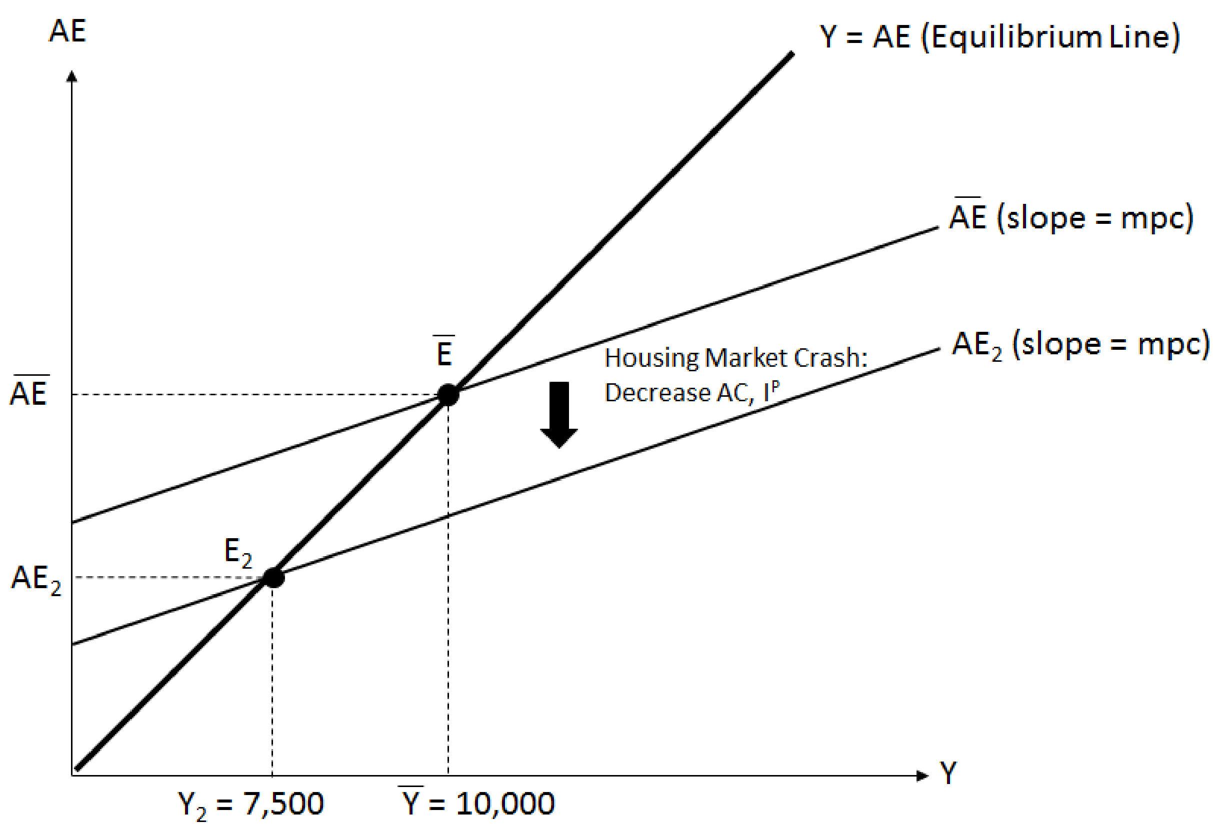

Figure 4.2.10

The new equilibrium is now where AE_2 intersects the equilibrium line, which is noted as E_2 and occurs at a value of $Y_2 = 7{,}500$. Now the economy is in an equilibrium, but it is not a full-employment equilibrium since $Y_2 <$ Y-bar. The difference between 10,000 (Y-bar) and 7,500 (Y_2) represents cyclical unemployment in the economy.

Is our depiction of the economy during a housing crash consistent with actual data? The figure below shows how housing prices (solid line) and planned investment spending (dashed line) changed between 2004 and 2010.

