The Keynesian Cross

In *The General Theory*, Keynes proposed that an economy's total income was, in the short run, determined largely by the desire to spend by households, firms, and the government. The more people want to spend, the more goods and services firms can sell. The more firms can sell, the more output they will choose to produce and the more workers they will choose to hire. Thus, the problem during recessions and depressions, according to Keynes, was inadequate spending. The Keynesian cross is an attempt to model this insight.

Planned Expenditure We begin our derivation of the Keynesian cross by drawing a distinction between actual and planned expenditure. *Actual expenditure* is the amount households, firms, and the government spend on goods and services, and as we first saw in Chapter 2, it equals the economy's gross domestic product (GDP). *Planned expenditure* is the amount households, firms, and the government would like to spend on goods and services.

Why would actual expenditure ever differ from planned expenditure? The answer is that firms might engage in unplanned inventory investment because their sales do not meet their expectations. When firms sell less of their product than they planned, their stock of inventories automatically rises; conversely, when firms sell more than planned, their stock of inventories falls. Because these unplanned changes in inventory are counted as investment spending by firms, actual expenditure can be either above or below planned expenditure.

Now consider the determinants of planned expenditure. Assuming that the economy is closed, so that net exports are zero, we write planned expenditure E as the sum of consumption C, planned investment I, and government purchases G:

$$E = C + I + G.$$

[1] The *IS–LM* model was introduced in a classic article by the Nobel Prize–winning economist John R. Hicks, "Mr. Keynes and the Classics: A Suggested Interpretation," *Econometrica* 5 (1937): 147–159.

To this equation, we add the consumption function

$$C = C(Y - T).$$

This equation states that consumption depends on disposable income $(Y - T)$, which is total income Y minus taxes T. To keep things simple, for now we take planned investment as exogenously fixed:

$$I = \bar{I}.$$

And as in Chapter 3, we assume that fiscal policy—the levels of government purchases and taxes—is fixed:

$$G = \bar{G},$$
$$T = \bar{T}.$$

Combining these five equations, we obtain

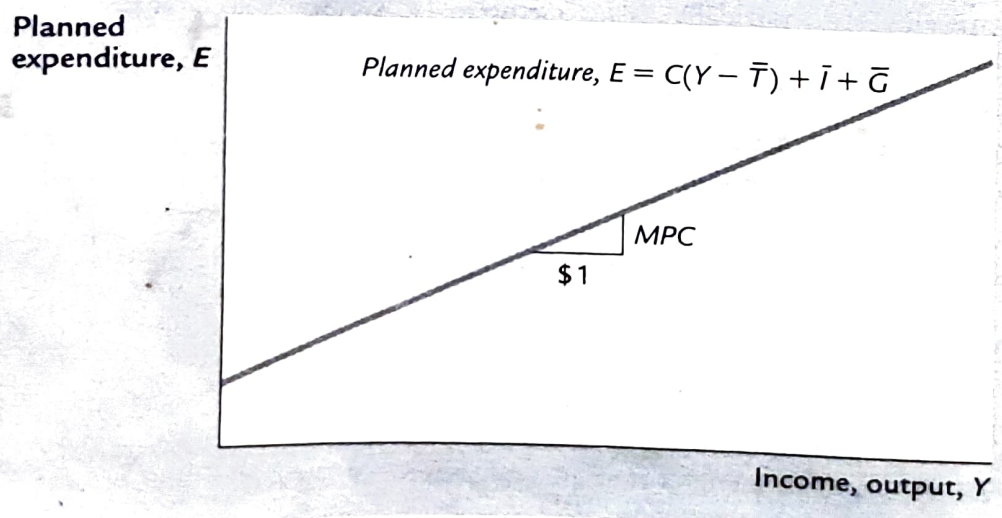
$$E = C(Y - \bar{T}) + \bar{I} + \bar{G}.$$

This equation shows that planned expenditure is a function of income Y, the level of planned investment $\bar{I}$, and the fiscal policy variables $\bar{G}$ and $\bar{T}$.

Figure 10-2 graphs planned expenditure as a function of the level of income. This line slopes upward because higher income leads to higher consumption and thus higher planned expenditure. The slope of this line is the marginal propensity to consume, the *MPC:* it shows how much planned expenditure increases when income rises by \$1. This planned-expenditure function is the first piece of the model called the Keynesian cross.

The Economy in Equilibrium The next piece of the Keynesian cross is the assumption that the economy is in equilibrium when actual expenditure equals planned expenditure. This assumption is based on the idea that when people's plans have been realized, they have no reason to change what they are doing.

figure 10-2



Planned Expenditure as a Function of Income Planned expenditure depends on income because higher income leads to higher consumption, which is part of planned expenditure. The slope of this planned-expenditure function is the marginal propensity to consume, *MPC*.

