Macroeconomics Review Course
LECTURE NOTES

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1 Course Information

Expected Audience: Students interested in starting a Master's in economics. In particular, students enrolled in the M.Sc. in European Economy and Business Law.
Preliminary Requirements: No background in economics is needed.
Final Exam: None.
Schedule (in common with Microeconomics): Mo 10 Sept (9.00 – 10.30 / 12.00 – 13.30), Tu 11 Sept (13.00 – 14.30), We 12 Sept (9.00 – 10.30 / 12.00 – 13.30), Th 13 Sept (13.00 – 14.30), Fr 14 Sept (9.00 – 10.30 / 12.00 – 13.30).
Office Hours: By appointment.

Outline

- Lecture 1: Introduction. GDP, Unemployment, and Inflation.
- Lecture 2: Aggregate Demand. Equilibrium Output. Investment and Savings.
- Lecture 3: Interest Rates and Demand for Money. Equilibrium in Financial Markets.
- Lecture 4: The IS-LM model.
- Lecture 5: Growth Facts. Convergence.

References

- **Main Reference**: O. Blanchard, A. Amighini, F. Giavazzi, Macroeconomics: A European Perspective, Pearson, 2nd edition.
- C.I. Jones, Introduction to Economic Growth, WW Norton. Company.

2 Introduction

Economics is a social science, and it studies a subset of economic activities, such as production and consumption, investment and savings, trade, and unemployment. Economics focuses on the interactions among *economic agents*, e.g. consumers, firms, the government, countries. Macroeconomics studies all this at the *aggregate* level. An *economic theory* aims at providing an explanation to certain human activities, starting from *assumptions* concerning agents' behaviours and getting to *predictions/theorems*.

In the remainder of these notes, we will use three different languages when analysing concepts, i.e. *words*, *graphs*, and *algebra* (formulas). Mastering these languages is crucial for a comprehensive economic analysis.

3 Main Economic Aggregates

3.1 Gross Domestic Product

The Gross Domestic Product (GDP) is a measure of a country's aggregate output in the national income accounts. Consider the following example:

There are two firms in the economy. Firm 1 produces steel employing workers (paid 80 Euro) and machines. Steel is sold at 100 Euro to Firm 2, which uses it for producing cars. The latter are produced using steel and labour (paid 70 Euro). Cars are sold at 200 Euro. This information is summarised in Figure 1:

GDP can be defined in three alternative and equivalent ways:

1. The value of final goods and services produced in the economy during a given period.

   To see this, proceed as if the two firms were merged. The merged firm earns 200 Euro from selling cars, pays workers a total of 150 Euro, and earns a profit of 50 Euro. The value of the final goods is 200 Euro;

2. The sum of value added in the economy during a given period.

   The value added for Firm 1 is simply the value of the steel, 100 Euro. As far as Firm 2 is concerned, its value added is (200-100)=100 Euro. The sum of value added is thus 200 Euro;

Steel company (Firm 1)		
Revenues from sales		€100
Expenses		€80
Wages	€80	
Profit		€20

Car company (Firm 2)		
Revenues from sales		€200
Expenses		€170
Wages	€70	
Steel purchases	€100	
Profit		€30

Figure 1: Gross Domestic Product. Source: Blanchard et Al, 2nd ed.

3. The sum of incomes in the economy during a given period.

   There are two types of income in this example, i.e. labour and profits. In a closed economy, GDP is also equal to (150+50)=200.

Nominal GDP is the product of the quantities of final goods produced times current prices. *Real* GDP (adjusted for inflation) multiplies these quantities for constant prices. Since we want to measure *output*, we normally use real GDP, obtained by multiplying quantities produced each year by a common price. This is done by setting a base year, and expressing prices in all other years as a percentage of the one in the base year.

The *level* of real GDP is useful to determine the economic size of a country, but it tells nothing about its standards of living. The latter are captured by *per capita* GDP, defined as the ratio of real GDP and the country's resident population. Again, this measure does not encompass the *distribution* of income among individuals or social groups.

Levels, however, are not informative on the performance of the economy in a given period. We thus define the *GDP Growth Rate* between periods t and *t-1* as $\frac{Y_t - Y_{t-1}}{Y_{t-1}}$. A period of positive (negative) growth is called an *expansion (recession)*. Economists are particularly concerned about recessions, as these are generally linked to a growth in *unemployment* and other undesirable outcomes.

