Supplementary material for Chapter 9

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9.8 Understanding aggregate demand and the multiplier in terms of the Keynesian cross model (supplementary material, recommended for higher level)

This material is included for the interested reader as a continuation of Chapter 9, section 9.8 (textbook page 264).

John Maynard Keynes was a famous British economist who lived in the twentieth century, and whose work laid the foundations for modern macroeconomics. The model presented here is attributed to him, though it is a simplification of his highly technical work. This model is very helpful for understanding some important macroeconomic concepts, including the relationship between aggregate demand and aggregate output (real GDP); the Keynesian idea of less than full employment equilibrium; and the multiplier effect.

Consumption and investment spending

We have defined both aggregate demand and real GDP to consist of $C+I+G+(X-M)$, yet the two are not the same. How is this possible? To understand this, we must begin by making a distinction between *actual expenditure*, and *desired expenditure*. Aggregate output, or real GDP, is measured by adding up all *actual expenditures*, $C+I+G+(X-M)$, for the purchase of output (in the expenditure approach). Aggregate demand, on the other hand, is concerned with all *desired aggregate expenditures*, which adds up *desired* $C+I+G+(X-M)$ for the purchase of output.

With this distinction in mind, we begin with a simple version of the model that includes only consumers and firms, and therefore only desired consumption (C) and desired investment (I) spending.

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Desired consumption and desired investment spending

It is assumed that desired consumption, consisting of expenditures consumers desire to make in order to buy final goods and services, depends on consumers' real income. There is a positive, causal relationship between real income and consumption, shown in Figure 1(a), where the vertical axis measures desired spending (the dependent variable), and the horizontal axis measures real income (Y, the independent variable).[1] The higher the income, the greater is desired consumption spending. Note that the area between the two axes is cut by a line making a 45-degree angle with the horizontal axis. This line represents all points of equality between the variables measured on the two axes, and therefore equality between desired spending and income. Therefore at point b, desired consumption spending is exactly equal to income; at a, desired consumption is greater than income, while at c, desired consumption is less than income.

The C line, representing consumption spending, is called a **consumption function**, because C is a function of national income, Y. Since it is a straight line, it has a constant slope, given by $\frac{\Delta C}{\Delta Y}$ (the change in the dependent variable divided by the change in the independent variable, between any two points[2]). The slope of the C function has a special meaning. It is the **marginal propensity to consume** (*MPC*), representing the change in desired consumption that results when there is a change in income. For example, suppose that income increases by \$1000 million and consumption spending increase by \$750 million. The slope, or *MPC*, is $\frac{750}{1000} = \frac{3}{4}$.

You may be wondering why the consumption function shown in Figure 1(a) has the particular shape

[1] Note that income, the independent variable, is plotted on the horizontal axis, following correct mathematical convention; see 'Quantitative techniques' chapter, on the CD-ROM, page 11.

[2] In the chapter 'Quantitative techniques' on the CD-ROM, page 18, the slope was defined as the change in the dependent variable divided by the change in the independent variable, between any two points on a straight line. Here, because of the use of the correct mathematical practice of plotting the dependent variable on the vertical axis, the slope is the vertical change divided by the horizontal change. This differs from the slope in demand and supply functions because of the reversal of the axes (see 'Quantitative techniques' chapter, pages 19 and 21).

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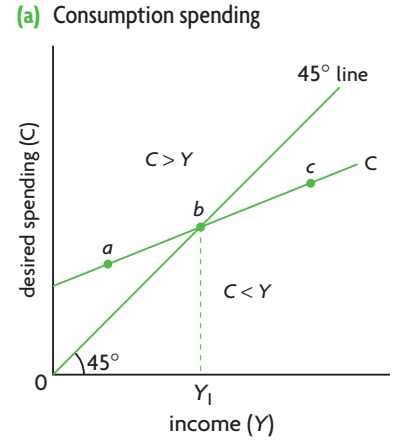