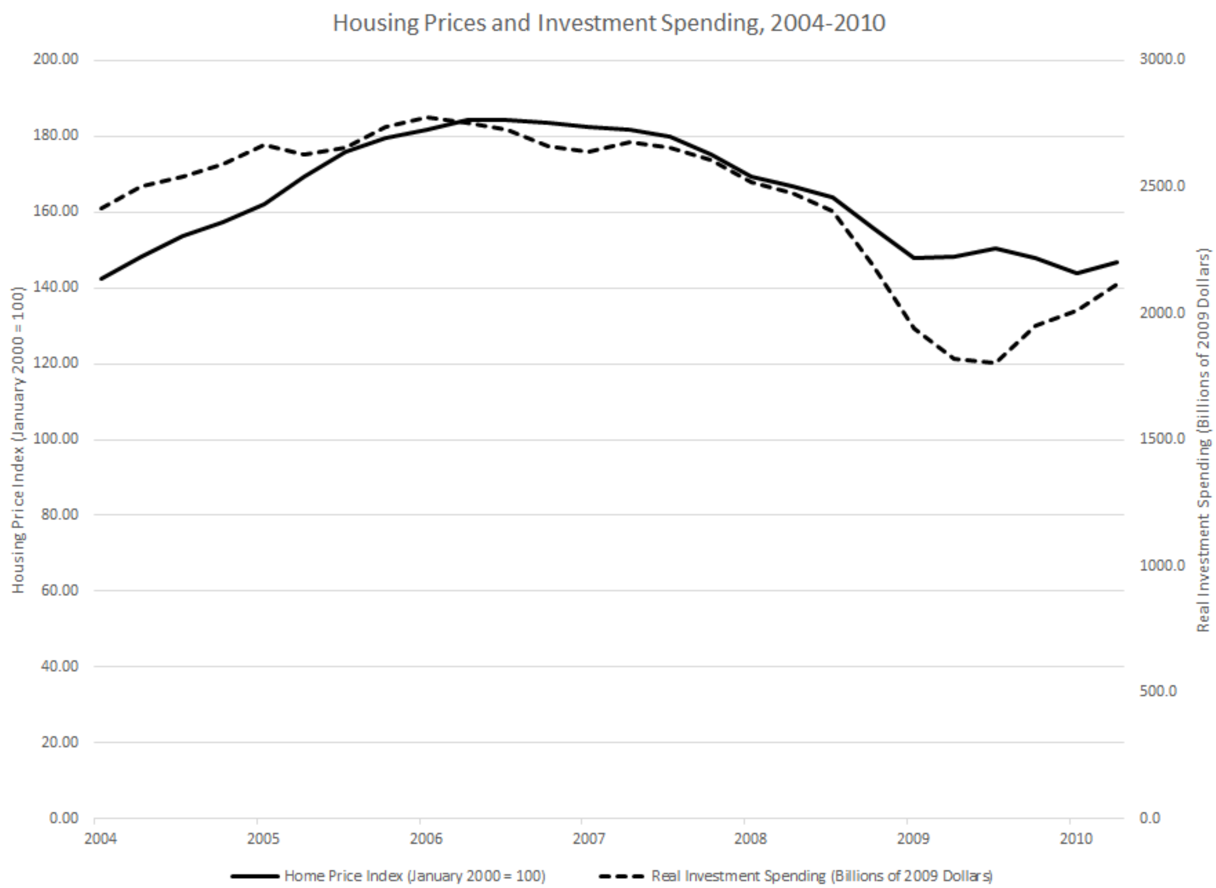

Figure 4.2.11

The two curves move together, with the exception of the start of 2009, where investment spending fell more than the housing prices. This is evidence that our model capturing a decrease in I^P when there is a housing market crash is correct.

Taking this a step further, the reduction in AE driven by the housing market should lead to a decrease in the overall level of output, Y. The graph below shows the original AE curve yielding a full-employment level of output around 2007. By 2009, investment spending and autonomous consumption had reduced AE to a significantly lower level. This is consistent with the reduction in real GDP between 2007 and 2009 seen in the right panel below.