3.2 The Unemployment Rate

In order to define unemployment, we start with the following equality:

$$L = N + U$$

Where L, N, and U are respectively the *Labour Force*, the number of *employed*, and the number of *unemployed* people in the economy. Be careful: U includes only people who are actively looking for a job. The *Unemployment Rate* is defined as

$$u = \frac{U}{L}$$

The unemployment rate is not necessarily the best indicator of the labour market, especially when many people are unemployed but are not looking for a job (*discouraged workers*). The latter are not included in the labour force. A better indicator in this case is the *participation rate*, the ratio of the labour force to the total population of working age.

Why do economists care about unemployment?

1. It has a direct effect on the *welfare* of the unemployed. This status is generally associated with psychological and financial suffering.

2. It provides a signal that the *human resources* in the economy are not used efficiently.

3.3 The Inflation Rate

Inflation is defined as a sustained rise of the general level of prices, the *Price Level* (P_t). Conversely, a *deflation* entails a drop in P_t. More formally, the *inflation rate* between periods t and $t-1$ is defined as

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

In practice, the *inflation rate* is computed in two alternative ways using:

1. The *GDP Deflator*, $P_t = \frac{NominalGDP_t}{RealGDP_t}$;
2. The *Consumer Price Index* (CPI), defined as the cost of a given list (basket) of goods.

Why do economists care about inflation?

1. It affects *income distribution*. Prices and wages do not change proportionately. Some social groups could be affected more than others;

2. It creates *uncertainty*, which affects, for instance, firm future investment decisions. At the same time, it creates distortions in taxation, as people move to higher tax brackets as their nominal income increases.

For the same reasons, economists are worried by *deflation*. The "right" amount of inflation is positive, and ranging between 1% and 4%.

3.4 Relations between Macroeconomic Variables

Okun's Law: Empirical (and negative) correlation between output growth and unemployment.

Phillip's Curve: Empirical (and negative) correlation between inflation rate and unemployment.

4 The Goods Market

The composition of aggregate output (GDP) is not homogeneous: the purchase of an ice cream by a consumer is very different from the purchase of aeroplanes by the government. Economists traditionally decompose GDP as follows:

- *Consumption* (C), includes all goods and services purchased by private consumers. This represents the largest component of GDP;
- *Investment* (I), encompasses the purchase of new machineries by firms (non-residential)and houses by people (residential);
- *Government Spending* (G), represents the purchases of goods and services by the (national and local) government. This category does not include *government transfers* or *interest* paid on public debt;

These three categories are the components of *domestic demand* for goods. In an *open economy*, however, two more elements exist:

- *Imports* (IM) represent the demand for goods produced abroad. The latter are subtracted from GDP;
- *Exports* (X) are the demand of goods produced by domestic firms by people in other countries. The latter is added to GDP.

4.1 The Demand for Goods

The aforementioned decomposition allows us to write aggregate demand (Z) as

$$Z = C + I + G + X - IM.$$

We make the following simplifying assumptions:

1. *Homogeneous good*: All firms produce the same good;
2. *Exogenous price*: Firms are supply any amount of good at a given price level P;

3. *Closed Economy*: No trade with the foreign sector, i.e. $X = IM = 0$;

4. *No inventory investment*: All quantity produced is sold.

Under these assumptions, demand for goods can be written as:

$$Z = C + I + G.$$

Let us analyse these three components. For the moment, we assume that (I) and (G) are exogenous, i.e. that they are given.

We want to understand the determinants of private consumption. It is reasonable to think that the main factor affecting the amount of goods and services purchased by consumers is the amount of resources they have, i.e. *disposable income* (Y_d). We say that consumption is a *positive function* of (Y_d). Aggregate consumption can thus be written as

$$C = c_0 + c_1 Y_d.$$

where there are two parameters, c_0 and c_1. c_0 is the *autonomous consumption*, i.e. the quantity consumed when (Y_d) is zero, and it is assumed to be positive. c_1 is the *marginal propensity to consume*, and it represents the effect of one additional unit of income on consumption. It seems reasonable to assume $0 < c_1 < 1$, as consumers are willing to allocate additional income to both consumption and savings.

