Macro Model

Objectives :

Understand the difference between desired expenditure and actual expenditure.

Explain the determinants of desired consumption and desired investment expeditures.

Understand the meaning of equilibrium national income.

Recognize the difference between movements along and shifts of the aggregate expenditure functions.

Desired expenditure

Everyone makes expenditure decisions. Fortunately, it is unnecessary for our purposes to look at each of the millions of such individual decisions. Instead, it is sufficient to consider four main groups of decision makers.

The sum of their desired expenditures on domestically produced output is called desired aggregate expenditure, or more simply aggregate expenditure (AE).

$AE = C + I + G + (X-M)$

Autonomus versus induced expenditure.

Components of aggregate expenditure that do not depend on national income are called autonomous expenditures.

Components of aggregate expenditure that do change in response to changes in national income are called induced expenditures.

Important simplifications
Our goal is to develop the simplest possible model of national-income determination. To do so we focus on only two of the four components of desired aggregate expenditure.

Consumption and investment

Desired consumption expenditure

By definition, there are only two possible uses of disposable income—consumption and saving. When the household decides how much to put to one use, it has automatically decided how much to put to the other use.

The consumption function relates to total desired consumption expenditures of all households.

The consumption behaviour of households depends on the income that they actually have to spend, which is called disposable income. Under the assumptions, here, there are no governments, therefore no taxes. Hence, disposable income, which we denote Y_d is equal national income, Y.

The consumption function describes the relationship between consumption and the variables that influence

it; in the simplest theory, consumption is determined primarily by current disposable income.

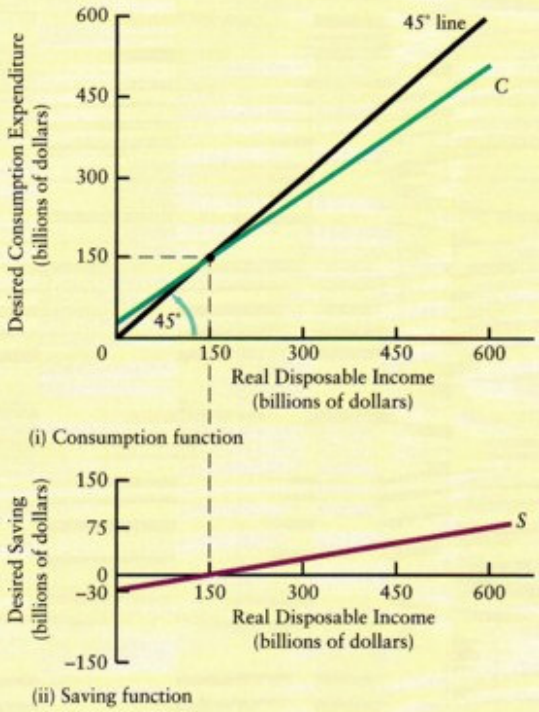
When a household's income is zero, it will still consume some minimal amount. This level of consumption expenditure is autonomous because it persists even when there is no income. The higher a households income, the more it will want to consume.

Let us take an example where autonomous consumption expenditure is $30 billion, where induced consumption expenditure is 80 percent of disposable income(for every $1 increase in disposable income, there is an 80 cent increase in consumption).

The equation for this simple consumption function is $C = a + b\ Y_d$ where is is eual to $30 billion and b is equal to 0.8.

FIGURE 22-2 The Consumption and Saving Functions

Disposable Income (Y_D)	Desired Consumption (C)	Desired Saving (S)	$APC = C/Y_D$	ΔY_D	ΔC	$MPC = \Delta C/\Delta Y_D$
0	30	−30	—			
				30	24	0.8
30	54	−24	1.800			
				90	72	0.8
120	126	−6	1.050			
				30	24	0.8
150	150	0	1.000			
				150	120	0.8
300	270	30	0.900			
				150	120	0.8
450	390	60	0.867			
				75	60	0.8
525	450	75	0.857			
				75	60	0.8
600	510	90	0.850			



Both consumption and saving rise as disposable income rises. Line *C* in part (i) of the figure relates desired consumption expenditure to disposable income by plotting the data from the second column of the accompanying table. The consumption function cuts the 45° line at the break-even level of disposable income. Note that the level of autonomous consumption is $30 billion. The slope of the consumption function is equal to the marginal propensity to consume, which is shown in the table to be 0.8.