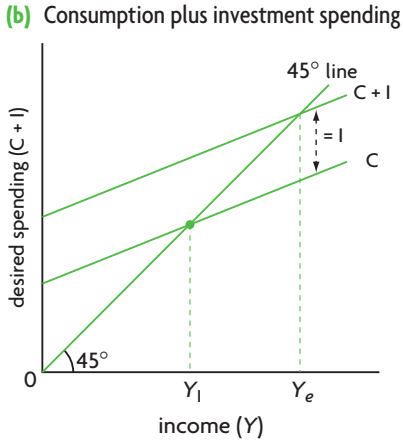

Figure 1 The Keynesian cross model with consumption and investment spending

it has. The answer has to do with desired saving. Income is equal to desired consumption plus desired saving. Abbreviating saving as S, we can write $Y = C+S$. When income is low (lower than Y_1 in the figure) and $C>Y$, saving is negative, because income is too low to provide consumers with enough money to buy their necessities (negative saving means that consumers are borrowing or else spending past savings from previous years). When incomes are higher (higher than Y_1) and $C<Y$, saving is positive.

What happens to desired saving; where does the money that consumers want to save go? To answer this question, we must recall the circular flow model with leakages and injections, where we saw that saving, a leakage from the spending flow, is matched by investment, an injection into the spending flow. We will now add investment spending to our model, which is assumed to be independent of income, and so is a constant amount for all income levels. We simply add desired investment spending to desired consumption spending, in order to arrive at total desired spending, shown in Figure 1(b). You can see that desired investment spending is a constant amount for all income levels, because the $C+I$ line is parallel to the C line.

Any kind of spending that is independent of income (meaning it is not 'caused' by income) is called *autonomous spending*. By contrast, any kind of spending that is dependent on income (is 'caused' by income) is called *induced spending*. Therefore, while consumption spending is induced, investment spending is autonomous.[3]

Equilibrium level of income and output

Now remember from the circular flow model that national income is equal to the value of aggregate output, or real GDP. This means we can re-label the horizontal axis of our diagram as in Figure 2(a).

We are now ready to put together all our information and arrive at some important conclusions using Figure 2(a), which is the same as Figure 1(b) except that the C line (the consumption function) has been left out. We can see immediately that at point e, total desired spending of consumers and firms is exactly equal to national income or real GDP. This means that the amount that consumers and firms want (desire) to buy is exactly equal to the amount that is actually produced. *This is the equilibrium level of output in this model, shown as* Y_e.

What happens when real GDP produced is less than Y_e? At Y_1, the amount consumers and firms want to buy (point a) is greater than the quantity of real GDP produced (point b). At Y_1, there is insufficient output to satisfy consumers' and firms' spending desires. On the other hand, if real GDP is greater than Y_e, such as Y_2, the amount that consumers and firms want to buy (point d) is less than real GDP produced (point c). Too many goods and services are being produced relative to what consumers and firms want to buy.

If the economy finds itself producing too much or too little real GDP relative to what buyers want, how is equilibrium restored? At Y_1, with too much spending relative to output produced, firms' inventories (unsold stocks from production of previous years) are sold, thus providing firms with the signal to increase production, causing real GDP to increase to Y_e. At Y_2, with too little spending relative to what is produced, firms' inventories increase, providing firms with the signal that they are producing too much, causing them to cut back on production, so real GDP falls

[3] Actually, only a portion of consumption spending is induced. When income is zero, there is a positive level of consumption spending (given by the vertical-intercept of the consumption function); this is autonomous consumption. All consumption above this level is induced, as it is 'caused' by income.

