Chapter 12: Aggregate Expenditure and Output in the Short Run

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Learning Objectives

1. Understand how macroeconomic equilibrium is determined in the aggregate expenditure model.

2. Discuss the determinants of the four components of aggregate expenditure and define the marginal propensity to consume and the marginal propensity to save.

3. Use a 45° line diagram to illustrate macroeconomic equilibrium.

4. Define the multiplier effect and use it to calculate changes in equilibrium GDP.

5. Understand the relationship between the aggregate demand curve and aggregate expenditure.
In this chapter, we explore the causes of the business cycle by examining the effect of fluctuations in total spending (i.e., aggregate expenditure) on real GDP (total production).

**Aggregate expenditure (AE)** The total amount of spending in the economy: the sum of consumption, planned investment, government purchases, and net exports.
During some years, AE increases about as much as does the production of goods and services:

- Most firms sell about what they expected to sell and they will remain production and employment unchanged.

During other years, AE increases more than the production:

- Firms will increase production and hire more workers.

However, during some year, AE didn’t increase as much as total production:

- Firms cut back on production and laid off workers.
The Aggregate Expenditure Model?

- Aggregate expenditure model: A macroeconomic model that focuses on the relationship between total spending and real GDP, assuming the price level is constant.
  - It is used to study the business cycle involving the interaction of many economic variables.

- The key idea of AE model: In any particular year, the level of GDP is determined mainly by the level of AE that have several components.

- Economists began to study the relationship between fluctuations in AE and fluctuations in GDP during the Great Depression of the 1930s:
  - In 1936, John M. Keynes systematically analyzed this relationship in his famous book ("The General Theory of Employment, Interest, and Money") and identified four categories of AE that together equal to GDP (these are the same four categories).
Aggregate Expenditure

\[ AE = C + I + G + NX \]  

1. Consumption \((C)\): Spending by HHs on G&S such as furniture, food, etc.
2. Planned Investment \((I)\): *Planned* spending by firms on capital goods, such as machinery, buildings, etc. or by HHs on new houses.
3. Government Purchases \((G)\): Spending by local, state, and federal governments on G&S, such as building airport, highway, and salaries of gov. employees.
4. Net Exports \((NX)\): Spending by foreign firms and hhs on G&S produced in the US minus spending by US firms and HHs on G&S produced in other countries.
The Difference between Planned Investment and Actual Investment

- Notice that planned investment spending, rather than actual investment spending, is a component of aggregate expenditure.
- The amount of that firms *plan* to spend on investment can be different from the amount they *actually* spend.
- The reason is that we need to consider *inventories*:
  - *Inventories*: Goods that have been produced, but not yet sold.
- Changes in inventories are included as part of investment spending:
  - Assume that the amount businesses plan to spend on inventories may be different from the amount they actually spend.
(cont.) Changes in inventories depend on *sales of goods*, which firms cannot always forecast with perfect accuracy.

- E.g., an auto company may produce 15,000 cars and expect to sell them all. If it does sell all 15,000, its inventories will be unchanged, but if it sells only 10,000 it will have an unplanned increase in inventories.

- Hence, for the economy as a whole, we can say that actual investment spending (IS) will be greater (less) than planned IS when there is an unplanned increase (decrease) in inventories.

- Actual investment will equal planned investment only when there is no unplanned change in inventories.
Macroeconomic Equilibrium

- *Macroeconomic equilibrium* is similar to microeconomic equilibrium (demand=supply of a product), in which the quantity of apples produced and sold will not change unless the demand or supply of this good changes.
- For the economy as a whole, macro equilibrium occurs where total spending equals to total production, that is,

\[
\text{Aggregate Expenditure} = \text{GDP}
\]
Adjustments to Macro Equilibrium

- Increases and decreases in AE cause the year-to-year fluctuations in GDP.
- When AE is greater than GDP, inventories will decline, and GDP and total employment will increase.
- When AE is less than GDP, inventories will increase, and GDP and total employment will decrease.
- Only when AE equals GDP will the economy be in macroeconomic equilibrium.
Economists forecast what will happen to each component of AE. If they forecast that AE will decline in the future, that is equivalent to forecasting that GDP will decline and that the economy will enter a recession.

Individuals and firms closely watch these forecasts because fluctuations in GDP can have dramatic effects on wages, profits, and employment.