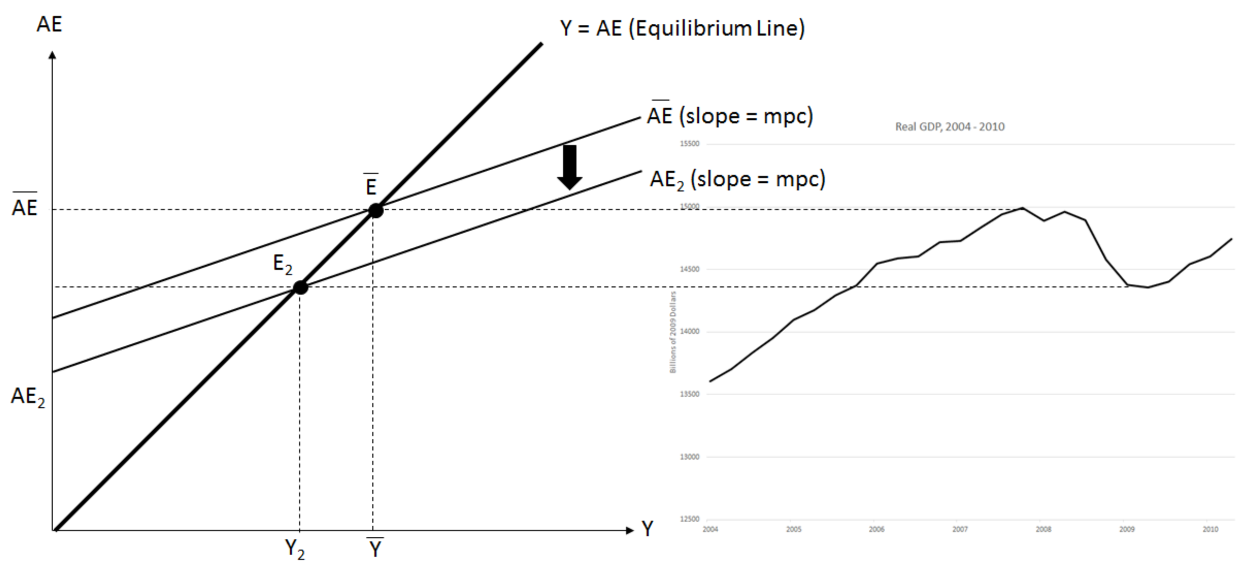

Figure 4.2.12

Our model makes a number of assumptions, but does a reasonable job accurately depicting shocks to the macroeconomy. When we see the value of output, we can assume that the economy is in equilibrium and Y is equal to AE, otherwise there would be adjustments that alter the level of output, move us along AE and return us to equilibrium.

Chapter 4.3: Expenditure and Tax Multipliers

In the previous section, we discussed how to find where aggregate expenditures is equal to output, which we defined as equilibrium. As we derived the aggregate expenditure line we learned that it captures a lot of important components of the economy. Shocks to the economy, such as the housing market crash in the late-2000s, is depicted by a decrease in autonomous consumption and planned investment spending, which decreases the aggregate expenditure line and reduces equilibrium output.

We achieved our initial goal of finding where equilibrium is, but we need to look at the broader picture and turn our attention to policy. This section will discuss how changes to different components of the aggregate expenditure curve influence the overall level of output. After understanding the way that spending moves through the economy, we will be able to weigh in on the effectiveness of different policy initiatives.

The Multiplier Effect

Expenditure Multiplier

In our example in the previous section, we defined full-employment equilibrium at a level of output equal to 10,000 and the housing market crash decreased our equilibrium level of output to 7,500.

4.18: Multiplier Effect

The economy current level of production (Y) is 7,500 and the mpc is 0.80. The full-employment level of output (Y-bar) is 10,000. How much would a fixed component of AE, such as planned investment spending, need to increase in order for the level of production to increase by 2,500 and return the economy to the full-employment level of output?

A

Less than 2,500

B

Exactly 2,500

C

More than 2,500

To illustrate the answer to this question, we need some more information. First, lets assume that the marginal propensity to consume (mpc) in this economy is 0.8. That means that for every dollar earned by someone, 80 cents is spent on consumption and 20 cents is saved. This means that the marginal propensity to save (mps) is 0.2 (mpc + mps = 1).

Second, imagine that a rich individual who owns a firm is observing the economy and wants to help bring it back to full-employment. The individual decides to go out and purchase \$500 worth of computers for his or her firm. The \$500 purchase directly increases GDP (Y) since a final good is being sold. Aggregate expenditures also increase since planned investment spending (I^P) increases.

The sellers of the computers now have \$500 more in income. What do they do with that income? According to the mpc, they spend 80% and save 20%. To continue our example, assume that the computer sellers go to a fancy meal and spend 80% of the \$500 at a restaurant, which is 0.80 x \$500 = \$400.