We define *disposable income* (Y_d) as the difference between gross income (Y) and net taxes, i.e. gross taxes minus government transfers (T), $Y_d \equiv Y - T$. Aggregate consumption can thus be written as

$$C = c_0 + c_1(Y - T).$$

In this simple model, consumption is a positive function of gross income, while it is reduced by taxes. Remember that consumption is never zero, as c_0 is assumed to be positive. Let us look at the following picture for a graphical intuition. The intercept for the consumption function is positive ang corresponding toc_0, while its slope is equal to the marginal propensity to consume c_1.

4.2 Equilibrium Output

We now characterise the equilibrium in the market for goods. This requires output (Y) be equal to aggregate demand (Z). More formally

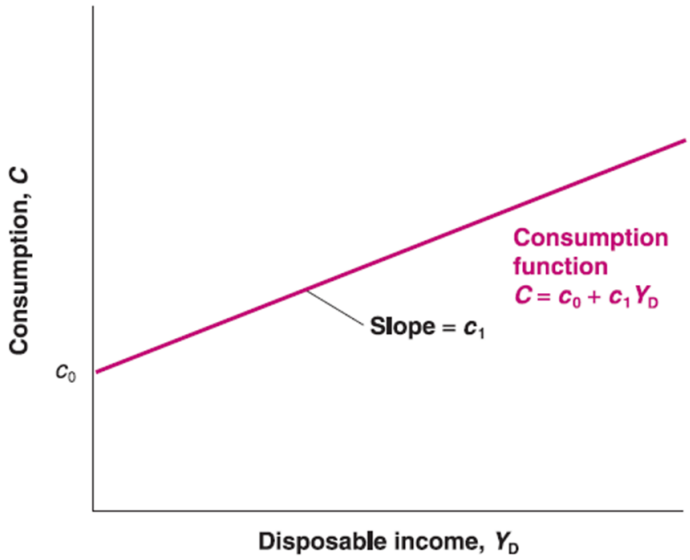

Figure 2: Consumption function. Source: Blanchard et Al, 2nd ed.

$$Y = \underbrace{c_0 + \bar{I} + G - c_1 T}_{\text{Autonomous spending}} + c_1 Y.$$

We can now solve for equilibrium output as follows

1. Move $c_1 Y$ to the left of the equal sign, $Y - c_1 Y = c_0 + \bar{I} + G - c_1 T$.
2. Factor Y out, $Y(1 - c_1) = c_0 + \bar{I} + G - c_1 T$.
3. Divide both terms by $(1 - c_1)$.

Equilibrium output is given by

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T]$$

The term $\dfrac{1}{1 - c_1}$ is called the *multiplier*. Since $0 < c_1 < 1$, this term is larger than one, implying that an increase by 1 Euro in any component of autonomous spending leads to a rise in (Y) by more than 1 Euro. The intuition is simple: suppose that c_0 increases by 1 Euro, the same happens to aggregate demand (Z). Production (Y) *immediately* adjusts. But now consumers have higher income (in this economy, production equals income), and they increase consumption by c_1. This again affects output, and so on and so forth. After n rounds, the increase in output is given by

$$1 + c_1 + c_1^2 + ... + c_1^n$$

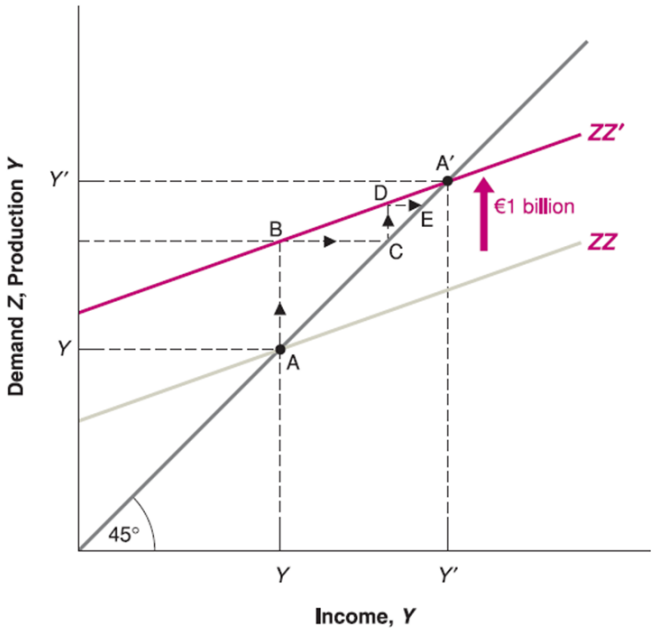

Figure 3: Multiplier and Equilibrium. Source: Blanchard et Al, 2nd ed.