The relationship between desired saving and disposable income is shown in part (ii) by line *S*, which plots the data from the third column of the table. The vertical distance between *C* and the 45° line in part (i) is by definition the height of *S* in part (ii); that is, any given level of disposable income must be either consumed or saved. Note that the level of autonomous saving is −$30 billion.

Average and marginal propensities to consume.

The average propensity to consume(APC) is total consumption expenditure divided by total disposable income:

$$APC = \frac{C}{Y_d}$$

The marginal propensity to consume(MPC) relates to change in desired consumption ot the change is disposable income.

$$MPC = \frac{\triangle C}{\triangle Y}$$

Where the Greek letter $\triangle$ means a change in.

The slope of the consumption function

The consumption function has a slope of $\frac{\triangle C}{\triangle Y}$

Which is, by definition, the marginal propensity to consume. The positive slope of the consumption function shows that MPC is positive; increases in income lead to increases in consumption expenditure.

The 45^o line.

This line is constructed by connecting all points where desired consumption (measured on the vertical axis) equals disposable income (measured on the horizontal axis). Because both axis are given the same units, this line has a positive slope equal to one; that is, it forms an angle of 45^o with the axes.

The 45^o is a useful reference line.

The consumption function cuts the 45^o line at the break-even level of income.

The 45^o line is also useful because its slope, which is equal to one, is greater than the slope of the consumption function, which is equal to the marginal propensity to consume.

This is simply a graphic reminder that the MPC is less than one, and that the higher is the MPC, the steeper is the consumption function.

The saving function
There are two saving concepts that are exactly parallel to the consumption concepts of APC and MPC.

The average propensity to save APS = S/Y_d

The marginal propensity to save MPS = $\triangle S/\triangle Y_d$

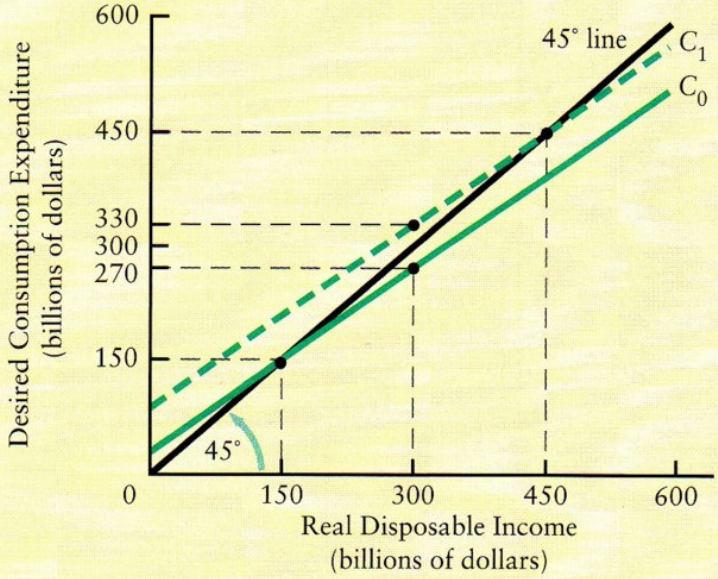
There is a simple relationship between the saving and the consumption propensities APC and APS must sum to one, so must MPC and MPS"

APC + APS = 1
MPC + MPS = 1

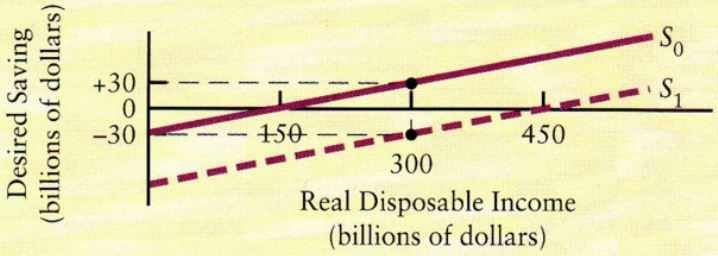
Wealth and the Consumption Function

We have been analysing the Keynesian consumption function—where consumption expenditure depends only on current disposable income. But this extreme depiction of consumption behaviour can easily be combined with the more recent life-cycle and permanent-income theories of consumption. According to these theories, households save to accumulate wealth that they can use during their retirement or during periods of unexpectedly low income. Suppose that there is an unexpected rise in aggregate wealth. This could be caused by an increase in the values of the shares that households own in the stock market. The increase in wealth means that less current income needs to be saved for the future and thus households will spend a larger fraction of income on current consumption. Hence, the consumption function will be shifted upward and the saving function downward, as shown in Figure 22-3. Conversely, a fall in wealth increases the incentive to save in order to restore wealth. This change shifts the consumption function downward and the saving function upward.