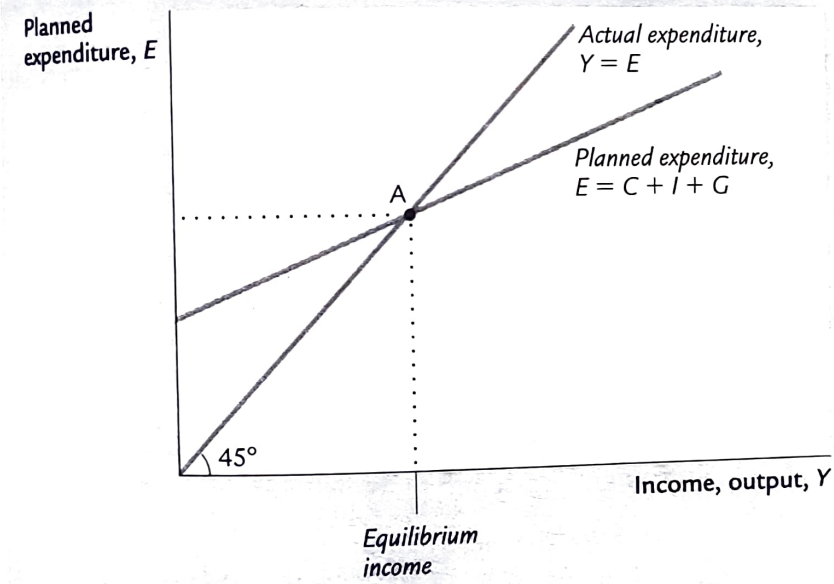
Recalling that Y as GDP equals not only total income but also total actual expenditure on goods and services, we can write this equilibrium condition as

$$\text{Actual Expenditure} = \text{Planned Expenditure}$$
$$Y = E.$$

The 45-degree line in Figure 10-3 plots the points where this condition holds. With the addition of the planned-expenditure function, this diagram becomes the Keynesian cross. The equilibrium of this economy is at point A, where the planned-expenditure function crosses the 45-degree line.

How does the economy get to the equilibrium? In this model, inventories play an important role in the adjustment process. Whenever the economy is not in equilibrium, firms experience unplanned changes in inventories, and this induces them to change production levels. Changes in production in turn influence total income and expenditure, moving the economy toward equilibrium.

figure 10-3

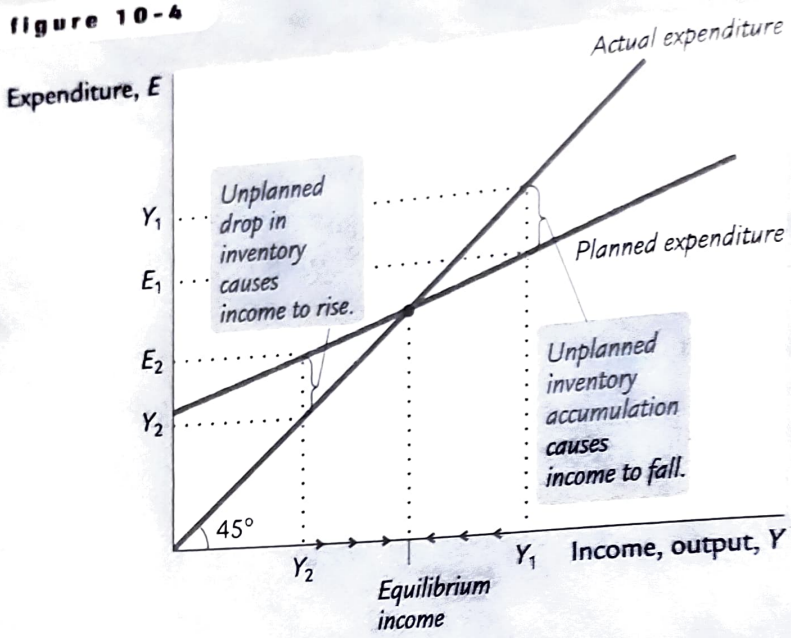


The Keynesian Cross The equilibrium in the Keynesian cross is at point A, where income (actual expenditure) equals planned expenditure.