This is a *geometric series* with limit $\frac{1}{1-c_1}$. Notice that, in the real world, adjustment does not take place immediately, but it depends on how often firms revise their production schedule. We can see this mechanism at work graphically in Figure 2, where ZZ represents the demand for goods, and the 45 degrees line (with slope one) is supply. Equilibrium occurs when the two lines meet.

4.3 An Alternative Approach: Saving equals Investment

An alternative way of characterising equilibrium output is by looking at the relationship between investment and saving.

Private Savings (S) by consumers are defined as the difference between disposable income and consumption, i.e. $S = Y_d - C = Y - T - C$.

Public Saving are defined as taxes minus government spending. If $T < G$, the government is running a *budget deficit*.

Let us now go back to our equilibrium equation

$$Y = C + \bar{I} + G,$$

and subtract taxes T on both sides and move C to the left-hand side

$$\begin{aligned} Y - T - C &= \bar{I} + G - T \\ \underbrace{Y_d - C}_{\text{Private Savings}} &= \bar{I} + G - T \\ S &= \bar{I} + G - T, \text{ or} \\ \bar{I} &= S + (T - G). \end{aligned}$$

Notice that investment is the sum of private (S) and public ($T - G$) savings. Equilibrium in the goods market requires that investment equal total saving. This condition is called the *IS relation* (where IS stands for investment equal saving).

We now characterise the equilibrium using the IS condition. Using the definition of consumption function, we write saving as

$$\begin{aligned} S &= Y - T - C \\ &= Y - T - c_0 - c_1(Y - T) \\ &= -c_0 + \underbrace{(1 - c_1)}_{\text{propensity to save}} (Y - T). \end{aligned}$$

Since $\bar{I} = S + (T - G)$ (alternatively, $S = \bar{I} - (T - G)$), we replace it in the equation for S

$$\begin{aligned} \bar{I} - (T - G) &= -c_0 + (1 - c_1)(Y - T), \\ \bar{I} &= -c_0 + (1 - c_1)(Y - T) + (T - G), \end{aligned}$$

which again gives

$$Y = \frac{1}{1 - c_1}[c_0 + \bar{I} + G - c_1 T].$$

What happens when consumers decide to consume less, i.e. when c_0 decreases? Let us have a look at the model's prediction. Equilibrium output decreases, as autonomous spending is reduced. What happens to savings?

$$S = -c_0 + (1 - c_1)(Y - T).$$

As c_0 decreases, $-c_0$ increases, and so do savings. On the other hand Y decreases. The effect is *a priori* ambiguous, but the clue is in the investment equation

$$\bar{I} = S + (T - G)$$

As I, G, and T are exogenous, the level of savings cannot change either. A decrease in c_0 does not affect private savings. This phenomenon is called the *Paradox of Saving*.

5 Financial Markets

Usually we use the words money, income, and wealth as synonymous. In economics, they have different meanings. Money is a medium of exchange that is ready to be used, like currency and checkable deposits at banks. Income is what we earn from working and what we receive in interest ad dividends (flow). Wealth is the value of all our financial assets minus all our financial liabilities (stock).

5.1 Demand for Money

In order to derive the demand for money, we assume that individual wealth can only be allocated between two assets:

- *Money*, which includes both *currency* and *deposit accounts*. This can be used for transactions, and pays no interest;
- *Bonds*, which pay an interest rate but cannot be used for transactions. There are both public and private bonds (several of them), each with a different interest rate.

