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Business Cycles: The Keynesian Approach

1 Introduction

In 1936 John Maynard Keynes published his book *"The General Theory of Employment Interest and Money"*. The background for his work was the great depression. As figure 1 shows, the real GDP per capita declined by almost 30% between 1929 and 1933 and the unemployment rate reached 25% in 1933.The great depression was indeed great, both in

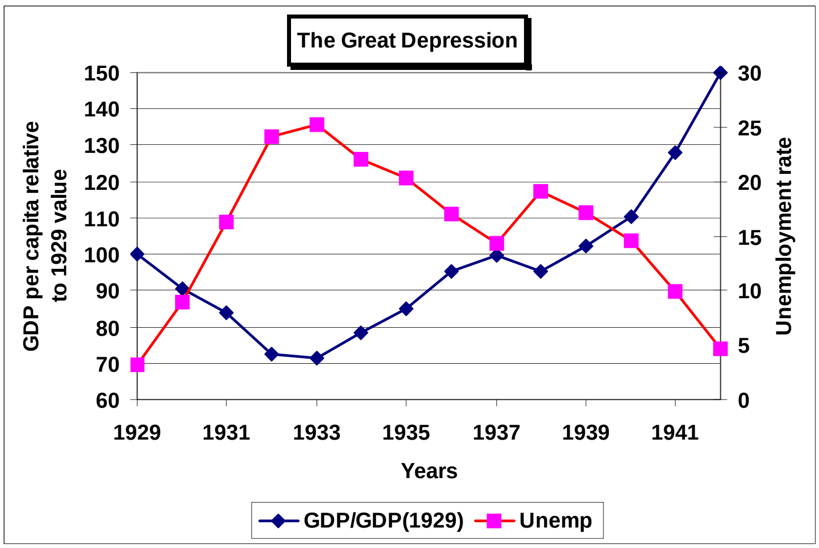

Figure 1: The Great Depression

magnitude and length. Notice that it took 10 years for GDP per capita to return to the 1929 level. In these notes we introduce one of many versions of a Keynesian model. In this model the driving force behind business cycles is fluctuations in investment (Keynes referred to this as "animal spirit" of investors), and unlike in the classical model, the government can implement policies that will smooth business cycles.

2 The (basic) Keynesian Model

In this model, we do not attempt to derive the behavior of firms and consumers from assumptions about their preferences, but instead we take a short cut and make assumptions about their behavior. In this model, total income and total output are assumed to be the same. The following are behavioral functions, that describe the behavior of consumers, investors and government.

1. Firms: produce output Y and invest $I = I_0$.

- Y is total output (GDP), which is assumed to be the same as total income.
- I is **planned** investment. For simplicity we assume that investment does not depend on output. The word planned is here because there is a possibility of unintended change in inventories as a result of firms not being able to sell everything they planned or the firms can experience unintended decline in inventories as a result of too much demand.

2. Government: $G = G_0$, $T = T_0 + tY$.

   - G is government spending, and it is assumed to be independent of total output. The taxes T have a fixed component, T_0 that does not depend on income, and taxes that depend on income tY, where t is the proportional tax rate.

3. Consumers: $C = C_0 + MPC \cdot (Y - T)$

   - C is total consumption in the economy.
   - $Y - T$ is disposable income, that is income net of taxes.
   - MPC is Marginal Propensity to Consume, i.e. the increase in consumption as disposable income increases by \$1. It is assumed that $0 < MPC < 1$. Suppose that MPC is 0.75, then this means that if disposable income goes up by \$1, then the consumption will increase by \$0.75.
   - $C_0 > 0$ is called autonomous consumption, the part of consumption that does not depend on income.
   - Using the government tax function, we can write the consumption function as

$$\begin{aligned} C &= C_0 + MPC \cdot (Y - T_0 - tY) \\ C &= C_0 - MPC \cdot T_0 + MPC\,(1-t)\,Y \end{aligned}$$

4. Planned aggregate expenditure: $E = C + I + G$, is what the consumers, the firms and the government are planning to spend at each level of total income. The planned expenditure might not be the same as the realized expenditure because of the investment (see above).

$$E = \underbrace{(C_0 - MPC \cdot T + MPC\,(1-t)\,Y)}_{C} + \underbrace{I_0}_{I} + \underbrace{G_0}_{G}$$

   Figure 2 illustrates the planned aggregate expenditure. Notice that consumption is increasing function of income Y, while investment and government spending is fixed. The planned aggregate expenditure function (labeled E) is the sum of all the expenditures.

5. Keynesian equilibrium in the goods market: the Keynesian equilibrium occurs when $Y = E$, that is when the total output is equal to what consumers, investors and government are planning to spend on it. The equilibrium output level is the level of Y that solves

$$Y = C_0 - MPC \cdot T + MPC\,(1-t)\,Y + I_0 + G_0 \tag{1}$$

   We denote the solution to equation (1) by Y^*.