When economists forecast that AE is likely to decline and the economy is headed for a recession, the gov. may implement macro policies to head off the decline in AE and avoid the recession.
Table 12.1 The Relationship between Aggregate Expenditure and GDP

<table>
<thead>
<tr>
<th>If . . .</th>
<th>then . . .</th>
<th>and . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>aggregate expenditure is equal to GDP</td>
<td>inventories are unchanged</td>
<td>the economy is in macroeconomic equilibrium.</td>
</tr>
<tr>
<td>aggregate expenditure is less than GDP</td>
<td>inventories rise</td>
<td>GDP and employment decrease.</td>
</tr>
<tr>
<td>aggregate expenditure is greater than GDP</td>
<td>inventories fall</td>
<td>GDP and employment increase.</td>
</tr>
</tbody>
</table>

When economists forecast that aggregate expenditure is likely to decline and that the economy is headed for a recession, the federal government may implement macroeconomic policies in an attempt to head off the decrease in expenditure and keep the economy from falling into recession.
Table 12.2 Components of Real Aggregate Expenditure, 2010

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Real Expenditure (billions of 2005 dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>$9,221</td>
</tr>
<tr>
<td>Planned investment</td>
<td>1,715</td>
</tr>
<tr>
<td>Government purchases</td>
<td>2,557</td>
</tr>
<tr>
<td>Net exports</td>
<td>−422</td>
</tr>
</tbody>
</table>

Each component is measured in *real* terms, meaning that it is corrected for inflation by being measured in billions of 2005 dollars.

Net exports were negative because in 2010, as in most years since the early 1970s, the United States imported more goods and services than it exported.
Consumption follows a smooth, upward trend, interrupted only infrequently by brief recessions.
Consumption

The five most important variables that determine the level of consumption:

- *Current disposable income* is the most important determinant of consumption.
  - Disposable income (DI) is the income remaining to HHs after paying the personal income tax and receiving gov. transfer payments.
  - For most HHs, the higher (lower) their DI, the more (the less) they spend.
  - Aggregate (macro) consumption is the total of the consumption of US HHs. The main reason for the general upward trend in consumption is that DI has followed a similar upward trend.
(cont.) Household wealth is the value of its assets minus the value of its liabilities.

- Assets include home, stock and bond holdings, and bank accounts.
- Liabilities include any loans that it owes.
- When the wealth of HHs increases (decreases), consumption increases (decreases).
- Since shares of stock are an important component of HHs’ wealth, consumption should increase with stock prices.
- A recent estimate of the effects of changes in wealth on consumption indicates a permanent one-dollar increase in wealth induces 4 – 5 cents increase in consumption.
(cont.) *Expected future income:* Most people prefer to keep their consumption fairly stable and smooth over time, even if their income fluctuates significantly. Both current income and expected future income need to be considered to determine current consumption.

*The price level:* Changes in the price level affect consumption mainly through their effect on HHs’ wealth. As the price level rises, the real value of HHs wealth declines and so will HHs consumption.
(cont.) *The interest rate:* When the interest rate (IR) is high, the reward to saving is increased and HHs are likely to save more and spend less.

- Note that consumption depends on the real IR that corrects the nominal IR for the impact of inflation.
- Spending on durable goods (such as autos, one category of consumption) is most likely to be affected by the interest rate because a high real IR increases the cost of spending financed by borrowing.
Because many macroeconomic variables move together, economists sometimes have difficulty determining whether movements in one are causing movements in another.

MyEconLab Your Turn: Test your understanding by doing related problem 2.11 at the end of this chapter.
The Consumption Function

Figure 12.2  The Relationship between Consumption and Income, 1960–2010

Panel (a) shows the relationship between consumption and income. The points represent combinations of real consumption spending and real disposable income for the years 1960 to 2010. In panel (b), we draw a straight line through the points from panel (a). The line, which represents the relationship between consumption and disposable income, is called the consumption function. The slope of the consumption function is the marginal propensity to consume.
The Consumption Function

- **Consumption function** The relationship between consumption spending and disposable income.
- **Marginal propensity to consume (MPC)**: The slope of the consumption function: the amount by which consumption spending increases when disposable income increases:

\[
MPC = \frac{\text{change in consumption}}{\text{change in disposable income}} = \frac{\Delta C}{\Delta YD}. \tag{2}
\]

- We can also use the MPC to determine how much consumption will change as income changes:

\[
\Delta C = MPC \times \Delta YD.
\]
The Relationship between Consumption and National Income

- Shift to discuss the relationship between *aggregate consumption spending* and *GDP*, rather than disposable income because we are interested in using the AE model to explain fluctuations in real GDP.
- Note that GDP and national income are almost the same.
- Note that

\[
\text{Disposable income} = \text{National income} - \text{Net taxes} \tag{3}
\]

where Net taxes = taxes minus gov transfer payments. Or, rearranging the equation:

\[
\text{National income} = \text{GDP} = \text{Disposable income} + \text{Net taxes}. \tag{4}
\]
Income, Consumption, and Saving