We assume that the demand for money is increasing in the level of income and decreasing in the interest rate paid on bonds. More formally

$$M^d = €Y\,L(i),$$

where $€Y$ denotes nominal income (expressed in Euro), and $L(i)$ is a (decreasing) function of the interest rate. Figure 4 depicts the relation between M^d and i in a graphical way. On the horizontal axis we have the demand for money, while the interest rate is measured on the vertical axis. The M^d curve tells us the demand for money, at a given level of nominal income, for any interest rate. Suppose that the latter increases from $€Y$ to $€Y'$. This shifts M^d to the right to $M^{d'}$ implying that, for each level of i, $M^{d'} > M^d$.

5.2 Money Supply and Equilibrium Interest Rate

The amount of money supply is set by the *central bank*

$$M^s = M$$

The equilibrium in the financial market requires demand equal supply

$$M = €Y\,L(i)$$

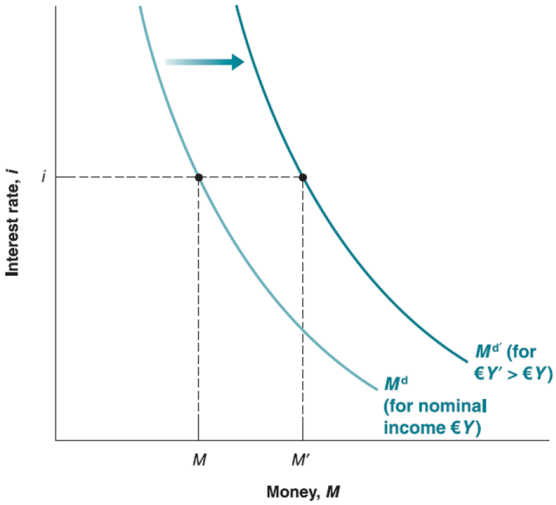

Figure 4: Money demand. Source: Blanchard et Al, 2nd ed.

This equality describes what is called the *LM relation*, i.e. the set of interest rates such that, given the level of nominal income, $M^s = M^d$. L stands for liquidity, M for money. What happens when $€Y$ increases? This is shown in Figure 5. An increase in nominal income shifts M^d rightwards. Money supply is, however, fixed at M. The interest rate rises to i' to ensure equilibrium.

5.3 Monetary Policy

The LM relations creates room for intervention by the central bank. Suppose the latter increases money supply to $M^{s'}$: the interest rate drops. The central bank affects money supply through *open market operations*, i.e. by either selling (contractionary open market op.) or buying (expansionary open market op.) bonds in open markets. When the central bank buys (sells) bonds, it introduces (withdraws) money from the economy.

In reality, we directly observe *bond prices* and then infer the interest rate. Suppose we have a one-year-bond which promises a payment of €100, and P_b is the price at which we purchased it. Then the interest rate and the price are respectively

$$i = \frac{€100 - €P_b}{€P_b}$$

$$€P_b = \frac{€100}{1+i}$$

When a central bank buys bonds, their demand and $€P_b$ increase, and i decreases. What happens in reality is that the central bank sets the interest rate to be achieved, and then

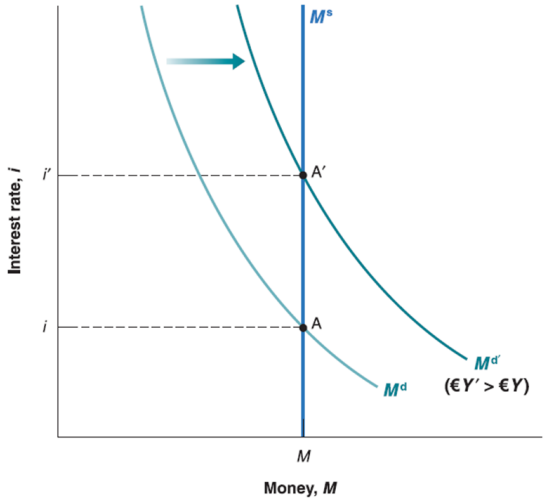

Figure 5: Equilibrium in financial markets. Source: Blanchard et Al, 2nd ed.

carries out the necessary open market operations.

6 The IS-LM Model

It is time to consider the goods and financial markets in conjunction. In doing so, we will assume that investment is not exogenous, but a (positive) function of production and (negative) interest rate. More formally

$$I = I(Y, i)$$

The equilibrium condition in the goods market becomes

$$Y = C(Y - \bar{T}) + I(Y, i) + \bar{G}$$

The IS and LM curves tell us the level of output for each value of the interest rate. The first is derived from the equilibrium relation in the goods market, the second in the financial one.