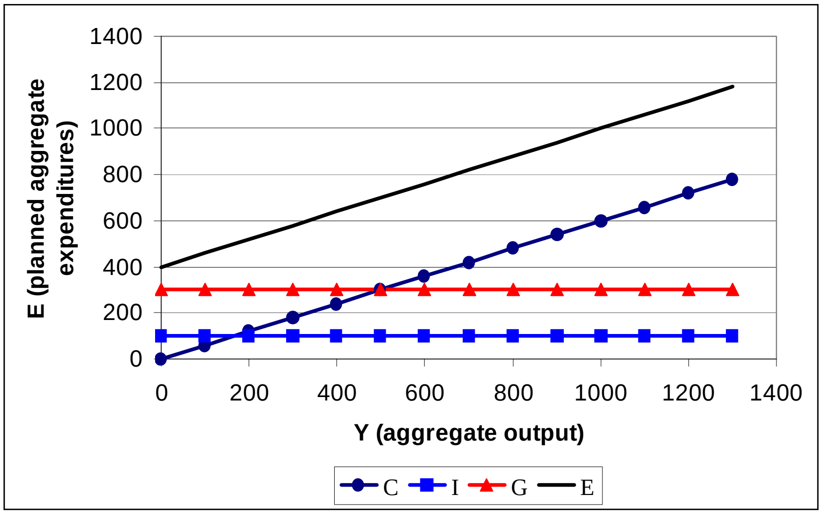

Figure 2: Planned aggregate expenditure.

2.1 Solving for equilibrium

Solving equation (1):

$$\begin{aligned} Y &= C_0 - MPC \cdot T + MPC\,(1-t)\,Y + I_0 + G_0 \\ Y - MPC\,(1-t)\,Y &= C_0 - MPC \cdot T + I_0 + G_0 \\ Y^* &= \frac{C_0 - MPC \cdot T + I_0 + G_0}{1 - MPC\,(1-t)} \end{aligned} \tag{2}$$

Figure 3 illustrates the Keynesian equilibrium in the goods market.

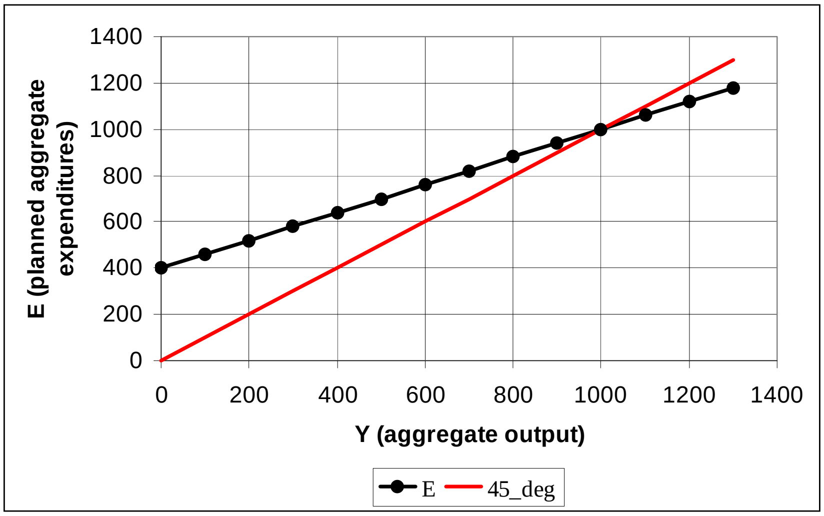

Figure 3: Keynesian equilibrium in the goods market.

The Keynesian equilibrium occurs at the point where planned aggregate expenditure is equal to the aggregate output (or aggregate income). The 45^0 line shows all the points where $E = Y$. Thus, the equilibrium is at the intersection of the E function with the 45^0 line. In the graph, the equilibrium output is $Y^* = 1000$.

To understand why this is an equilibrium, suppose that firms produced output above Y^*. At this output level the planned expenditure is less than the output so not all the output will be bought and inventories will pile up. The critical assumption is that **prices are fixed** so when firms can't sell all their products, theyreduce output. Similarly, if the firms produce less than Y^*, the planned expenditure is more than the output, so inventories will decline, encouraging firms to produce more. Thus, the unintended changes in inventories tend to navigate the production towards equilibrium.

Numerical example: suppose that the economy is described by the following behavioral functions.

$$\begin{aligned} C &= 75 + 0.75\,(Y - T) \\ I &= 100 \\ G &= 300 \\ T &= 100 + 0.2Y \end{aligned}$$

Solve for the Keynesian equilibrium in the goods market.