- HHs either (1) spend their income, (2) save it, or (3) use it to pay taxes. For the economy as a whole,

\[
\text{National income} = \text{Consumption} + \text{Saving} + \text{Taxes}, \quad (5)
\]

which means that

\[
\text{Change in national income} = \text{Change in consumption} \quad (6)
+ \text{Change in saving} + \text{Change in taxes}
\]

- Using symbols, where \( Y \) represents national income (and GDP), \( C \) represents consumption, \( S \) represents saving, and \( T \) represents taxes,

\[
Y = C + S + T \quad \text{and} \quad \Delta Y = \Delta C + \Delta S + \Delta T. \quad (7)
\]
The Relationship between Consumption and National Income

Because national income differs from disposable income only by net taxes—which, for simplicity, we assume are constant—we can graph the consumption function using national income rather than disposable income. We can also calculate the MPC, which is the slope of the consumption function, using either the change in national income or the change in disposable income and always get the same value. The slope of the consumption function between point A and point B is equal to the change in consumption—$1,500 billion—divided by the change in national income—$2,000 billion—or 0.75.

<table>
<thead>
<tr>
<th>National Income or GDP (billions of dollars)</th>
<th>Net Taxes (billions of dollars)</th>
<th>Disposable Income (billions of dollars)</th>
<th>Consumption (billions of dollars)</th>
<th>Change in National Income (billions of dollars)</th>
<th>Change in Disposable Income (billions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000</td>
<td>$1,000</td>
<td>$0</td>
<td>$750</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3,000</td>
<td>1,000</td>
<td>2,000</td>
<td>2,250</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>5,000</td>
<td>1,000</td>
<td>4,000</td>
<td>3,750</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>7,000</td>
<td>1,000</td>
<td>6,000</td>
<td>5,250</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>9,000</td>
<td>1,000</td>
<td>8,000</td>
<td>6,750</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>11,000</td>
<td>1,000</td>
<td>10,000</td>
<td>8,250</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>13,000</td>
<td>1,000</td>
<td>12,000</td>
<td>9,750</td>
<td>2,000</td>
<td>2,000</td>
</tr>
</tbody>
</table>
(cont.) To simplify, we can assume that taxes are always a constant amount, in which case $\Delta T = 0$, so that:

$$\Delta Y = \Delta C + \Delta S.$$  

**Marginal propensity to save (MPS)** The change in saving divided by the change in income:

$$1 = \frac{\Delta C}{\Delta Y} + \frac{\Delta S}{\Delta Y} \quad \text{or} \quad 1 = MPC + MPS$$
Solved Problem 12.2

Calculating the Marginal Propensity to Consume and the Marginal Propensity to Save

Fill in the blanks in the following table. For simplicity, assume that taxes are zero.

<table>
<thead>
<tr>
<th>National Income and Real GDP (Y)</th>
<th>Consumption (C)</th>
<th>Saving (S)</th>
<th>Marginal Propensity to Consume (MPC)</th>
<th>Marginal Propensity to Save (MPS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$9,000</td>
<td>$8,000</td>
<td>$1,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>10,000</td>
<td>8,600</td>
<td>1,400</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>11,000</td>
<td>9,200</td>
<td>1,800</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>12,000</td>
<td>9,800</td>
<td>2,200</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>13,000</td>
<td>10,400</td>
<td>2,600</td>
<td>0.6</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Show that the $MPC$ plus the $MPS$ equals 1.

**Step 3:** Show that the $MPC$ plus the $MPS$ equals 1.

At every level of national income, the $MPC$ is 0.6 and the $MPS$ is 0.4. Therefore, the $MPC$ plus the $MPS$ is always equal to 1.

MyEconLab Your Turn: For more practice, do related problem 2.13 at the end of this chapter.
Planned Investment

Figure 12.4 Real Investment


Note: The values are quarterly data, seasonally adjusted at an annual rate.
Planned Investment

- *Expectations on future profitability*
  - Investment goods (equipment, office buildings) are long-lived.
  - A firm is unlikely to make a new investment unless it is *optimistic* that the demand for its product will remain strong for several years.
  - The *optimism or pessimism* of firms is an important determinant of investment.
(cont.)

**The interest rate**

- Borrowing takes the form of issuing corporate bonds or receiving loans from banks. A significant fraction of investment is financed by *borrowing*. HHs also borrow to finance most of their spending on new houses.
- Because households and firms are interested in the cost of borrowing after taking into account the effects of inflation, investment spending depends on the real interest rate.
- Holding the other factors that affect investment spending constant, there is an inverse relationship between the real interest rate and investment spending:
- A higher real interest rate results in less investment spending, and a lower real interest rate results in more investment spending.
(cont.) *Taxes*

- Firms focus on the profits that remain after paying taxes.
- A reduction in the corporate income tax on the profits increases the after-tax profitability of investment.
- Investment tax incentives (it provides firms with a tax reduction when they spend on *new investment goods*) also increase investment spending.