FIGURE 22-3 Wealth and the Consumption Function



(i) The consumption function shifts upward with an increase in wealth



(ii) The saving function shifts downward with an increase in wealth

Changes in wealth shift the consumption function. In part (i), line C_0 reproduces the consumption function from Figure 22-2(i). An increase in wealth raises desired consumption at each level of disposable income, thus shifting the consumption function up to C_1. In the figure, the consumption function shifts up by \$60 billion, so with disposable income of \$300 billion, for example, desired consumption rises from \$270 billion to \$330 billion.

The saving function in part (ii) shifts down by \$60 billion, from S_0 to S_1. Thus, for example, at a disposable income of \$300 billion, desired saving falls from \$30 billion to −\$30 billion.

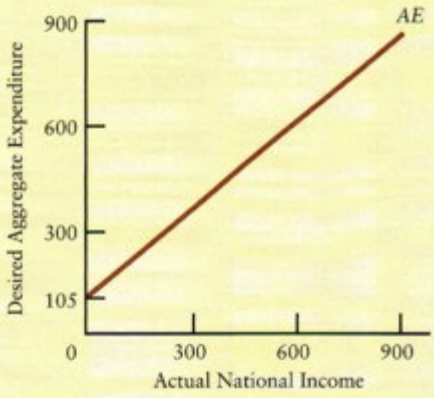
The aggregate expenditure function
The aggregate expenditure AE function relates the level of desired expenditure to the level of actual income.

In this simplified model, in which there is no government and no international trade, desired aggregate expenditure is just equal to desired consumption plus desired investment, C + I.

AE = C + I

FIGURE 22-6 The Aggregate Expenditure Function

National Income (Y)	Desired Consumption Expenditure ($C = 30 + 0.8 \times Y$)	Desired Investment Expenditure ($I = 75$)	Desired Aggregate Expenditure ($AE = C + I$)
30	54	75	129
120	126	75	201
150	150	75	225
300	270	75	345
450	390	75	465
525	450	75	525
600	510	75	585
900	750	75	825



The aggregate expenditure function relates total desired expenditure to actual national income. The curve *AE* in the figure plots the data from the first and last columns of the accompanying table. Its intercept, which in this case is $105 billion, shows the sum of autonomous consumption and autonomous investment. Its slope is equal to the marginal propensity to spend (which in this simple economy is just the marginal propensity to consume).

Equilibrium national income

Suppose that firms are producing a final output of $300 billion, and thus national income is $300. At this level of income aggregate desired expenditure is $345 billion.

In our example the plans to purchase $345 billion worth of commodities is the face of current output of $300 billion will reduce inventories by $45 billion. Eventually inventories will run out and firms will increase their outputs(more production, more work, more income) and national income will increase.

TABLE 22-1 Equilibrium National Income (billions of dollars)

National Income (Y)	Desired Aggregate Expenditure ($AE = C + I$)	Effect
30	129	Pressure
120	201	on income
150	225	to rise
300	345	↓
450	465	↓
525	525	Equilibrium income
600	585	↑
900	825	Pressure on income to fall

National income is in equilibrium when aggregate desired expenditure equals actual national income. The data are from Figure 22-6.

Desired saving and desired investment.

$Y = C + I$

$Y = C + S$ and $S = Y - C$

$C + I = C + S$

$I = S$

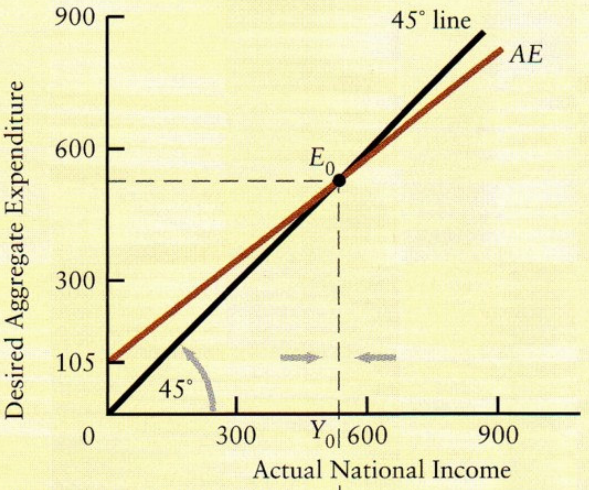
TABLE 22-2 The Saving-Investment Balance

