Keynesian Theory (IS-LM Model): how GDP and interest rates are determined in Short Run with Sticky Prices.

Historical background: The Keynesian Theory was proposed to show what could be done to shorten the Great Depression. The key idea is that during recessions producers have excessive capacity, they can supply any quantity at given price. That means the supply curve is flat (sticky price). In that case, the equilibrium quantity is determined by demand only. In other words, inadequate demand leads to insufficient quantity (recession). Recession can be avoided by increasing demand!

Chapter 3: The Goods Market (Keynesian Cross)

The key idea is that, person A’s expenditure will become person B’s income, so B will spend, then person C’s income will rise, and C will spend, so on. In short, there are successive increases in output after someone spends.

First of all, the aggregate demand for domestic goods can be decomposed as

\[ Z = C + I + G + X - IM \] (1)

This is an identity so we use \( \equiv \). In other words, such decomposition is always possible, see Table 3-1.

Q1: which component will change if US government starts a new war against ISIS? Which component will be affected, in what way, by the fact that US dollar is appreciating?

Next, we try to explain each component. For consumption, we let it be determined by disposable income. The consumption function is given by

\[ C = C_0 + C_1Y_D = C_0 + C_1(Y - tax + transfer) \] (2)

where \( C_0 \) is called ________________________________, and can be interpreted as___________________

\( C_1 \) is called ________________________________, and can be interpreted as___________________.

If people save some of their additional income, then \( C_1 \) satisfies the inequality restriction that ________________________

Equation (2) is an example of behavior equation. The consumption function can be represented by a graph:

Q2: Are there other factors that affect \( C \)?

Q3: Suppose everyone holds stocks, and the stock prices rise (so people feel wealthier than before, even though their incomes are unchanged), then \( (C_0 \quad C_1) \) will go (up    down). Can you draw a new graph?
For simplicity, we assume closed economy (no trade), so _________________. We also assume (for a moment) investment and government purchase are given (determined outside the model, or exogenous), so _________________.

Now the aggregate demand is

\[ Z \equiv C_0 + C_1Y_D + I + G \quad (Aggregate \ Demand) \quad (3) \]

At equilibrium, the aggregate supply (total output, GDP) equals aggregate demand:

\[ Y = Z \quad (Equilibrium \ Condition: \ Aggregate \ Supply = \ Aggregate \ Demand) \]

If we put \( Y \) on the horizontal axis, \( Z \) on the vertical axis, then the equilibrium can be represented by a 45-degree straight line.

Keynesian Cross just puts the two graphs together, and the intersection gives the equilibrium \( Y \) and \( C \) (two endogenous variables).

Q4: What will happen to equilibrium \( Y \) when \( G \) rises?

You may notice that the increase in \( Y \) may be greater than the increase in \( G \). So one dollar government expenditure may generate more than one dollar GDP. This fact is called multiplier effect of expansionary fiscal policy. We can show the multiplier easily using calculus:

\[ Y = Z \quad \rightarrow \quad Y = C_0 + C_1(Y - T) + I + \bar{G} \rightarrow \]

\[ Y = \]

\[ \frac{dY}{dG} = \]

Alternatively, we can derive the multiplier using geometric series:

To summarize, macro models typically consists of the identity, the behavior equation and the equilibrium condition. The variables are solved inside the model are endogenous. The variables whose values are given (outside the model) are exogenous. Comparative Static Analysis is concerned with how exogenous variables affect endogenous variables.
Chapter 4: The Financial Market (The Theory of Liquidity Preference)

One limitation of the Keynesian Cross is that investment is treated as exogenous. In reality, investment (buying new house or new capital goods) depends on interest rates. In this chapter we learn how interest rate is determined. Then we can allow investment to be endogenous.

**Key idea 3:** people face a simple portfolio choice, whether to hold money or hold bonds (there is tradeoff).

Money is convenient to use (highly liquid), but earns no interest.

Bonds earn interests, but need to be sold for money (not liquid) before being used in transaction.

Everything else equal, if interest rate rises, the opportunity cost of holding money will go (up down). Thus the demand for money will (rise fall). So the money demand is (positively negatively) related to interest rate.