In order to derive the IS, we proceed as in the following figure (notice that demand is a curve now).
Suppose that the interest rate increases to $i' > i$, then demand for investment (and subsequently, aggregate demand) drops from ZZ to ZZ'. Output decreases to Y'. The IS represents the level of equilibrium output at *each* interest rate. For a given i, factors that reduce (increase) aggregate demand ($\bar{G}$, $\bar{T}$) shift the IS leftwards (rightwards). This is depicted in Figure 6.

In order to derive the LM, we first divide both sides of the equation by the price level P

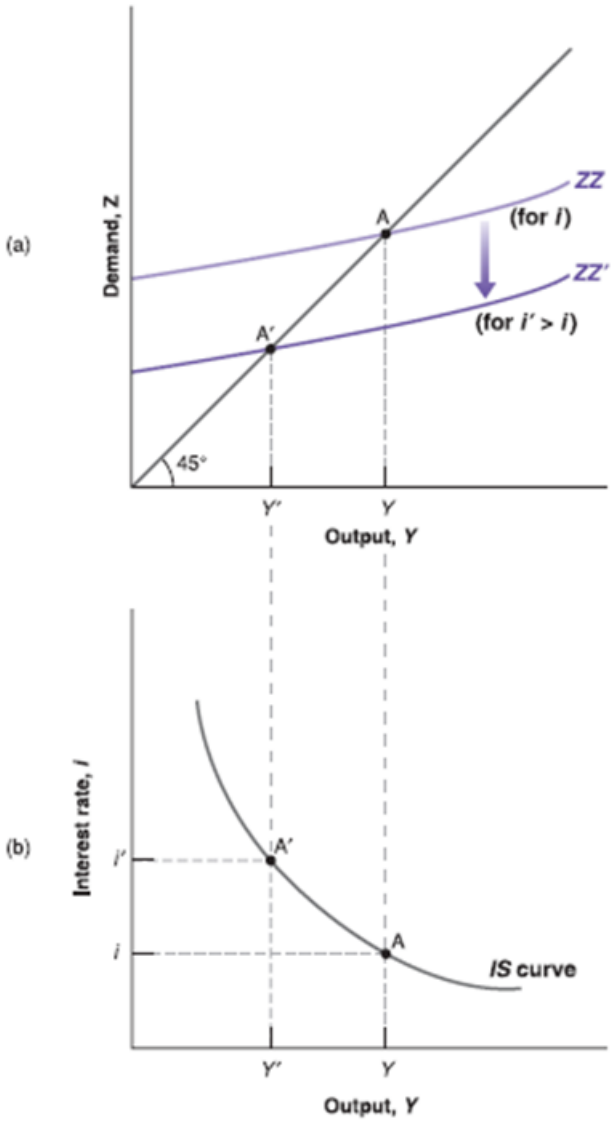

Figure 6: IS curve. Source: Blanchard et Al, 2nd ed.