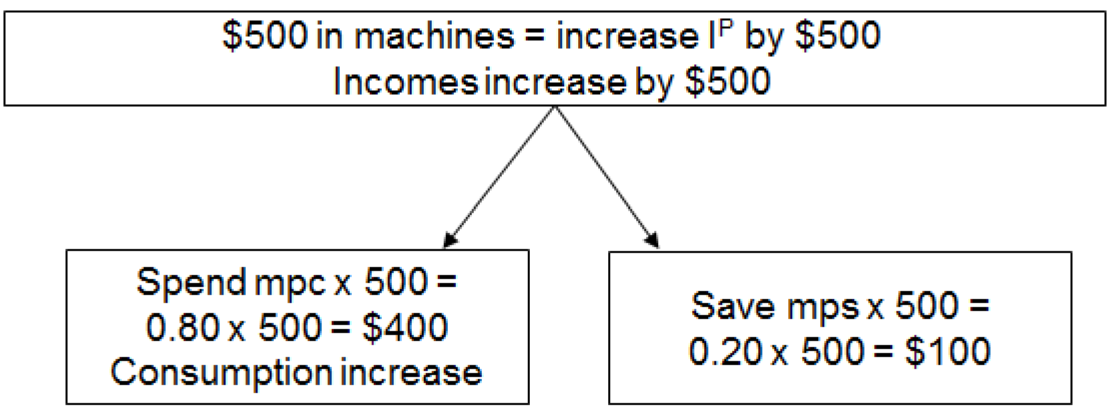

Figure 4.3.01

Now there is a \$400 increase in consumption to go along with the original \$500 increase in I^P. The owners of the restaurant receive a \$400 increase in income as a result of the meal purchase by the computer sellers. Now the total increase in output is \$900 and the total increase in spending is \$900.

But the pattern does not stop there. The restaurant owners, happy with their $400 boost in income, decide to celebrate at a Bed & Breakfast on the coast over the weekend. They spend a total of 80% of the $400 and save the remaining 20%. This means that 0.80 x $400 = $320 is spent on the mini-vacation and 0.20 x $400 = $80 is put into savings.

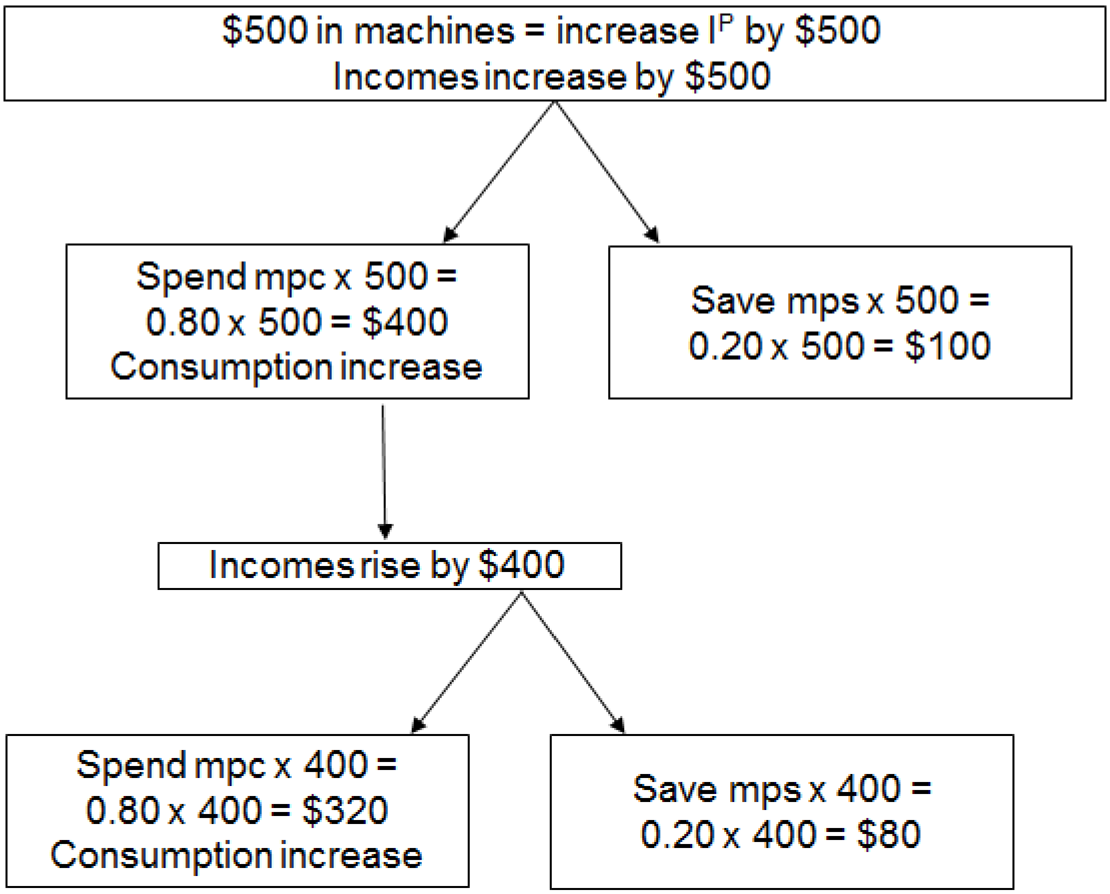

Figure 4.3.02

After the mini-vacation, the B&B owners have an increase in income of $320. The total increase in income and spending at this point is $500 + $400 + $320 = $1220. And we are not done! Where is the roof on this thing?

