Nanyang Technological University
School of Social Sciences

Q&A from Students in HE2002 Macroeconomics II

Guangzhi Ye

1 Lecture 1

Q1: We have $Y = C + I + G + NX$ in HE1002 when using the expenditure method for measuring GDP, what is the difference between Z and Y?
Ans: In this lecture, the total demand for goods is denoted by Z and by definition it is consumption, plus investment, plus government, plus export minus imports. Both production and income are denoted by Y. When the goods market is in the equilibrium production equals demand. $Y = Z$ is the equilibrium condition imposed to solve for Y. We distinguish these two for analyzing the determination of equilibrium output.

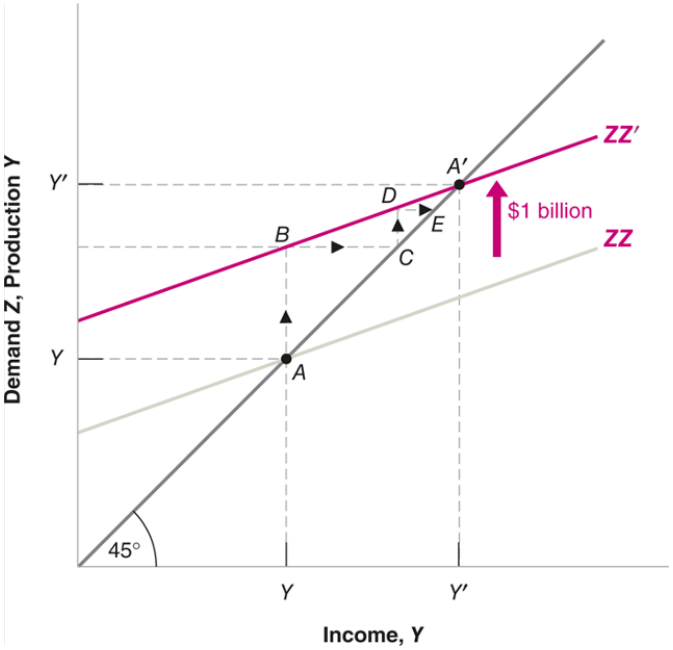
Q2: In sample question 1, why is saving (S) an endogenous variable? If investment is taken as given by $\bar{I}$, and investment equals saving ($I = S + (T - G)$), we have $S = \bar{I} + G - T$. Then S should be exogenous.
Ans: In the lecture slides, S represents the private saving. By definition, it is $Y - T - C$. People use their disposable income for consumption and saving, so $S \equiv Y - T - C$ is an identity. Investment equals saving ($I = S + (T - G)$) is an equilibrium condition that must hold in equilibrium and we can use it to determine equilibrium output. There is no contradiction between $S = \bar{I} + G - T$ and S is endogenous. In this model, the endogenous variable S depends on the exogenous variables $\bar{I}, G$ and T in the equilibrium. It means once we know the values of $\bar{I}, G$ and T, we will know the equilibrium value of private saving (S). We also solve for Y in equilibrium and it is written as a function of the exogenous variables: $Y = \frac{1}{1-c_1}[c_0 + \bar{I} + G - c_1 T]$.
If you think about saving from its identity, Y is endogenous and C is endogenous, then you understand $S \equiv Y - T - C$ is an endogenous variable. We assume $I = \bar{I}$ in lecture 1 to focus on consumption. It will be relaxed after Lecture 2. In fact, investment depends on production Y and the interest rate.

Q3: I am unsure about the statement on income (Y) itself being equal to production. Seek your clarifications and explanation on this.
Ans: It may not seem straightforward, but it must be true in the closed economy when we ignore international trade. When the firms produce goods and sell them to the market, they receive the goods' value. The value of the goods is the production. Then the value is distributed to the labor through wage payments and to the firm owners who provide capital and have the stocks of the firms. They get income from the production of goods. You can also refer to page 71 in Chapter 3, and there is one paragraph discussing this issue:
In equilibrium, production Y (the left side of the equation), is equal to demand (the right side). Demand in turn depends on income Y, which is itself equal to production. Note that we are using the same symbol

Y for production and income. This is no accident! As you saw in Chapter 2, we can look at GDP either from the production side or from the income side. Production and income are identically equal.