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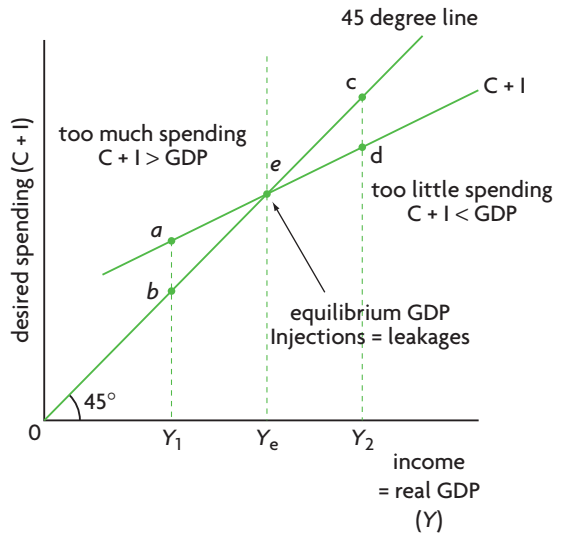
(a) Equilibrium in the Keynesian cross model with *C* and *I*



(b) Equilibrium in the Keynesian cross model with *C*, *I*, *G*, and (*X* − *M*)

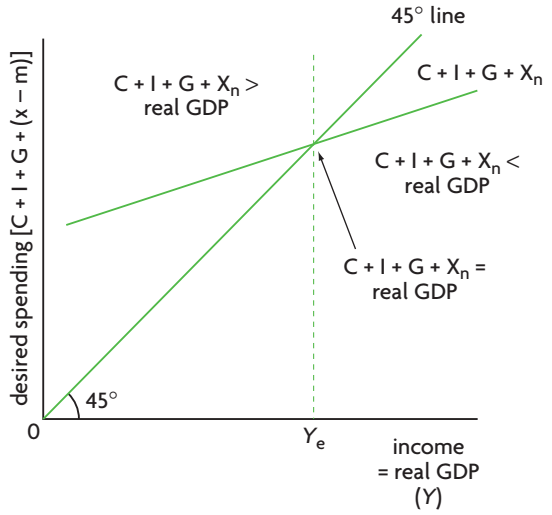


Figure 2 Equilibrium in the Keynesian cross model

to Y_e. Through this mechanism involving changes in inventories that provide signals to firms on whether they should produce less or more, equilibrium real GDP is restored.

We can also understand the meaning of Y_e by thinking in terms of leakages and injections. Recall that saving is a leakage and investment is an injection into the income flow. Since saving is that part of income that is not consumed, it follows that when total desired spending ($C+I$) is exactly equal to income, desired saving, or the leakage must be equal to desired investment, or the injection. Therefore, Y_e is the only level of real GDP where desired saving is exactly equal to desired investment, so that the leakage equals the injection.

Adding government and the foreign sector

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It is assumed that government spending (G), and spending of foreigners for exports minus the spending of domestic residents for imports ($X-M$ or X_n for net exports) are independent of national income, and are therefore autonomous. It is thus a simple matter to add them into our model. We do so simply by adding $G+(X-M)$ to the $C+I$ function, as shown in Figure 2(b).

It may be noted that adding X, which is an injection into spending, works to increase total desired spending, while adding M, a leakage, works to decrease it. Therefore, whether the addition of $(X-M)$ will increase or decrease total desired spending depends on the relative size of exports and imports. If $X>M$, then $(X-M)>0$, and desired spending increases. However if $X<M$, then $(X-M)<0$, and desired spending decreases. It should also be noted that the addition of government spending G is actually more complicated than shown in Figure 2(b) because of the role of taxes, which are ignored here for simplicity.

$C+I+G+X_n$, representing total desired spending, are referred to as **aggregate expenditure**. When aggregate expenditure is equal to real GDP, the economy is in equilibrium, as seen in Figure 2(b). At this equilibrium, the sum of leakages is equal to the sum of injections, so that:

$$S+T+M=I+G+X$$

It is easy to understand the meaning of this equilibrium if we refer to the principle we studied in the circular flow model (see Chapter 8 of the textbook, page 217): in any given time period, the value of output produced by an economy is equal to the total income that is generated in producing that output, which is equal to the expenditures made to purchase that output. When the economy is at equilibrium in the Keynesian cross model, the value of output (real GDP) is exactly equal to the spending that purchases that output. This is made possible by the equality between injections and leakages. If the sums of injections and leakages are not equal to each other, the economy cannot be in equilibrium, because desired spending to buy output will be different from the value of output actually produced.