National Income (Y)	Desired Aggregate Expenditure ($AE = C + I$)	Desired Consumption ($C = 30 + 0.8 \times Y$)	Desired Saving ($S = Y - C$)	Desired Investment (I)
30	129	54	−24	75
120	201	126	−6	75
300	345	270	30	75
525	525	450	75	75
600	585	510	90	75
900	825	750	150	75

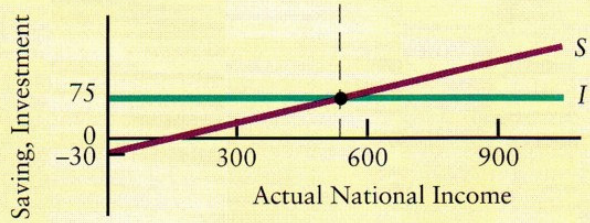
National income is in equilibrium where desired saving is equal to desired investment. The data for Y, AE, and I are from Figure 22-2. At every level of national income, the difference between national income and desired aggregate expenditure is exactly equal to the difference between desired saving and desired investment.

Changes in equilibrium National Income

FIGURE 22-7 Equilibrium National Income



(i) Income and expenditure

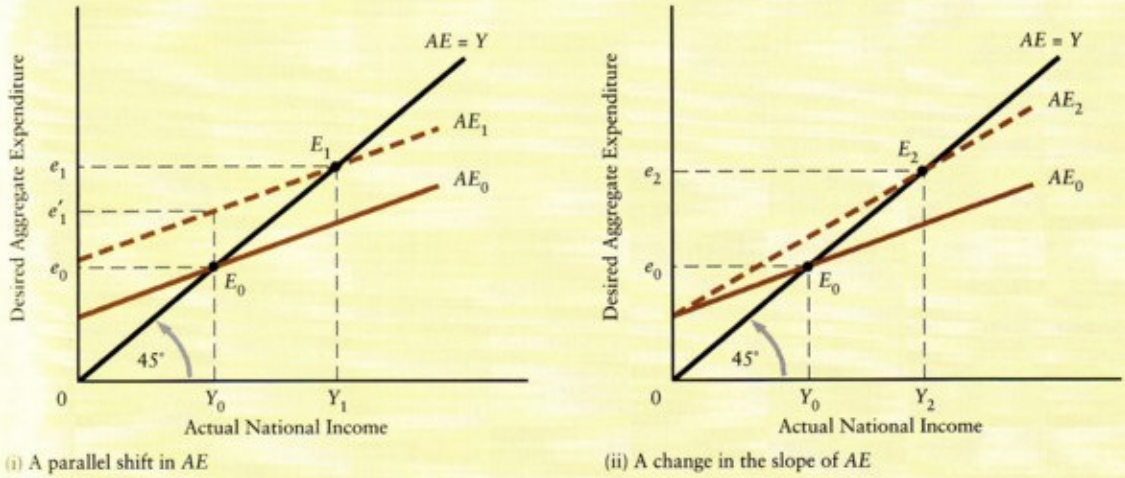


(ii) Saving and investment

Equilibrium national income is that level of national income where desired aggregate expenditure equals actual national income. If actual national income is below Y_0 in panel (i), desired aggregate expenditure will exceed national income, and output will rise. This is shown by the arrow to the left of Y_0. If national income is above Y_0, desired aggregate expenditure will be less than national income, and production will fall. This is shown by the arrow to the right of Y_0. Only when national income is equal to Y_0 will the economy be in equilibrium.

Panel (ii) shows desired saving and desired investment on the same scale as panel (i). Equilibrium national income occurs where desired saving equals desired investment. The vertical distance between saving and investment is exactly the same as the vertical distance in part (i) between *AE* and the 45° line.

FIGURE 22-9 Shifts in the Aggregate Expenditure Function



Upward shifts in the *AE* function increase equilibrium income; downward shifts decrease equilibrium income. In parts (i) and (ii), the *AE* function is initially AE_0 with equilibrium national income equal to Y_0.

In part (i), a parallel upward shift in the *AE* curve from AE_0 to AE_1 reflects an increase in desired expenditure at each level of national income. For example, at Y_0, desired expenditure rises from e_0 to e_1' and therefore exceeds national income. Equilibrium is reached at E_1, where income is Y_1. The increase in desired expenditure from e_1' to e_1, represented by a movement along AE_1, is an induced response to the increase in income from Y_0 to Y_1.