The B&B owners will go out and spend 80% of their income on goods and services and those beneficiaries will spend 80% of that...all the way until we get to a penny stamp and there is nowhere left to go.

If we repeated this example for 50 rounds, we find ourselves approaching a total increase in spending of $2500. The table below provides a few more details about this process.

Round	Additional I^P	Additional Consumption	Total Additional Spending = Additional GDP
1	500	0	500
2	0	mpc x 500 = 400	500 + 400 = 900
3	0	mpc x 400 = 320	500 + 400 + 320 = 1,220
4	0	mpc x 320 = 256	500 + 400 + 320 + 256 = 1,476
5	0	mpc x 256 = 204.8	500 + 400 + 320 + 256 + 204.8= 1680.8
…			
10	0	mpc x 83.89 = 67.11	2231.56
…			
25	0	mpc x 2.95 = 2.36	2490.56
…			
50	0	mpc x 0.011 = 0.009	2500

In round 1, the $500 increase in I^P leads to $500 increase in GDP (Y). In round 2, mpc x 500 is spent on consumption. In round 3, mpc x 400 is spent on consumption, which is equal to mpc x (mpc x 500) = mpc^2 x 500. By the 50th round, the amount of additional spending has decreased to mpc^{50} x 500 = 0.009, not even a penny.

The original $500 purchase was all that was needed to increase the economy by $2500. This means that the answer to the question earlier in this section was that less than $2500 had to be spent in order to increase the level of output by $2500. Each dollar spent in the first round is multiplied through the economy 5 times.

This example can be visualized, but it is hard to imagine taking this concept to a different setting. Fortunately, there is a way to apply our multiplier to an alternative setting. First, lets see the multiplier effect visually.