*Cash flow*

- The difference between the cash *revenues received* by the firm and the cash *spending* by the firm.
- Most firms use their own funds to finance investment goods instead of borrowing outside.
- The largest contributor to CF is profit. The more profitable a firm is, the greater its CF and the greater its ability to finance investment.
Government Purchases

Figure 12.5 Real Government Purchases

Government purchases grew steadily for most of the 1979–2011 period, with the exception of the early 1990s, when concern about the federal budget deficit caused real government purchases to fall for three years, beginning in 1992.

Note: The values are quarterly data, seasonally adjusted at an annual rate.
Net Exports

- *The price level in US relative to the price levels in other countries:* If prices in US increase more slowly than the prices of other countries, the demand for US products increases relative to other countries.

- *The growth rate of GDP in US relative to the growth rates of other countries:* When incomes (GDP) rise faster in US than in other countries, US consumers’ purchases of foreign G&S will increase faster than foreign consumers’ purchases of US G&S.

- *The exchange rate between the dollar and other currencies:* An increase in the value of the US dollar will reduce exports and increase imports.
Figure 12.6 Real Net Exports

Net exports were negative in most years between 1979 and 2011. Net exports have usually increased when the U.S. economy is in recession and decreased when the U.S. economy is expanding, although they fell during most of the 2001 recession. Note: The values are quarterly data, seasonally adjusted at an annual rate.
The Important Role of Inventories

Whenever aggregate expenditure is less than real GDP, some firms will experience an *unplanned* increase in inventories.

If firms don’t cut back on their production promptly, they will accumulate excess inventories. As a result, even if spending quickly returns to its normal levels, firms will have to sell their excess inventories before they can return to producing at normal levels.

This possibility can explain why a brief decline in AE can result in a fairly long recession. Hence, efficient systems of inventories control help make recessions shorter and less severe.
The 45°-line diagram is sometimes referred to as the Keynesian cross because it is based on the analysis of John Maynard Keynes.

**Figure 12.7**

An Example of a 45°-Line Diagram

The 45° line shows all the points that are equal distances from both axes. Points such as A and B, at which the quantity produced equals the quantity sold, are on the 45° line. Points such as C, at which the quantity sold is greater than the quantity produced, lie above the line. Points such as D, at which the quantity sold is less than the quantity produced, lie below the line.
The Relationship between Planned Aggregate Expenditure and GDP on a 45°-Line Diagram

Every point of macroeconomic equilibrium is on the 45° line, where planned aggregate expenditure equals GDP. At points above the line, planned aggregate expenditure is greater than GDP. At points below the line, planned aggregate expenditure is less than GDP.

Although all points of macroeconomic equilibrium must lie along the 45° line, only one of these points will represent the actual level of equilibrium real GDP during any particular year, given the actual level of planned real expenditure.

The aggregate expenditure function shows us the amount of planned aggregate expenditure that will occur at every level of national income, or GDP.
Macroeconomic equilibrium occurs where the aggregate expenditure (AE) line crosses the 45° line. The lowest upward-sloping line, C, represents the consumption function. The quantities of planned investment, government purchases, and net exports are constant because we assumed that the variables they depend on are constant. So, the total of planned aggregate expenditure at any level of GDP is the amount of consumption at that level of GDP plus the sum of the constant amounts of planned investment, government purchases, and net exports. We successively add each component of spending to the consumption function line to arrive at the line representing aggregate expenditure.
Macroeconomic Equilibrium

Macroeconomic equilibrium occurs where the $AE$ line crosses the 45° line. In this case, that occurs at GDP of $10$ trillion. If GDP is less than $10$ trillion, the corresponding point on the $AE$ line is above the 45° line, planned aggregate expenditure is greater than total production, firms will experience an unplanned decrease in inventories, and GDP will increase. If GDP is greater than $10$ trillion, the corresponding point on the $AE$ line is below the 45° line, planned aggregate expenditure is less than total production, firms will experience an unplanned increase in inventories, and GDP will decrease.
Showing a Recession on the 45°-Line Diagram

*Macroeconomic equilibrium can occur at any point on the 45° line.*

Ideally, we would like equilibrium to occur at potential GDP.

At potential GDP, firms will be operating at their normal level of capacity, and the economy will be at the natural rate of unemployment.

At the natural rate of unemployment, the economy will be at full employment: Everyone in the labor force who wants a job will have one, except the structurally and frictionally unemployed.