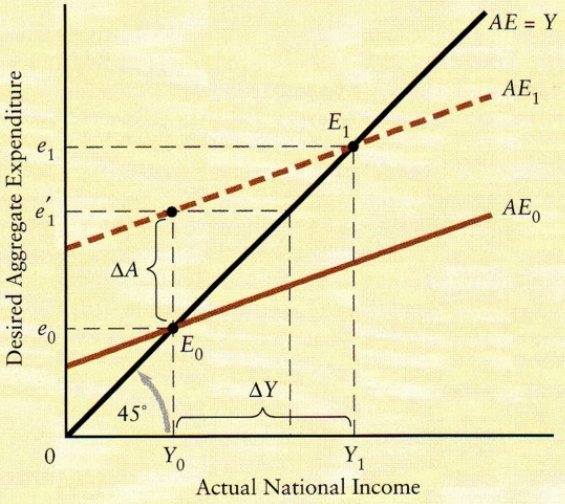
In part (ii), a nonparallel upward shift in the *AE* curve from AE_0 to AE_2 reflects an increase in the marginal propensity to spend. This leads to an increase in equilibrium national income. Equilibrium is reached at E_2, where national income is equal to Y_2.

The multiplier

We have learned how to predict the direction of the changes in national income that occur in response to various shifts in the AE function. We would also like to predict the magnitude of these changes.

The multiplier is the change in equilibrium national income divided by the change in autonomous expenditure that brought it about. The mutiplier is greater than one.

FIGURE 22-11 The Simple Multiplier



An increase in the autonomous component of desired aggregate expenditure increases equilibrium national income by a multiple of the initial increase. The initial equilibrium is at E_0, where AE_0 intersects the 45° line. At this point, desired expenditure, e_0, is equal to national income, Y_0. An increase in autonomous expenditure of ΔA then shifts the AE function upward to AE_1.

Equilibrium occurs when income rises to Y_1. Here desired expenditure, e_1, equals national income, Y_1. The increase in desired expenditure from e_1' to e_1 represents the induced increase in expenditure. It is the amount by which the overall increase in national income, ΔY, exceeds the initial increase in autonomous expenditure, ΔA. Because ΔY is greater than ΔA, the simple multiplier is greater than one ($\Delta Y/\Delta A > 1$).

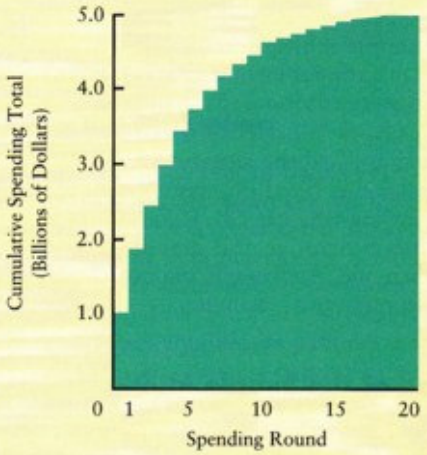
The Multiplier: A Numerical Example

Consider an economy that has a marginal propensity to spend out of national income of 0.80. Suppose an increase in business confidence leads many firms to increase their spending on new buildings and factories. Specifically, suppose desired investment increases by $1 billion per year. National income initially rises by $1 billion, but that is not the end of it. The factors of production that received the first $1 billion spend $800 million. This second round of spending generates $800 million of new income. This new income, in turn, induces $640 million of third-round spending, and so it continues, with each successive round of new income generating 80 percent as much in new expenditure. Each additional round of expenditure creates new income and yet another round of expenditure.

The table carries the process through 10 rounds. Students with sufficient patience (and no faith in mathematics) may compute as many rounds in the process as they wish; they will find that the sum of the rounds of expenditures approaches a limit of $5 billion, which is five times the initial increase in expenditure. [31]

The graph of the cumulative expenditure increases shows how quickly this limit is approached. The multiplier is 5, given that the marginal propensity to spend is 0.8. Had the marginal propensity to spend been lower, say, 0.667, the process would have been similar, but it would have approached a limit of three instead of five times the initial increase in expenditure.