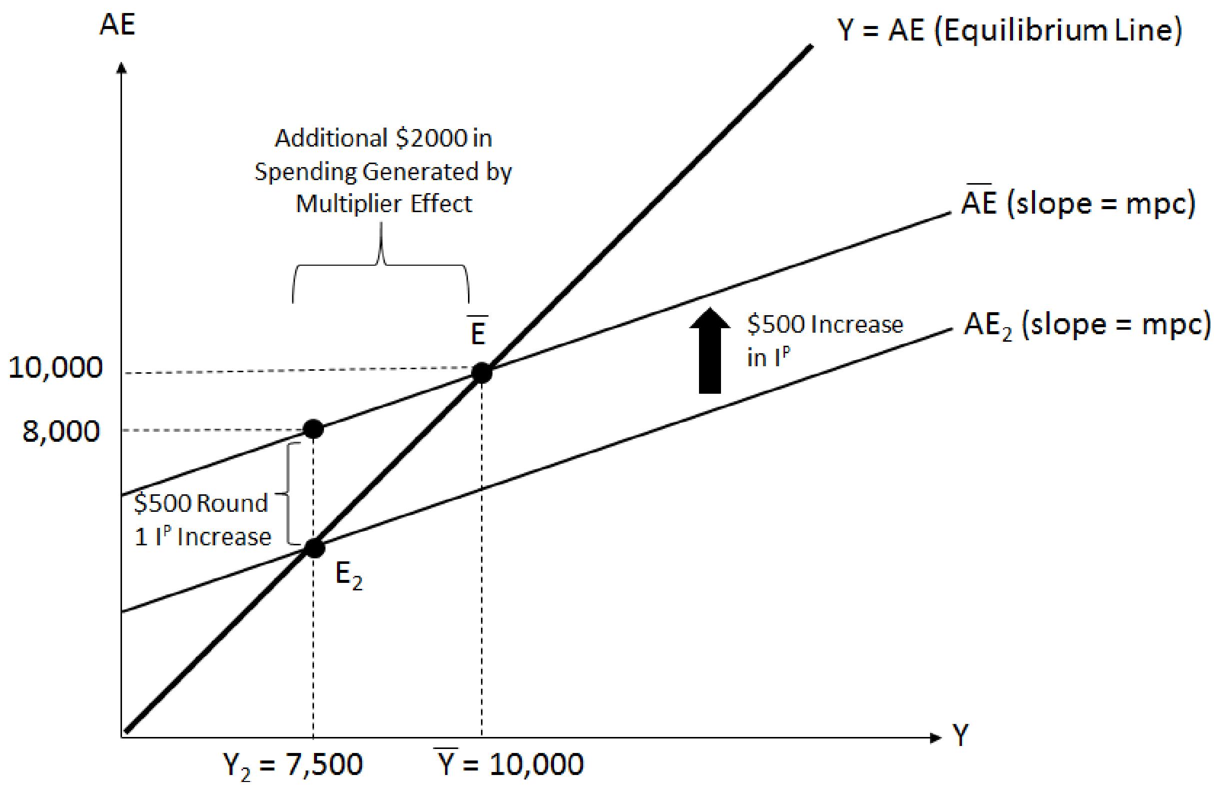

Figure 4.3.04

If we are at an output of 7,500, an increase of $500 in I^P increases the entire AE curve so that now there is $8,000 in spending. Now the economy is not in equilibrium since spending is 8,000 but output is 7,500. The movement towards our equilibrium of 10,000 is associated with an additional increase of $2,000. Overall, the $500 shift in I^P led to an increase of $2,500 in our equilibrium level of output.

The change in equilibrium output can be written as:

Change in Equilibrium Output (Y) = Expenditure Multiplier x Initial Change in I^P

This means we need to figure out what the value of the expenditure multiplier is. In our example above, it was 5. This means that each initial change in I^P multiplied through the economy 5 times. The value of the multiplier is derived from the fact that each period we add a fraction of spending the previous round to spending. In the example above, in every round, spending in the current round was 80% of the previous round.

A geometric series can be created that allows to represent the total change in output in the economy as:

$$\textit{Change in Total Output } (\Delta Y) = \sum_{i=0}^{\infty} (mpc)^i \times \textit{Change in } I^P = \frac{1}{1-mpc} \times \Delta I^P$$

Do not get intimidated by the math here as it will fall away soon. From the equation above, each dollar spent in the first round is multiplied by 1/(1-mpc) by the time it runs out of stream. This is what we define as our **Expenditure Multiplier:**

$$\textit{Expenditure Multiplier} = \frac{1}{1-mpc}$$

In our example, the mpc was equal to 0.8 and 1/(1-0.8) = 1/0.2 = 5. The change in I^P, which can be written as ΔI^P, is equal to 500 and the total change in Y is $2,500.

How would the outcome have been different if a random household suddenly decided to increase spending by $500? Or if the government increased G by $500? What about an increase in NX of $500? All of these situation would give us the same outcome as a $500 increase in I^P. We can then define the **Expenditure Multiplier Equation** as:

$$\Delta Y = \frac{1}{1-mpc} \times (\Delta I^P \textit{ or } \Delta G \textit{ or } \Delta NX \textit{ or } \Delta AC)$$

Notice that we denote the term "change in" with the Greek letter, delta, Δ. We would read the equation above as, the change in Y is equal to (1/1-mpc) times the change in G (or any other component in the equation).

4.19: Multiplier Equation

The economy you are analyzing has an mpc of 0.9. What is the value of the expenditure multiplier in this economy?

A

0.1

B

0.9

C

9

D

10

4.20: Multiplier Equation

The economy you are analyzing has an mpc of 0.9. There is a $1000 decrease in autonomous consumption (AC). What is the total change in the equilibrium level of output?

A

-10000

B

-9000

C

9000

D

10000

Armed with the multiplier equation, these questions can be answered quickly. When the mpc is 0.9, each dollar is multiplied through the economy 1/1-mpc times. Plugging in 0.9 yields, 1/(1-0.9) = 1/0.1 = 10. For every dollar change in the first round, the equilibrium changes by 10. That means that when AC decreases by $1000, the total change in output is 10 x -1000 = -10000.

We can apply the multiplier to our analysis using the table of spending categories and obtain an alternative view of what is happening.

4.22: Multiplier Equation

Consider the following economy is initially in equilibrium at a level of output of 500. The government decides to increase purchases by $25. What is the new level of equilibrium in the economy?

Real GDP (Y)	Taxes (T)	Disposable Income (Y - T)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Net Exports (NX)	AE = C + IP + G + NX
200	100	100	175	35	40	25	275
300	100	200	250	35	40	25	350
400	100	300	325	35	40	25	425
500	100	400	400	35	40	25	500
600	100	500	475	35	40	25	575
700	100	600	550	35	40	25	650
800	100	700	625	35	40	25	725
900	100	800	700	35	40	25	800
1000	100	900	775	35	40	25	875

A

525

B

600

C

750

D

800

Here, a table from earlier in the chapter returns. You may remember this as the question where the equilibrium level of output is $500. When the government increases G by $25, the level of G rises from 40 to 65. Consequently, each AE term rises by 25 (275 becomes 300, 350 becomes 375, etc.). Notice that when output is 600, consumption rises from 575 to 600, giving us our new equilibrium level of output.