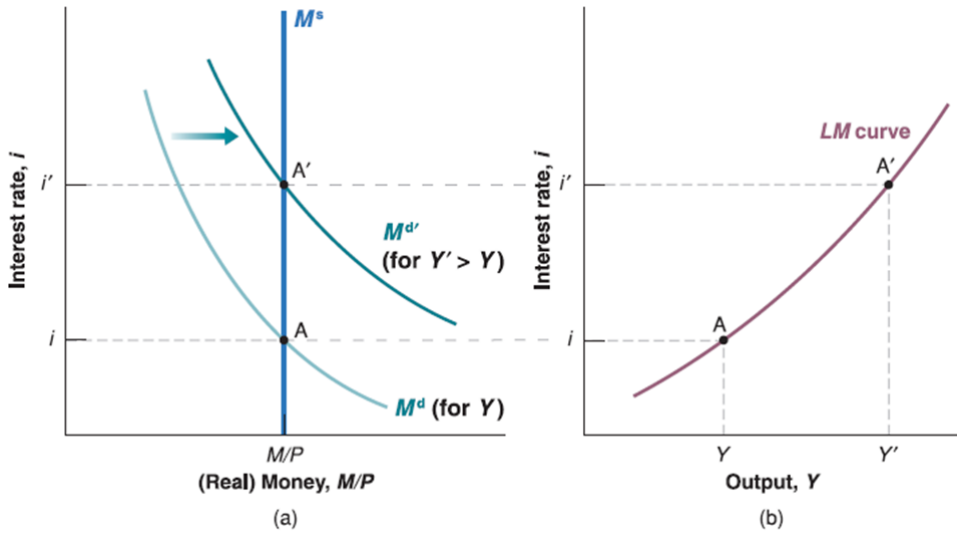

Figure 7: LM curve. Source: Blanchard et Al, 2nd ed.

to obtain the demand for *real money*

$$\frac{M}{P} = YL(i)$$

Suppose that income increases to $Y' > Y$, then M^d shifts to the right to $M^{d'}$. As M^s is fixed, however, the i increases to i'. The LM is derived by registering the interest rate for any level of income, given money supply. An increase in M^s shifts the LM down, as a lower interest rate is needed to ensure that people want to keep the more money, as shown in Figure 7.

We want to find the point in which both the goods and the financial markets are in equilibrium. This happens when the IS and LM curves cross, as shown in Figure 8.

6.1 Fiscal and Monetary Policy

What happens to equilibrium output when taxes increase to $T' > T$? This is shown graphically in Figure 9.

1. Higher taxes mean lower disposable income. Demand decreases, and the IS moves leftwards (output is lower for each level of the interest rate);

2. The LM is unaffected by the increase in T;

3. The new equilibrium is characterised by lower output and interest rate. The effect on investment is ambiguous, as $I(Y, i)$ is a function of both the interest rate and output.

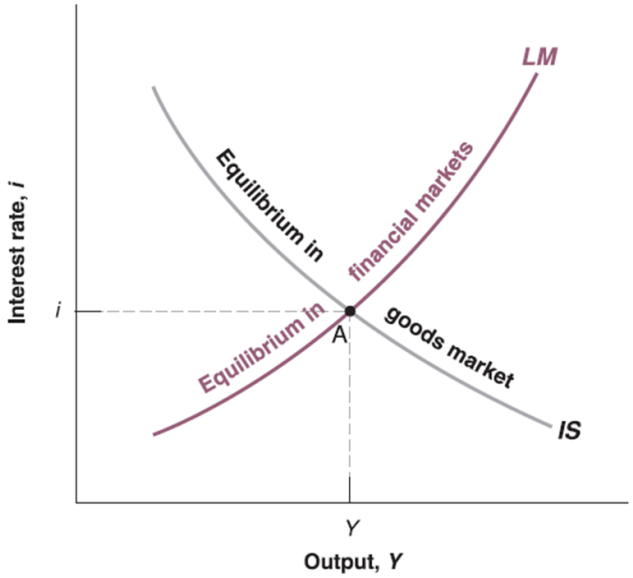

Figure 8: IS-LM equilibrium. Source: Blanchard et Al, 2nd ed.

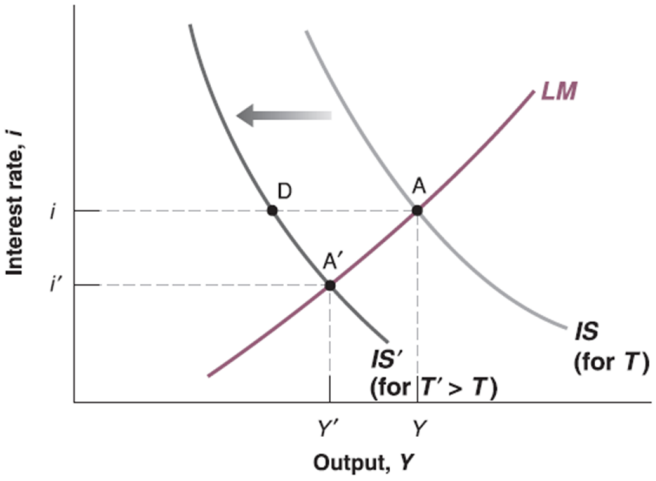

Figure 9: Fiscal contraction. Source: Blanchard et Al, 2nd ed.