Relating aggregate expenditure to aggregate demand

You may have noticed that in the discussion above, there was no mention of the price level. The reason is that in the Keynesian cross model, total desired

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spending and real GDP are compared for a *single given price level*. The Keynesian cross model does not show changes in the price level. The question that arises is what happens if the price level changes?

Consider Figure 3, showing an aggregate expenditure curve, AE_1, for a price level 1, with equilibrium real GDP Y_{e1}. Suppose there is an increase in the price level, from price level 1 to price level 2. This will appear in the figure as a downward shift of the entire aggregate expenditure function, to AE_2. With AE_2, the equilibrium level of real GDP falls from Y_{e1} to Y_{e2}. If the price level increases further to price level 3, the AE function shifts further downward to AE_3, and equilibrium GDP falls to Y_{e3}.

Why does an increase in the price level cause a fall in aggregate expenditures? There are three reasons for this:

- A higher price level means a decrease in the real value of wealth; consumers feel worse off and cut back on their desired level of spending.
- A higher price level means an increase in the demand for money, resulting in higher interest rates that cause the desired spending of consumers and firms to decrease due to the higher cost of borrowing.
- A higher price level means exports become more expensive to foreigners, while imports become less expensive to domestic buyers, causing X_n to fall.

Note that these reasons are exactly what accounts for the downward-sloping aggregate demand curve. In fact, by varying the price level in the Keynesian cross model, *we are deriving the aggregate demand curve*. This can be seen in Figure 3(b), which derives an aggregate demand curve from the corresponding equilibrium points of the Keynesian cross model. In Figure 3(a), at price level 1, equilibrium is at point a, which corresponds to point a of the aggregate demand curve in Figure 3(b). As the price level falls, equilibrium moves to point b, and then to point c, resulting in the corresponding points of the aggregate demand curve.

We thus arrive at an important conclusion:

> Each point on the aggregate demand curve corresponds to a particular price level where the amount of output buyers want to buy is just that output that generates the spending needed to buy the output (recall the circular flow model).

We can now return to our initial question: how is it that aggregate demand and real GDP, two very different concepts, are both defined in terms of $C+I+G+(X-M)$? The answer is that real GDP, appearing on the horizontal axis, shows various quantities of aggregate output that can be produced. If we were to measure this output for a particular year, we would add up the *actual spending* of the four groups of buyers ($C+I+G+(X-M)$) in order to obtain the value of aggregate output. Aggregate demand, on the other hand, shows the amount of aggregate output that the four groups of buyers *want to buy at each possible price level*, when that output generates just enough spending allowing them to buy that output.

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The Keynesian cross model and output gaps

Output gaps were noted in our discussion of the business cycle in Chapter 8 (page 232), as well as in Chapter 9 (pages 244 and 252). They arise whenever actual output differs from potential output. We can now see how output gaps arise in the context of the Keynesian cross model, shown in Figure 4. In both parts, Y_p represents potential output, which is full employment output. Y_e represents the equilibrium level of output, determined by the level of aggregate expenditures, AE_e. Note that *the equilibrium level of output need not be equal to potential output.*