For equilibrium to occur at the level of potential GDP, planned aggregate expenditure must be high enough.
Figure 12.11

Showing a Recession on the 45°-Line Diagram

When the aggregate expenditure line intersects the 45° line at a level of GDP below potential GDP, the economy is in recession. The figure shows that potential GDP is $10 trillion, but because planned aggregate expenditure is too low, the equilibrium level of GDP is only $9.8 trillion, where the $AE$ line intersects the 45° line. As a result, some firms will be operating below their normal capacity, and unemployment will be above the natural rate of unemployment. We can measure the shortfall in planned aggregate expenditure as the vertical distance between the $AE$ line and the 45° line at the level of potential GDP.
A Numerical Example of Macroeconomic Equilibrium

We can capture some key features contained in the quantitative models that economic forecasters use by looking at several hypothetical combinations of real GDP and planned aggregate expenditure.

**Table 12.3  Macroeconomic Equilibrium**

<table>
<thead>
<tr>
<th>Real GDP (Y)</th>
<th>Consumption (C)</th>
<th>Planned Investment (I)</th>
<th>Government Purchases (G)</th>
<th>Net Exports (NX)</th>
<th>Planned Aggregate Expenditure (AE)</th>
<th>Unplanned Change in Inventories</th>
<th>Real GDP Will …</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8,000</td>
<td>$6,200</td>
<td>$1,500</td>
<td>$1,500</td>
<td>−$500</td>
<td>$8,700</td>
<td>−$700</td>
<td>increase</td>
</tr>
<tr>
<td>9,000</td>
<td>6,850</td>
<td>1,500</td>
<td>1,500</td>
<td>−500</td>
<td>9,350</td>
<td>−350</td>
<td>increase</td>
</tr>
<tr>
<td>10,000</td>
<td>7,500</td>
<td>1,500</td>
<td>1,500</td>
<td>−500</td>
<td>10,000</td>
<td>0</td>
<td>be in equilibrium</td>
</tr>
<tr>
<td>11,000</td>
<td>8,150</td>
<td>1,500</td>
<td>1,500</td>
<td>−500</td>
<td>10,650</td>
<td>+350</td>
<td>decrease</td>
</tr>
<tr>
<td>12,000</td>
<td>8,800</td>
<td>1,500</td>
<td>1,500</td>
<td>−500</td>
<td>11,300</td>
<td>+700</td>
<td>decrease</td>
</tr>
</tbody>
</table>

*Note:* The values are in billions of 2005 dollars

**Don’t Let This Happen to You**

Don’t Confuse Aggregate Expenditure with Consumption Spending

Planned aggregate expenditure equals the sum of consumption spending, planned investment spending, government purchases, and net exports, *not* consumption spending by itself.

**MyEconLab Your Turn:** Test your understanding by doing related problem 3.11 at the end of this chapter.
### Solved Problem 12.3
Determining Macroeconomic Equilibrium

Fill in the blanks in the following table and determine the equilibrium level of real GDP.

<table>
<thead>
<tr>
<th>Real GDP (Y)</th>
<th>Consumption (C)</th>
<th>Planned Investment (I)</th>
<th>Government Purchases (G)</th>
<th>Net Exports (NX)</th>
<th>Planned Aggregate Expenditure (AE)</th>
<th>Unplanned Change in Inventories</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8,000</td>
<td>$6,200</td>
<td>$1,675</td>
<td>$1,675</td>
<td>$-500</td>
<td>$9,050</td>
<td>$-1,050</td>
</tr>
<tr>
<td>9,000</td>
<td>6,850</td>
<td>1,675</td>
<td>1,675</td>
<td>-500</td>
<td>9,700</td>
<td>-700</td>
</tr>
<tr>
<td>10,000</td>
<td>7,500</td>
<td>1,675</td>
<td>1,675</td>
<td>-500</td>
<td>10,350</td>
<td>-350</td>
</tr>
<tr>
<td>11,000</td>
<td>8,150</td>
<td>1,675</td>
<td>1,675</td>
<td>-500</td>
<td>11,000</td>
<td>0</td>
</tr>
<tr>
<td>12,000</td>
<td>8,800</td>
<td>1,675</td>
<td>1,675</td>
<td>-500</td>
<td>11,650</td>
<td>350</td>
</tr>
</tbody>
</table>

*Note:* The values are in billions of 2005 dollars.

To fill in the first row, we have

\[ AE = 6,200 \text{ billion} + 1,675 \text{ billion} + 1,675 \text{ billion} + (-500 \text{ billion}) = 9,050 \text{ billion}; \]

and

\[ \text{unplanned change in inventories} = 8,000 \text{ billion} - 9,050 \text{ billion} = -1,050 \text{ billion}. \]

**Step 3:** Determine the equilibrium level of real GDP.

Once you fill in the table, you should see that equilibrium real GDP must be $11,000 billion because only at that level is real GDP equal to planned aggregate expenditure.