The $25 increase by the government led to a $100 increase in equilibrium output (Y). Is this consistent with our multiplier equation? Definitely. The mpc in this economy is 0.75. Plugging this into our multiplier gives us 1/(1-0.75) = 1/0.25 = 4. Each dollar spent in the first round is multiplied through the economy four times, so the total change in output is 4 times the $25 increase in G, which is equal to $100. Our starting equilibrium was $500, it increases by $100 and becomes $600.

Tax Multiplier

The expenditure multiplier is relevant to changes in AC, I^P, G and NX. It does not apply to a change in taxes (T). This is because in the first round of a change in taxes, there is not a change in spending or output, the government simply takes more money from households or allows households to take home more money.

Once a worker receives a tax break, we will assume that they respond in the same way as before: spend mpc of the tax break and save mps of the tax break. From there, whoever benefits from the first round of spending will experience an increase in income and spend mpc and save mps next round. This will go on until we reach that penny stamp again.

Every round of spending and income resulting from a tax change is the same as a change in AC, I^P, G or NX with one notable exception: round 1. Return to the setting from above where mpc is 0.8 and instead of there being an increase in I^P of $500, there is a decrease in T of $500.

In round 1, the worker takes home $500 more, but there is no increase in production or purchase of a good or service in the first round. In second round, the worker takes 80% (mpc) of the $500 and goes out to a fancy restaurant. This means that $400 is spent on the meal and the restaurant owners increase their income by $400. After round 2, the total increase in income and spending is $400. (In our previous example, we had increased output by $900 after two rounds.)

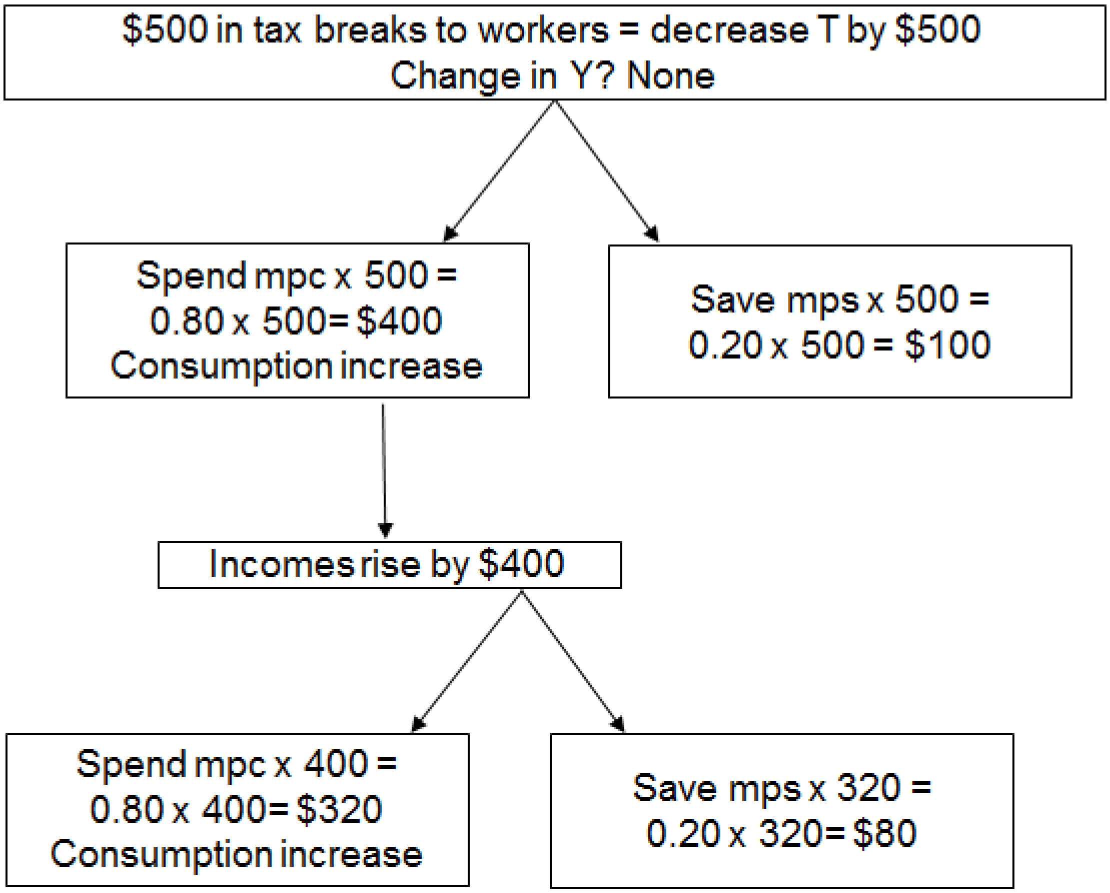

Figure 4.3.05

This should sound familiar to earlier in the section. Those restaurant owners are going on a mini-vacation and plan to spend $320. Now the total increase in spending after three rounds is $720 since the first $500 is still missing.