Round of spending	Increase in Expenditure (millions of dollars)	Cumulative Total
1 (initial increase)	1000.0	1000.0
2	800.0	1800.0
3	640.0	2440.0
4	512.0	2952.0
5	409.6	3361.6
6	327.7	3689.3
7	262.1	3951.4
8	209.7	4161.1
9	167.8	4328.9
10	134.2	4463.1
11 to 20 combined	479.3	4942.4
All others	57.6	5000.0



The multiplier

Deriving The Simple Multiplier

Basic algebra is all that is needed to derive the exact expression for the multiplier. Readers who feel at home with algebra may want to follow this derivation. Others can skip it and rely on the graphical and numerical arguments that have been given in the text.

First, we derive the equation for the *AE* curve. Desired aggregate expenditure can be decomposed into autonomous expenditure and induced expenditure. In the simple model of this chapter, autonomous expenditure is just equal to investment plus autonomous consumption. Induced expenditure is just equal to induced consumption.

Hence, we can write

$$AE = z\,Y + A \qquad [1]$$

where A is autonomous expenditure and $z\,Y$ is induced expenditure, z being the marginal propensity to spend out of national income. In the simple model of this chapter, with no government and no international trade, z is equal to the marginal propensity to consume.

Now we write the equation of the 45° line,

$$AE = Y \qquad [2]$$

which states the equilibrium condition that desired aggregate expenditure equals actual national income. Equations 1 and 2 are two equations with two unknowns, *AE* and *Y*. To solve them, we substitute Equation 1 into Equation 2 to obtain

$$Y = z\,Y + A \qquad [3]$$

Equation 3 can be easily solved to get Y expressed in terms of A and z. The solution is

$$Y = \frac{A}{1 - z} \qquad [4]$$

Equation 4 tells us the equilibrium value of Y in terms of autonomous expenditures and the marginal propensity to spend out of national income. Now consider a \$1 increase in A. The expression $Y = A/(1 - z)$ tells us that if A changes by one dollar, the change in Y will be $1/(1 - z)$ dollars. Generally, for a change in autonomous spending of ΔA, the change in Y will be

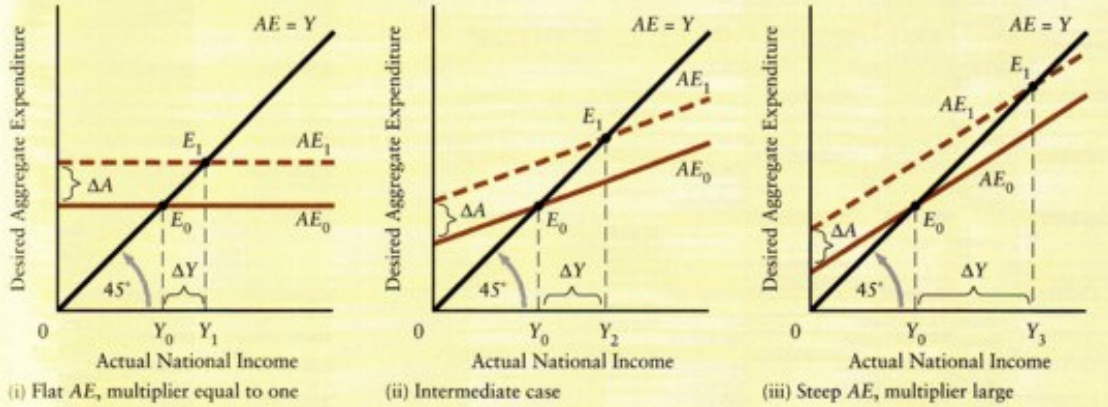
$$\Delta Y = \frac{\Delta A}{1 - z} \qquad [5]$$

Dividing through by ΔA gives the value of the multiplier, which is designated by K:

$$K = \frac{\Delta Y}{\Delta A} = \frac{1}{1 - z} \qquad [6]$$

The larger the marginal propensity to spend, the steeper the AE function and thus the larger the simple multiplier.

FIGURE 22-12 The Size of the Simple Multiplier



The larger the marginal propensity to spend out of national income (*z*), the steeper is the *AE* curve and the larger is the multiplier. In each part of the figure, the initial *AE* function is AE_0, equilibrium is at E_0, with income Y_0. The *AE* curve then shifts upward to AE_1 as a result of an increase in autonomous expenditure of ΔA. ΔA is the same in each part. The new equilibrium in each case is at E_1.