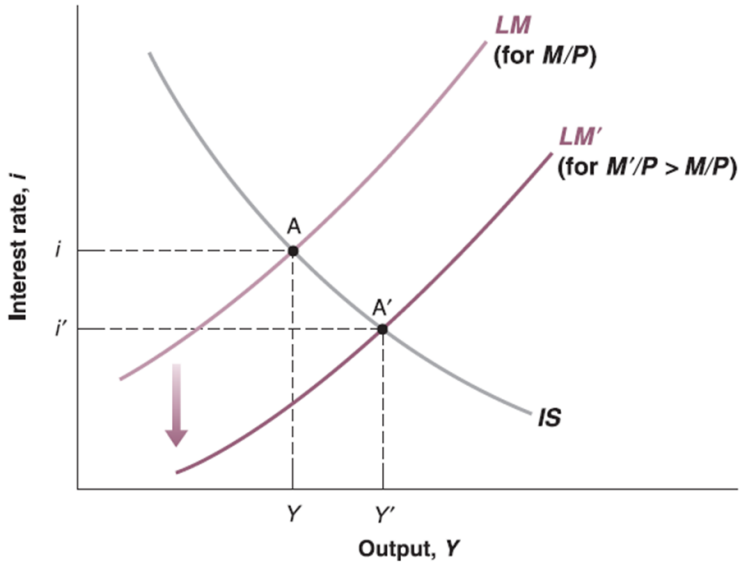

Figure 10: Monetary expansion. Source: Blanchard et Al, 2nd ed.

What happens to equilibrium output when money supply increases to $M' > M$? This is shown graphically in Figure 10.

1. The LM shifts downwards, as a lower interest rate is needed to keep financial markets in equilibrium;

2. The IS is unaffected;

3. The new equilibrium is characterised by higher output and lower interest rate. Consumption goes up (taxes are unchanged), as well as investment.

Can the central bank always affect output through monetary policy? The answer is no. When $i = 0$, people are indifferent between holding money or assets, i.e. the demand for money becomes horizontal. The same happens to the LM curve. The dynamics are depicted in Figure 11. Suppose that we are in point B, and the central bank increases money supply, shifting the LM curve rightwards. Equilibrium output is unchanged at Y', as the IS and LM' cross exactly at the same point as before. This situation is known as the *liquidity trap*.

Figure 12 shows the effect of changes in aggregate demand and money demand and supply on the IS, LM, equilibrium output, and interest rate.

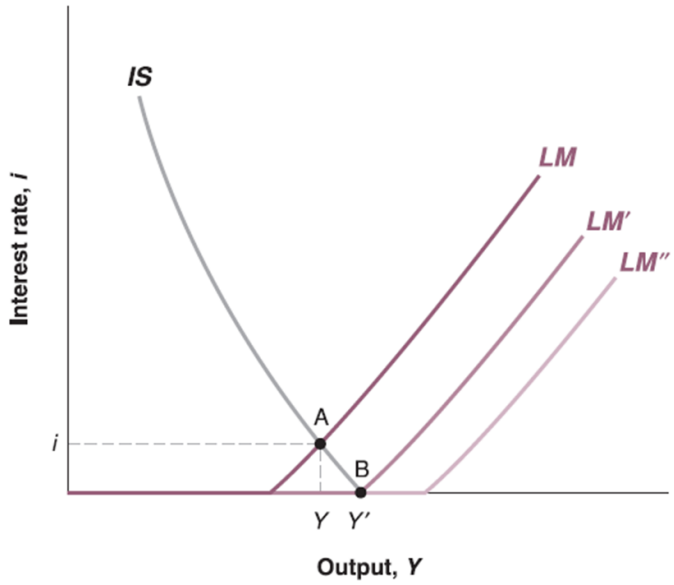

Figure 11: The liquidity trap. Source: Blanchard et Al, 2nd ed.

	Shift of *IS*	Shift of *LM*	Movement in output	Movement in interest rate
Increase in taxes	Left	None	Down	Down
Decrease in taxes	Right	None	Up	Up
Increase in spending	Right	None	Up	Up
Decrease in spending	Left	None	Down	Down
Increase in money	None	Down	Up	Down
Decrease in money	None	Up	Down	Up

Figure 12: . Source: Blanchard et Al, 2nd ed.