For example, suppose the economy were ever to find itself with GDP at a level greater than the equilibrium level, such as the level Y_1 in Figure 10-4. In this case, planned expenditure E_1 is less than production Y_1, so firms are selling less than they are producing. Firms add the unsold goods to their stock of inventories. This unplanned rise in inventories induces firms to lay off workers and reduce production, and these actions in turn reduce GDP. This process of unintended inventory accumulation and falling income continues until income Y falls to the equilibrium level.

Similarly, suppose GDP were at a level lower than the equilibrium level, such as the level Y_2 in Figure 10-4. In this case, planned expenditure E_2 is greater than production Y_2. Firms meet the high level of sales by drawing down their inventories.

figure 10-4

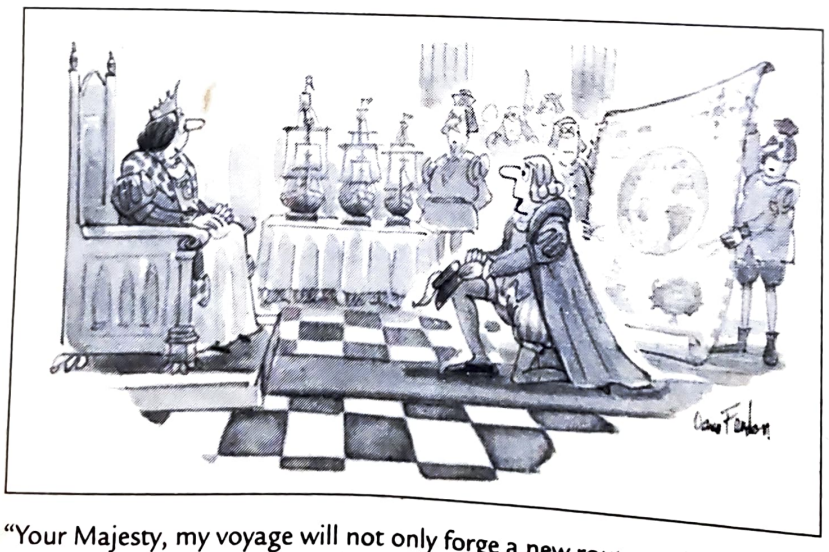


The Adjustment to Equilibrium in the Keynesian Cross If firms were producing at level Y_1, then planned expenditure E_1 would fall short of production, and firms would accumulate inventories. This inventory accumulation would induce firms to reduce production. Similarly, if firms were producing at level Y_2, then planned expenditure E_2 would exceed production, and firms would run down their inventories. This fall in inventories would induce firms to raise production. In both cases, the firms' decisions drive the economy toward equilibrium.

But when firms see their stock of inventories dwindle, they hire more workers and increase production. GDP rises, and the economy approaches the equilibrium.

In summary, the Keynesian cross shows how income Y is determined for given levels of planned investment I and fiscal policy G and T. We can use this model to show how income changes when one of these exogenous variables changes.

Fiscal Policy and the Multiplier: Government Purchases Consider how changes in government purchases affect the economy. Because government purchases are one component of expenditure, higher government purchases result in higher planned expenditure for any given level of income. If government purchases rise by ΔG, then the planned-expenditure schedule shifts upward by ΔG, as in Figure 10-5. The equilibrium of the economy moves from point A to point B.

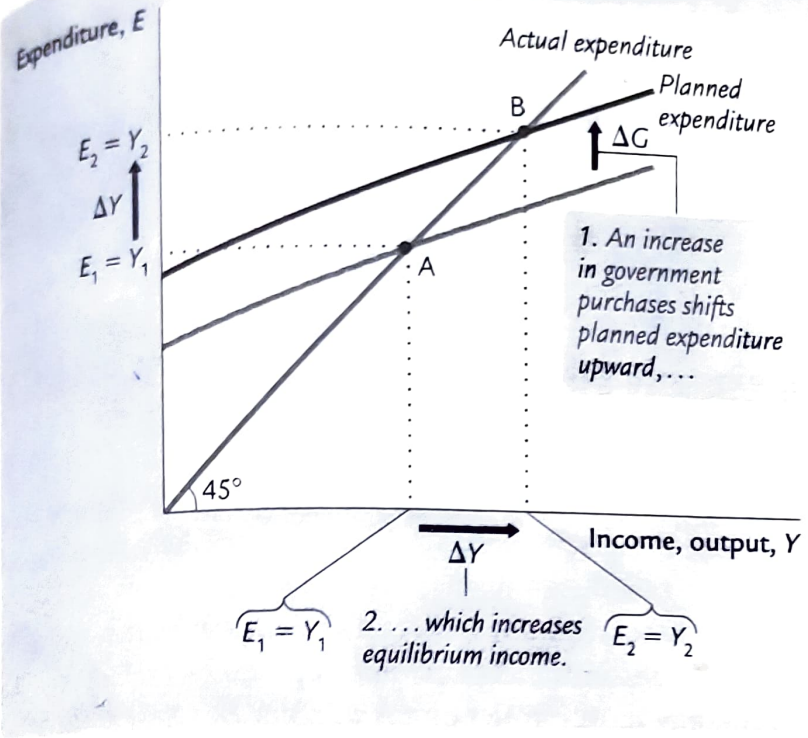


"Your Majesty, my voyage will not only forge a new route to the spices of the East but also create over three thousand new jobs."