Solution. Equilibrium condition is:

$$\begin{aligned} Y^* &= \frac{C_0 - MPC \cdot T + I_0 + G_0}{1 - MPC\,(1-t)} \\ Y^* &= \frac{75 - 0.75 \cdot 100 + 100 + 300}{1 - 0.75\,(1 - 0.2)} \\ Y^* &= \frac{400}{0.4} \\ Y^* &= 1000 \end{aligned}$$

2.2 Business cycles and government policies

This version of the Keynesian model does not explicitly describe the labor market. There are no forces in this model that ensure that the equilibrium in the final goods market will coincide with full employment, i.e. **wages do not adgust** to restore equilibrium in the labor market. For example, with the above behavioral functions, we found that equilibrium output is $Y^* = 1000$. It is possible that when the economy produces this output, there is unemployment. Lets denote the output level associated with full employment by Y_f. It is possible that $Y^* < Y_f$, for example $Y^* = 1000$, while $Y_f = 1100$. If this is the case, then the economy is experiencing recession. According to Keynes, the equilibrium output falls bellow the full employment as a result of sudden drops in investment, because of pessimism of investors (investors are driven by "animal spirit"). In what follows, we assume that it is impossible to produce above Y_f.

Consider the above example, and suppose that investment falls by \$1. The new equilibrium output will be 399/0.4

$$Y^* = \frac{399}{0.4} = 997.5$$

Thus, the equilibrium output will fall by \$2.5, i.e. by more than the change in investment. In general, from equation (2) we see that any change of \$1 in autonomous magnitudes C_0, I_0, G_0 will result in a change of

$$m_k = \frac{1}{1 - MPC\,(1-t)} \tag{3}$$

in equilibrium output. The number m_k is called the Keynesian multiplier, and it gives the change in the equilibrium output that results from a \$1 change in autonomous expenditure. In the above numerical example, the multiplier is

$$m_k = \frac{1}{1 - 0.75\,(1-0.2)} = 2.5$$

Thus, a change of \$1 in C_0, I_0, G_0 will result in \$2.5 increase in equilibrium output. Formally,

$$\frac{\partial Y^*}{\partial C_0} = \frac{\partial Y^*}{\partial I_0} = \frac{\partial Y^*}{\partial G_0} = m_k$$

This suggests that the government is capable of eliminating business cycles simply by changing its spending G_0. Suppose that in the previous example, suppose that investment falls by \$10, how can the government change its spending in order to keep the equilibrium output at the same level as before? Answer: increase G by \$10.

2.2.1 Tax policies

From the equilibrium equation (2) we can easily find the effect of a change in the autonomous taxes.

$$Y^* = \frac{C_0 - MPC \cdot T + I_0 + G_0}{1 - MPC\,(1-t)}$$

Notice that

$$m_k\,(T) = \frac{\partial Y^*}{\partial T_0} = -\frac{MPC}{1 - MPC\,(1-t)}$$

In the above numerical example,

$$m_k\,(T) = -\frac{0.75}{1 - 0.75\,(1-0.2)} = -1.875$$

This means, that if the government increases T_0 by \$1, the equilibrium output will fall by \$1.875. Alternatively, if a government gives a tax break of \$1, this will increase the equilibrium output by \$1.875. Thus, the effect of a change in T_0 is 0.75 times the effect of C_0, I_0, G_0. Suppose that the investment falls by \$10, how can the government use the autonomous tax in order to keep the equilibrium output unchanged? Answer:

$$\begin{aligned} -0.75 \cdot \Delta T - 10 &= 0 \\ \Delta T &= -13\frac{1}{3} \end{aligned}$$

What about the proportional tax rate t? Notice that when $t \uparrow$, the Keynesian multiplier m_k goes down and the equilibrium output goes down as well. Look again at the equilibrium equation

$$Y^* = \frac{C_0 - MPC \cdot T + I_0 + G_0}{1 - MPC\,(1-t)}$$

Notice that t has two minus signs in front of it, that cancel each other, so t has a positive sign. But t is in the denominator, so higher t reduces the entire fraction. Thus, the government in this model has the option of giving a tax break by reducing the proportional tax rate.

Example. Suppose that the government in the above example, reduces the tax rate from $t = 0.2$ to $t = 0.15$. Find the new equilibrium output Y^*.

Solution.

$$\begin{aligned} Y^* &= \frac{C_0 - MPC \cdot T + I_0 + G_0}{1 - MPC\,(1-t)} \\ Y^* &= \frac{75 - 0.75 \cdot 100 + 100 + 300}{1 - 0.75\,(1 - 0.15)} \\ Y^* &= \frac{75 - 0.75 \cdot 100 + 100 + 300}{1 - 0.75\,(1 - 0.15)} = 1103.45 \end{aligned}$$

3 Summary

We presented two models that give predictions about the equilibrium output. The models give different answer to the 3 questions that we posted.

Question	Classical Model	Keynesian Model
1. What causes business cycles?	Shocks to productivity	Shocks to investment
2. Can the government smooth them?	No	Yes, if $Y^* < Y_f$
3. Should the government smooth them?	No	Yes, if $Y^* < Y_f$