In part (i), the *AE* function is horizontal, indicating a marginal propensity to spend of zero ($z = 0$). The change in equilibrium income ΔY is only the increase in autonomous expenditure because there is no induced expenditure by the people who receive the initial increase in income. The simple multiplier is then equal to one, its minimum possible value.

In part (ii), the *AE* curve slopes upward but is still relatively flat (z is low). The increase in equilibrium national income to Y_2 is only slightly greater than the increase in autonomous expenditure that brought it about.

In part (iii), the *AE* function is quite steep (z is high). Now the increase in equilibrium income to Y_3 is much larger than the increase in autonomous expenditure that brought it about. The simple multiplier is quite large.

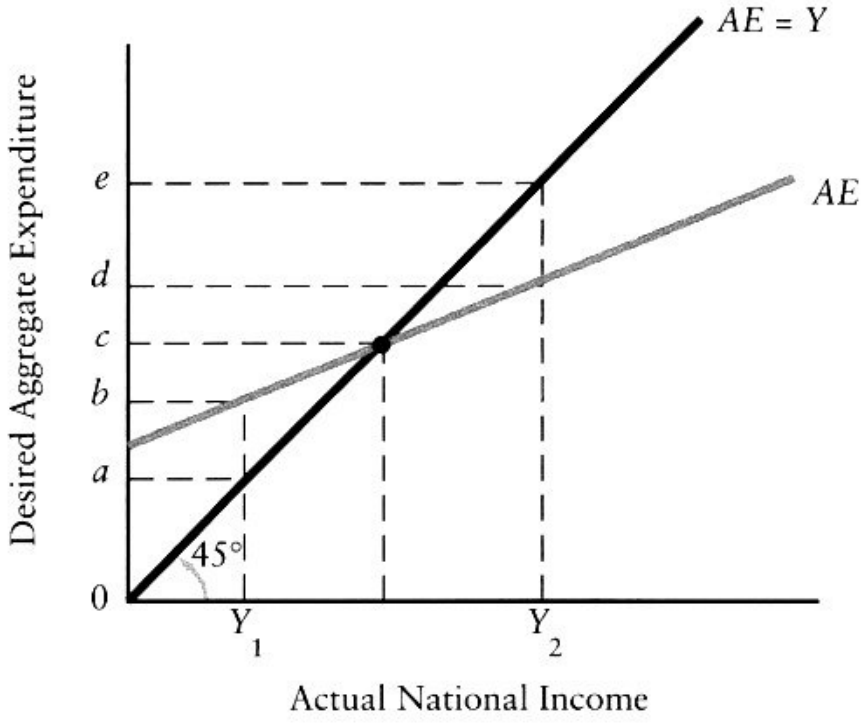
Exercises

1. Consider the following table for a household's consumption expenditures and disposable income. All values are expressed in real 1992 dollars.

Disposable Income (Y_D)	Desired Consumption (C)	$APC = C/Y_D$	$MPC = \Delta C/\Delta Y_D$
0	150	—	
100	225	—	—
200	300	—	—
300	375	—	—
400	450	—	—
500	525	—	—
600	600	—	—
700	675	—	—
800	750	—	—

   a. Compute the average propensity to consume for each level of income and fill in the table.
   b. Compute the marginal propensity to consume for each successive change in income and fill in the table.
   c. Plot the consumption function on a scale diagram. What is its slope?

2) Consider the following diagram of the AE function and the 45° line.



a. Suppose the level of actual national income is Y_1. What is the level of desired aggregate expenditure? Is it greater or less than actual output? Are inventories being depleted or accumulated?
b. If actual income is Y_1, explain the process by which national income changes toward equilibrium.
c. Suppose the level of actual national income is Y_2. What is the level of desired aggregate expenditure? Is it greater or less than actual output? Are inventories being depleted or accumulated?
d. If actual income is Y_2, explain the process by which national income changes toward equilibrium.

5. Suppose that you are given the following information for an economy without government spending, exports, or imports. C is desired consumption, I is desired investment, and Y is income. C and I are given by:

$$C = 1400 + 0.8Y$$
$$I = 400$$

a. What is the equation for the aggregate expenditure (AE) function?
b. Applying the equilibrium condition that $Y = AE$, determine the level of equilibrium national income.
c. Using your answer from part **b**, determine the values of consumption, saving and investment when the economy is in equilibrium.

4) What happens to the level of national income if every household in the economy tries to increase its level of desired savings? Will it increase? Fall? Will saving end up being more, less, the same as initially?