MyEconLab Your Turn: For more practice, do related problem 3.12 at the end of this chapter.
The Multiplier Effect

- **Autonomous expenditure**: Expenditure that does *not* depend on the level of GDP.
  - Planned investment, gov. spending, and net exports are all autonomous expenditures.
  - Note that consumption also includes an autonomous component. E.g., if HHs decide to spend more of their incomes and save less *at every level of income* there will be an autonomous increase in consumption.

- **Multiplier**: The increase in equilibrium real GDP divided by the increase in autonomous expenditure.

- **Multiplier effect**: The process by which an increase in autonomous expenditure leads to a *larger increase* in real GDP.
Figure 12.12

The Multiplier Effect

The economy begins at point A, at which equilibrium real GDP is $9.6 trillion. A $100 billion increase in planned investment shifts up aggregate expenditure from $AE_1$ to $AE_2$. The new equilibrium is at point B, where real GDP is $10.0 trillion, which is potential real GDP. Because of the multiplier effect, a $100 billion increase in investment results in a $400 billion increase in equilibrium real GDP.
A Formula for the Multiplier

The total change in GDP

\[ \text{The total change in GDP} = \$100 + MPC \times \$100 \]
\[ + MPC \times MPC \times \$100 + \ldots \quad \implies \quad \frac{1}{1 - MPC}. \]

Multiplier

\[ \text{Multiplier} = \frac{\text{Change in real GDP}}{\text{Change in autonomous expenditure}} = \frac{1}{1 - MPC}. \]
By thinking of the multiplier effect occurring in rounds of spending, we can summarize how changes in GDP and spending caused by the initial $100 billion increase in investment will result in equilibrium GDP rising by $400 billion.

### Table 12.4  The Multiplier Effect in Action

<table>
<thead>
<tr>
<th>Round</th>
<th>Additional Autonomous Expenditure (investment)</th>
<th>Additional Induced Expenditure (consumption)</th>
<th>Total Additional Expenditure = Total Additional GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>$100 billion</td>
<td>$0</td>
<td>$100 billion</td>
</tr>
<tr>
<td>Round 2</td>
<td>0</td>
<td>75 billion</td>
<td>175 billion</td>
</tr>
<tr>
<td>Round 3</td>
<td>0</td>
<td>56 billion</td>
<td>231 billion</td>
</tr>
<tr>
<td>Round 4</td>
<td>0</td>
<td>42 billion</td>
<td>273 billion</td>
</tr>
<tr>
<td>Round 5</td>
<td>0</td>
<td>32 billion</td>
<td>305 billion</td>
</tr>
<tr>
<td>Round 10</td>
<td>0</td>
<td>8 billion</td>
<td>377 billion</td>
</tr>
<tr>
<td>Round 15</td>
<td>0</td>
<td>2 billion</td>
<td>395 billion</td>
</tr>
<tr>
<td>Round 19</td>
<td>0</td>
<td>1 billion</td>
<td>398 billion</td>
</tr>
<tr>
<td>Round n</td>
<td>0</td>
<td>0</td>
<td>$400 billion</td>
</tr>
</tbody>
</table>
Making the Connection

The Multiplier in Reverse: The Great Depression of the 1930s

An increase in autonomous expenditure causes an increase in equilibrium real GDP, but the reverse is also true: A decrease in autonomous expenditure causes a decrease in real GDP.

Americans became aware of this fact in the 1930s when the multiplier effect magnified reductions in autonomous expenditure, leading to very high levels of unemployment and the largest decline in real GDP in U.S. history.

The following table shows the severity of the economic downturn by contrasting the business cycle peak of 1929 with the business cycle trough of 1933:

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption</th>
<th>Investment</th>
<th>Net Exports</th>
<th>Real GDP</th>
<th>Unemployment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1929</td>
<td>$737 billion</td>
<td>$102 billion</td>
<td>−$11 billion</td>
<td>$977 billion</td>
<td>3.2%</td>
</tr>
<tr>
<td>1933</td>
<td>$601 billion</td>
<td>$19 billion</td>
<td>−$12 billion</td>
<td>$716 billion</td>
<td>24.9%</td>
</tr>
</tbody>
</table>

Note: The values are in 2005 dollars.
We can use a 45°-line diagram to illustrate the multiplier effect working in reverse during these years.

The economy was at potential real GDP in 1929, before the declines in aggregate expenditure began.

Declining consumption, planned investment, and net exports shifted the aggregate expenditure function down from $AE_{1929}$ to $AE_{1933}$, reducing equilibrium real GDP from $977$ billion in 1929 to $716$ billion in 1933.