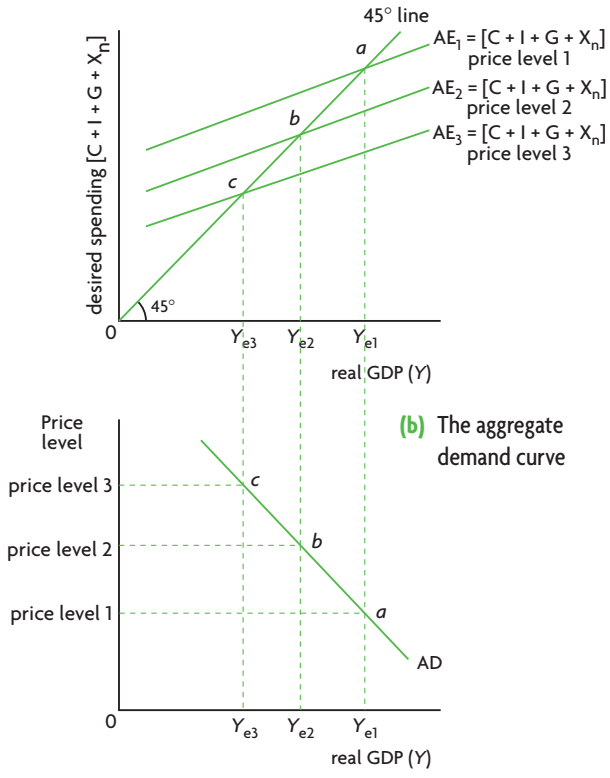

Figure 3 Relating aggregate demand to aggregate expenditure

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In part a, where Y_e is less than Y_p, there is an output gap called a **recessionary gap** (or **deflationary gap**). At Y_e, there is unemployment and recession. Actual equilibrium output is less than potential output, and unemployment is greater than the natural rate of unemployment. For potential output to be achieved, it would be necessary for aggregate expenditures to increase to the level of the dotted line, represented by AE_p.

In part (b), Y_e is greater than Y_p, and here there is an output gap called an **inflationary gap**. Actual equilibrium output is greater than potential output, and unemployment is less than the natural rate of unemployment. For potential output to be achieved, it would be necessary to have lower aggregate expenditures at the level of AE_p, shown by the dotted line.

However, there is nothing to guarantee that aggregate expenditures will be at the level of AE_p in both parts (a) and (b). This leads to the following important conclusion (which you are already familiar with from Chapter 9).

In the Keynesian cross model, equilibrium can occur at any level of output, and there is nothing to guarantee that the equilibrium level of output will be the same as potential output. Recessionary (deflationary) gaps or inflationary gaps may persist indefinitely.

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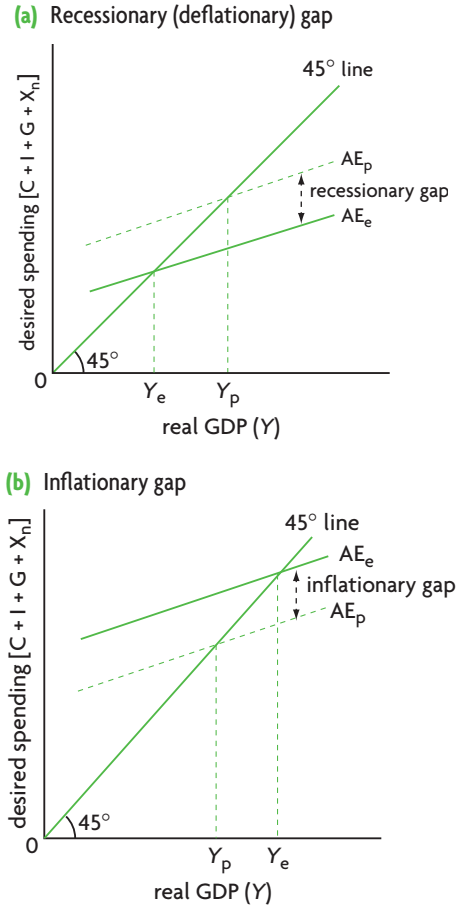

Figure 4 Output gaps in the Keynesian cross model

The Keynesian multiplier

The Keynesian multiplier can be very conveniently illustrated by use of the Keynesian cross model. According to the Keynesian multiplier effect, whenever there is an autonomous change in any of the components of aggregate expenditure (C, I, G or $X-M$), a *larger change* in real GDP results. Consider Figure 5, showing an initial aggregate expenditure function AE_1, with equilibrium real GDP at Ye_1. Suppose there is an increase in investment spending of ΔI. This will cause aggregate expenditures to shift upward to AE_2 ($= AE_1 + \Delta I$), with the new equilibrium real GDP at Ye_2. As you can see in the figure, the increase in real GDP, shown by $Y_2 - Y_1$ is larger than ΔI.