If we put interest rate (denoted by letter $i$) on the vertical axis, and the quantity of money (liquidity, denoted by letter $M$) on the horizontal axis, the money demand curve looks like

Q1: Money demand curve shifts (right left) if people’s income rises (more transactions will happen). See Figure 4-1

Q2: Discuss: how does the introduction of credit card affect money demand?

Now we need a money supply curve. For simplicity, we assume the money supply is controlled by the central bank (Federal Reserve or Fed in US), and is independent of interest rate. So the money supply curve looks like

Q3: Interest rate will go (up down) when Fed increases money supply, see Figure 4-4

Q4: Interest rate will go (up down) when people expect high inflation is coming.
In reality, Fed changes money supply through open-market operations (OMO). The money supply increases when the Fed buys bonds (open-market purchase, or expansionary open market operation), and money supply decreases when Fed sells bonds (contractionary open market operation).

OMO will change the balance sheet of Fed. See Figure 4-5. Note that money is asset for everyone, except Fed. Money is liability for Fed! By comparing the balance sheet of Fed before and after, we can figure out what happens to money supply.

There is another way to look at how OMO affects interest rates. Essentially, interest rate is a rate of return (yield). Let $P_B$ be the today’s price of treasury bill (T-bill, a short term bond), which will pay you the face value $100 after one year. The rate of return, yield or interest rate is

$$i = \frac{100 - P_B}{P_B} \rightarrow P_B = \frac{100}{1+i}$$ (5)

The last equation shows that the bond price and interest rate are (positively  negatively) related.

Now suppose Fed buys T-bills, which is (expansionary  contractionary) open market operation. This will lead to (increase  decrease) in the demand for T-bill. Then the price of T-bill $P_B$ will (rise  fall), and interest rate will (rise  fall). We get the same conclusion as Figure 4-4.

Q5: Is it possible that OMO cannot change interest rate at all?

Q6: Suppose Fed increases money supply, but the new money goes to abroad rather than staying in US. What will happen to US interest rate?
Chapter 5: Goods and Financial Markets Together (IS-LM Model)

Partial equilibrium analysis investigates one market at a time. General equilibrium analysis look at all markets jointly. IS-LM model a general equilibrium analysis, in which goods and financial markets are considered simultaneously.

First we let investment to depend on GDP and interest rate. The goods market is described by $Y = Z$, i.e.,

$$Y = C(Y - T) + I(Y, i) + \bar{G}, \quad \frac{dC}{d(Y - T)} > 0, \quad \frac{dI}{di} < 0$$  \hspace{1cm} (6)

The last two derivatives indicate that as disposable income rises, consumption (rises falls); as interest rate rises, investment (rises falls).

Now consider the generalized Keynesian Cross. After the interest rate rises, investment will (rise fall). So for each given $Y$, aggregate demand $Z$ will go (up down). That means the aggregate demand curve will shift _____________. This will cause $Y$ to go (up down).

In short in the goods market $i$ and $Y$ have (positive negative) relationship. So the IS curve is (upward downward) sloping.

Please draw figure 5-2 here:

Now, consider what will happen if the government increases its expenditure $\bar{G}$ (expansionary fiscal policy). Show this using Keynesian Cross.

The equation that characterizes the money market is (money supply = money demand), i.e.,

$$\frac{M}{P} = YL(i), \quad \frac{dL}{di} < 0$$  \hspace{1cm} (7)

where $P$ is the price, $M/P$ is called real balance, and the money demand $L$ is negatively related to interest rate $i$. For a fixed real balance, after $Y$ rises, $i$ must (rise fall) in order to clear the money market. So, on the money market, $i$ and $Y$ have (positive negative) relationship. So the LM curve is (upward downward) sloping.

Use the graph to show the effect of expansionary open market operation.
We get the IS-LM model by putting the IS-LM curves together. The equilibrium $i$ and $Y$ are at the intersections. Those equilibrium values clear both goods and money markets.

Let’s do some exercises:

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| $i$                     |                         |                      |
| $Y$                     |                         |                      |

Q8: So far we treat money supply $M$ as exogenous, and interest rate $i$ as endogenous. Consider an alternative scenario where the central bank will do whatever it can to maintain the interest rate at a fixed level (now $i$ becomes exogenous). Please show what will happen to money supply if government increases its expenditure. This is an example of policy mix.