This graph shows that an increase in government purchases leads to an even greater increase in income. That is, ΔY is larger than ΔG. The ratio $\Delta Y/\Delta G$ is called the **government-purchases multiplier**; it tells us how much income rises in response to a $1 increase in government purchases. An implication of the Keynesian cross is that the government-purchases multiplier is larger than 1.

Why does fiscal policy have a multiplied effect on income?

Figure 10-5



An Increase in Government Purchases in the Keynesian Cross
An increase in government purchases of ΔG raises planned expenditure by that amount for any given level of income. The equilibrium moves from point A to point B, and income rises from Y_1 to Y_2. Note that the increase in income ΔY exceeds the increase in government purchases ΔG. Thus, fiscal policy has a multiplied effect on income.

The reason is that, according to the consumption function $C = C(Y - T)$, higher income causes higher consumption. When an increase in government purchases raises income, it also raises consumption, which further raises income, which further raises consumption, and so on. Therefore, in this model, an increase in government purchases causes a greater increase in income.

How big is the multiplier? To answer this question, we trace through each step of the change in income. The process begins when expenditure rises by ΔG, which implies that income rises by ΔG as well. This increase in income in turn raises consumption by $MPC \times \Delta G$, where MPC is the marginal propensity to consume. This increase in consumption raises expenditure and income once again. This second increase in income of $MPC \times \Delta G$ again raises consumption, this time by $MPC \times (MPC \times \Delta G)$, which again raises expenditure and income, and so on. This feedback from consumption to income to consumption continues indefinitely. The total effect on income is

$$\begin{aligned}
\text{Initial Change in Government Purchases} &= \Delta G \\
\text{First Change in Consumption} &= MPC \times \Delta G \\
\text{Second Change in Consumption} &= MPC^2 \times \Delta G \\
\text{Third Change in Consumption} &= MPC^3 \times \Delta G \\
&\vdots \\
\Delta Y &= (1 + MPC + MPC^2 + MPC^3 + \cdots)\Delta G.
\end{aligned}$$

The government-purchases multiplier is

$$\Delta Y / \Delta G = 1 + MPC + MPC^2 + MPC^3 + \cdots$$

This expression for the multiplier is an example of an *infinite geometric series*. A result from algebra allows us to write the multiplier as[2]

$$\Delta Y/\Delta G = 1/(1 - MPC).$$

For example, if the marginal propensity to consume is 0.6, the multiplier is

$$\begin{aligned}\Delta Y/\Delta G &= 1 + 0.6 + 0.6^2 + 0.6^3 + \cdots \\ &= 1/(1 - 0.6) \\ &= 2.5.\end{aligned}$$

In this case, a \$1.00 increase in government purchases raises equilibrium income by \$2.50.[3]

Fiscal Policy and the Multiplier: Taxes Consider now how changes in taxes affect equilibrium income. A decrease in taxes of ΔT immediately raises disposable income $Y - T$ by ΔT and, therefore, increases consumption by $MPC \times \Delta T$. For any given level of income Y, planned expenditure is now higher. As Figure 10-6 shows, the planned-expenditure schedule shifts upward by $MPC \times \Delta T$. The equilibrium of the economy moves from point A to point B.

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[2] *Mathematical note:* We prove this algebraic result as follows. Let

$$z = 1 + x + x^2 + \cdots.$$

Multiply both sides of this equation by x:

$$xz = x + x^2 + x^3 + \cdots.$$

Subtract the second equation from the first:

$$z - xz = 1.$$

Rearrange this last equation to obtain

$$z(1 - x) = 1,$$

which implies

$$z = 1/(1 - x).$$

This completes the proof.

[3] *Mathematical note:* The government-purchases multiplier is most easily derived using a little calculus. Begin with the equation

$$Y = C(Y - T) + I + G.$$

Holding T and I fixed, differentiate to obtain

$$dY = C'dY + dG,$$

and then rearrange to find

$$dY/dG = 1/(1 - C').$$

This is the same as the equation in the text.