The multiplier effect has caused real GDP to increase by more than the increase in the component of aggregate expenditure. The increase in real GDP, or the difference between Y_2 and Y_1, consists of two parts: one is an increase due to the increase in autonomous investment expenditure equal to ΔI; and the rest is an increase due to induced consumption expenditure. This idea corresponds to Figure 9.17 (page 262), where the total increase in aggregate demand is broken down into two parts: that due to an increase in autonomous investment spending and that due to induced consumption spending.

Also, note that the increase in real GDP from Ye_1 to Ye_2 in Figure 5 is the result of the full multiplier effect, which can only occur when the price level is constant (see page 263 in the textbook). Since the Keynesian cross model presupposes a constant price level, this means that an increase in autonomous spending and the subsequent increases in induced spending will be felt in their entirety as increased output. This can be seen in Figure 9.18 (page 263) as the *AD* shift that takes place entirely within the horizontal part of the *AS* curve, which represents a constant price level.

The multiplier is a Keynesian concept showing the power of increased spending to induce larger increases in real GDP when the economy is in recession and is not experiencing upward pressures on the price level.

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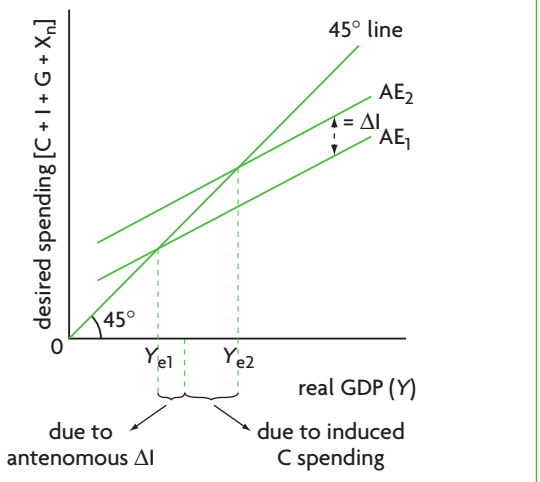

Figure 5 Illustrating the Keynesian multiplier

It is now also possible to use Figure 5 to understand the relationship between the size of the multiplier and the *MPC*. As you know, the larger the *MPC*, the larger the multiplier (see page 262). Now that you know that the *MPC* is the slope of the aggregate expenditure function,[4] you can see why this is so. *The larger the slope of the aggregate expenditure function, the steeper the aggregate expenditure function, and the larger is the multiplier and increase in real GDP given a change in autonomous expenditure. The smaller the slope, the flatter the aggregate expenditure function, and the smaller the multiplier and the increase in real GDP given a change in autonomous expenditure.* To convince yourself that this is so, draw an aggregate expenditure function, AE_1, that is parallel to the horizontal axis; this has a slope = *MPC* = 0. Now assume an increase in investment spending equal to ΔI, and draw a new aggregate expenditure function, $AE_2 = AE_1 + \Delta I$; this will also be parallel to the horizontal axis. You will see that the resulting change in real GDP will be equal to ΔI. The reason is that when the *MPC* = 0, the multiplier of $\frac{1}{1 - MPC}$ is equal to 1. Therefore, the change in real GDP is equal to the change in investment spending, and induced consumption spending is zero.

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[4] Actually, the *MPC* is the slope of the consumption function, as we saw earlier. However, since the aggregate expenditure function is a parallel upward shift of the consumption function, the slope does not change.