After multiple rounds of spending, we will eventually converge on a total increase in output from the tax break.

4.23: Tax Multiplier

When we increased planned investment spending by $500 in an economy where mpc equaled 0.80, the total increase in Y was $2500. When taxes are reduced by $500, we are missing the first round of spending compared to the planned investment spending increase. What is the total change in output (Y) when there is a $500 tax break and mpc is 0.8?

A

500

B
2000
C
2500
D
3000

Every round from two to infinity is the same between a tax change and an expenditure change. Because the tax change is missing the first round, we can subtract $500 from the total change in Y from our expenditure multiplier to learn how the tax change will impact Y. This means that the $500 decrease in taxes leads to a $2,000 increase in our equilibrium level of output, Y. The tax multiplier in this economy is -4, since a tax decrease increases equilibrium Y by 2000.

When trying to figure out what our total change in output is from a tax change, we can subtract the initial tax change from the overall change associated with a change in a non-tax expenditure. Fortunately, there is an easier way. The expenditure multiplier was equal to 1/(1-mpc). The tax multiplier is a fraction of the expenditure multiplier. Specifically, the tax multiplier is:

$$Tax\ Multiplier\ =\ \frac{-mpc}{1-mpc}$$

When the mpc is 0.8, -0.8/(1-0.8) = -0.8/0.2 = -4. Extending this to capture the total change in Y can be done in a similar fashion as above. The **Tax Multiplier Equation**:

$$\Delta Y = \frac{-mpc}{1-mpc}\Delta T$$

Our tax multiplier of -4 is multiplied by the change in taxes, which was -500 in the example above. The total change in Y is then -4 x -500 = 2000.

Notice the similarities and differences between the expenditure and tax multiplier equations. Both of the multipliers have 1-mpc in the denominator. The tax multiplier has -mpc in the numerator and applies only to changes in taxes. The expenditure multiplier has 1 in the numerator and applies to changes in AC, I^P, G and NX. The negative sign in the numerator of the tax multiplier reflects the fact that tax decreases increase spending and tax increases decrease spending.

4.24: Tax Multiplier

The economy you are analyzing has an mpc of 0.9. What is the value of the tax multiplier in this economy?

A

-0.1

B

0.9

C

-9

D

9

4.25: Tax Multiplier

The economy you are analyzing has an mpc of 0.9. There is a $1000 increase in taxes (T). What is the total change in the equilibrium level of output?

A

-10000

B

-9000

C

9000

D

10000

Using the tax multiplier equation, the tax multiplier when mpc is 0.9 is -0.9/(1-0.9) = -0.9/0.1 = -9. Every dollar increase in taxes will decrease output by $9. Extending the tax multiplier to the next question, we need to note that the change in taxes is $1000 and the tax multiplier is -9. The total change in output is then -9 x 1000 = -9000. Watch your signs!

Similar to the expenditure multiplier, let's take a look at how the tax multiplier works in the table.

4.26: Tax Multiplier

Consider the following economy is initially in equilibrium at a level of output of 500. The government decides to increase taxes by $66.67. What is the new level of equilibrium in the economy?

Real GDP (Y)	Taxes (T)	Disposable Income (Y - T)	Consumption (C)	Planned Investment Spending (IP)	Government Purchases (G)	Net Exports (NX)	AE = C + IP + G + NX
200	100	100	175	35	40	25	275
300	100	200	250	35	40	25	350
400	100	300	325	35	40	25	425
500	100	400	400	35	40	25	500
600	100	500	475	35	40	25	575
700	100	600	550	35	40	25	650
800	100	700	625	35	40	25	725
900	100	800	700	35	40	25	800
1000	100	900	775	35	40	25	875

A
300
B
400
C
600
D
700

The numbers in this question are not quite as easy to work with as previous examples, but the process is the same as the previous two questions. The mpc in this economy is 0.75, which means that the tax multiplier is -0.75/(1 - 0.75) = -0.75/0.25 = -3. Taxes in this economy are increased by 66.67, making the total change in output (Y) equal to -3 x 66.67 = -200.

The economy started at an output of 500. After the tax increase, the level of equilibrium decreased by 200 and the new equilibrium is at 300 (500 - 200 = 300).

Now that you understand short run equilibrium in the economy and can explain how shocks to the spending impact output, we can start looking at the optimal policy responses that align with our goal of full-employment.