The depth and length of this economic downturn led to its being labeled the Great Depression.

MyEconLab Your Turn: Test your understanding by doing related problem 4.4 at the end of this chapter.
Summarizing the Multiplier Effect

- The multiplier effect occurs both when autonomous expenditure increases and when it decreases.
  - For example, with an MPC of 0.75, a decrease in planned investment of $100 billion will lead to a decrease in equilibrium income of $400 billion.
- The multiplier effect makes the economy more sensitive to changes in autonomous expenditure than it would otherwise be.
  - Because of the multiplier effect, a decline in spending and production in one sector of the economy can lead to declines in spending and production in many other sectors of the economy.
- The larger the MPC, the larger the value of the multiplier.
- The formula for the multiplier, $\frac{1}{1-\text{MPC}}$, is oversimplified because it ignores some real world complications, such as the effect that an increasing GDP can have on imports, inflation, and interest rates. These effects combine to cause the simple formula to overstate the true value of the multiplier.
Solved Problem 12.4
Using the Multiplier Formula

Use the information in the table to answer the following questions:

<table>
<thead>
<tr>
<th>Real GDP ($Y$)</th>
<th>Consumption ($C$)</th>
<th>Planned Investment ($I$)</th>
<th>Government Purchases ($G$)</th>
<th>Net Exports ($NX$)</th>
<th>Planned Aggregate Expenditure ($AE$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8,000$</td>
<td>$6,900$</td>
<td>$1,000$</td>
<td>$1,000$</td>
<td>$-500$</td>
<td>$8,400$</td>
</tr>
<tr>
<td>$9,000$</td>
<td>$7,700$</td>
<td>$1,000$</td>
<td>$1,000$</td>
<td>$-500$</td>
<td>$9,200$</td>
</tr>
<tr>
<td>$10,000$</td>
<td>$8,500$</td>
<td>$1,000$</td>
<td>$1,000$</td>
<td>$-500$</td>
<td>$10,000$</td>
</tr>
<tr>
<td>$11,000$</td>
<td>$9,300$</td>
<td>$1,000$</td>
<td>$1,000$</td>
<td>$-500$</td>
<td>$10,800$</td>
</tr>
<tr>
<td>$12,000$</td>
<td>$10,100$</td>
<td>$1,000$</td>
<td>$1,000$</td>
<td>$-500$</td>
<td>$11,600$</td>
</tr>
</tbody>
</table>

*Note:* The values are in billions of 2005 dollars.

**Step 2:** Determine equilibrium real GDP.
Just as in Solved Problem 12.2, we can find macroeconomic equilibrium by calculating the level of planned aggregate expenditure for each level of real GDP. We can see that macroeconomic equilibrium will occur when real GDP equals $10,000 billion.

**Step 3:** Calculate the $MPC$.

\[ MPC = \frac{\Delta C}{\Delta Y} \]

In this case:

\[ MPC = \frac{$800\text{ billion}}{$1,000\text{ billion}} = 0.8 \]
Solved Problem 12.4

Using the Multiplier Formula

**Step 4:** Use the multiplier formula to calculate the new equilibrium level of real GDP.

We could find the new level of equilibrium real GDP by constructing a new table with government purchases increased from $1,000 billion to $1,200 billion. But the multiplier allows us to calculate the answer directly.

In this case:

\[
\text{Multiplier} = \frac{1}{1 - MPC} = \frac{1}{1 - 0.8} = 5
\]

So:

\[
\text{Change in equilibrium real GDP} = \text{Change in autonomous expenditure} \times 5
\]

Or:

\[
\text{Change in equilibrium real GDP} = 200 \text{ billion} \times 5 = 1,000 \text{ billion}
\]

Therefore:

\[
\text{New level of equilibrium GDP} = 10,000 \text{ billion} + 1,000 \text{ billion} = 11,000 \text{ billion}
\]

*MyEconLab* **Your Turn:** Test your understanding by doing related problem 4.5 at the end of this chapter.
In discussing the AE model, John Maynard Keynes argued that if many households decide at the same time to increase their saving and reduce their spending, they may make themselves worse off by causing aggregate expenditure to fall, thereby pushing the economy into a recession.

The lower incomes in the recession might mean that total saving does not increase, despite the attempts by many individuals to increase their own saving.

Keynes referred to this outcome as the paradox of thrift because what appears to be something favorable to the long-run performance of the economy might be counterproductive in the short run.
When demand for a product increases, firms will usually respond by *increasing production*, but they are also likely to increase *prices*. So far, we have fixed the price level (PL).

In fact, as we will see, increases (decreases) in the PL will cause AE decrease (rise). There are 3 reasons for this *inverse* relationship between changes in the PL and changes in AE.
1. A rising PL decreases consumption by decreasing the real value of household wealth.
2. If the PL in US rises relative to the PLs in other countries, US exports will become relatively more expensive and foreign imports will become relatively less expensive, causing net exports to fall.
3. When prices rise, firms and HHs need more money to finance buying and selling. If the central bank doesn’t increase money supply, the result will increase the IR and then reduce investment as firms and HHs borrow less to build new factories, etc., and new houses, respectively.

Aggregate demand curve (AD) A curve showing the relationship between the price level and the level of planned aggregate expenditure in the economy, holding constant all other factors that affect aggregate expenditure.
In panel (a), an increase in the price level results in declining consumption, planned investment, and net exports and causes the aggregate expenditure line to shift down from $AE_1$ to $AE_2$. As a result, equilibrium real GDP declines from $10.0$ trillion to $9.8$ trillion.

In panel (b), a decrease in the price level results in rising consumption, planned investment, and net exports and causes the aggregate expenditure line to shift up from $AE_1$ to $AE_2$. As a result, equilibrium real GDP increases from $10.0$ trillion to $10.2$ trillion.
Appendix

The Algebra of Macroeconomic Equilibrium

LEARNING OBJECTIVE

Apply the algebra of macroeconomic equilibrium.

Graphs help us understand economic change qualitatively.

When we write an economic model using equations, we make it easier to make quantitative estimates.

An econometric model is an economic model written in the form of equations, where each equation has been statistically estimated, using methods similar to the methods used in estimating demand curves.
The following equations are based on the example shown in Table 12.3. Y stands for real GDP, and the numbers (with the exception of the MPC) represent billions of dollars.

1. \( C = 1,000 + 0.65Y \)  
   Consumption function

2. \( I = 1,500 \)  
   Planned investment function

3. \( G = 1,500 \)  
   Government spending function

4. \( NX = -500 \)  
   Net export function

5. \( Y = C + I + G + NX \)  
   Equilibrium condition

The parameters of the functions—such as the value of autonomous consumption and the value of the MPC in the consumption function—would be estimated statistically, using data on the values of each variable over a period of years.
In this model, GDP is in equilibrium when it equals planned aggregate expenditure.

Equation 5—the equilibrium condition—shows us how to calculate equilibrium in the model: We need to substitute equations 1 through 4 into equation 5. Doing so gives us the following:

\[ Y = 1,000 + 0.65Y + 1,500 + 1,500 - 500 \]

We need to solve this expression for \( Y \) to find equilibrium GDP. The first step is to subtract 0.65\( Y \) from both sides of the equation:

\[ Y - 0.65Y = 1,000 + 1,500 + 1,500 - 500 \]

Then, we solve for \( Y \):

\[ 0.35Y = 3,500 \]

Or:

\[ Y = \frac{3,500}{0.35} = 10,000 \]
To make this result more general, we can replace particular values with general values represented by letters:

1. $C = \bar{C} + MPC(Y)$  
   Consumption function

2. $I = \bar{I}$  
   Planned investment function

3. $G = \bar{G}$  
   Government spending function

4. $NX = \bar{NX}$  
   Net export function

5. $Y = C + I + G + NX$  
   Equilibrium condition

The letters with bars over them represent fixed, or autonomous, values.

For example, $\bar{C}$ represents autonomous consumption, which had a value of 1,000 in our original example.
Solving now for equilibrium, we get

\[ Y = \bar{C} + MPC\ (Y) + \bar{I} + \bar{G} + \bar{NX} \]

or

\[ Y - MPC\ (Y) = \bar{C} + \bar{I} + \bar{G} + \bar{NX} \]

or

\[ Y (1 - MPC) = \bar{C} + \bar{I} + \bar{G} + \bar{NX} \]

or

\[ Y = \frac{\bar{C} + \bar{I} + \bar{G} + \bar{NX}}{1 - MPC} \]

Remember that \(1/(1 - MPC)\) is the multiplier, and all four variables in the numerator of the equation represent autonomous expenditure. Therefore, an alternative expression for equilibrium GDP is:

Equilibrium GDP = Autonomous expenditure \(\times\) Multiplier
Figure 12.14
The Aggregate Demand Curve

The aggregate demand (AD) curve shows the relationship between the price level and the level of planned aggregate expenditure in the economy. When the price level is 97, real GDP is $10.2 trillion. An increase in the price level to 100 causes consumption, investment, and net exports to fall, which reduces real GDP to $10.0 trillion.

**Aggregate demand (AD) curve** A curve that shows the relationship between the price level and the level of planned aggregate expenditure in the economy, holding constant all other factors that affect aggregate expenditure.