Q4: How does the effect of an increase in tax on equilibrium output depend on the value of c1?
Ans: An increase in tax may have more than or less than a one-for-one effect on equilibrium output. The tax multiplier is $\frac{-c_1}{1-c_1}$. If c_1 is smaller than 0.5, then $\frac{c_1}{1-c_1}$ is less than 1. If c_1 is larger than 0.5, then $\frac{c_1}{1-c_1}$ is larger than 1.But $\frac{1}{1-c_1}$ is always greater than 1.

Q5: How do the dynamics occur when there is an increase in autonomous spending?
Ans: With the help of the graph, it becomes easier to tell how and why the economy moves from A to A'. The initial increase in consumption leads to an increase in demand of \$1 billion. At the initial level of income, Y, the level of demand is shown by point B: Demand is \$1 billion higher. To satisfy this higher level of demand, firms increase production by \$1 billion. This increase in production of \$1 billion implies that income increases by \$1 billion (recall: income = production), so the economy moves to point C. (In other words, both production and income are higher by \$1 billion.) But this is not the end of the story. The increase in income leads to a further increase in demand. Demand is now shown by point D. Point D leads to a higher level of production, and so on, until the economy is at A', where production and demand are again equal. This is therefore the new equilibrium.
Reference: Page 74 - 75, Chapter 3, Olivier Blanchard, Macroeconomics.



Q6: I have been confused about the concept and definition of inventory investment given by the textbook: From the textbook, it defines inventory investment as not a component of demand. Which confuses us that, in last semester in HE1002, we were taught that inventory investment is a part of the Investment component of GDP. We are just wondering whether inventory investment is a part of GDP or investment or not, and if we are given question to calculate GDP from table of data, should we include inventory investment?

Ans: Good question. As I checked the lecture slides for Lecture 2 in HE1002, that table shows inventory as part of the investment. Many differences like this are why I spent some time in class to point out the differences between HE1002 and HE2002. In HE2002 and HE3002, let us follow our textbook's definitions, approaches, and notations. There will be no questions about calculating GDP from the table of data in quizzes and the final. In general, we focus more on the economic theories and intuitions. If there is one question like what you mentioned, inventory investment will be stated as a separate item.

The short answer to your question is that Inventory investment is part of GDP, as you can see from Slide 5, "The Composition of U.S. GDP, 2018". You can understand this through the output method of GDP. It is not part of the investment. The investment in our course or textbook represents the fixed investment only, the sum of non-residential and residential investments. You can also see that inventory investment is a separate item in the table of Slide 5. Defining investment in this way is more consistent with most modern economic theories.

First, you can refer to Page 67 in the textbook, and inventory investment is defined as the difference between goods produced and goods sold in a given year - the difference between production and sales. The word investment is slightly misleading. In contrast to fixed investment, which represents decisions by firms, inventory investment is partly involuntary, reflecting that firms did not anticipate sales accurately in making production plans.

Second, the total demand for goods (Z) does not include inventory investment because inventory is the additional production within the year that is not demanded by the market, right? If inventory investment is positive, it equals Y - Z. When we ignore inventory, and we can impose production equals demand (Y = Z) as the equilibrium condition for the goods market.

Q7: What is the precise problem we are aiming to solve? For instance, in Chapter 3, Question 5, when should we retain C, T, and G, and when is it necessary to substitute C and T? What is the expected representation for Y?

Ans:

In the simplified model covered in our lectures, our objective is to determine the values of the output variable Y that satisfy the equilibrium condition in the goods market. We initiate the analysis by setting the equilibrium condition $Y = Z$. In each economic model, there exist endogenous variables, exogenous variables, and parameters. The values of exogenous variables and parameters are externally given, while the endogenous variables are our variables of interest. In Chapter 3, Question 5, we choose to replace C and T because they are considered endogenous. Retaining them in the equation doesn't provide us with the final equilibrium output value for Y because they also depend on Y. In this model, our goal is to derive an equation or representation for Y in terms of only exogenous variables and parameters. This formulation allows us to express Y as a function of variables with externally assigned values. By getting an equation for Y in this form, comprising solely exogenous variables and parameters, we gain a clearer understanding. Once we have the numerical values for the exogenous variables and parameters, we can determine the value of the endogenous variable, Y.

In economics, a closed-form solution refers to an analytical solution expressed in a mathematical formula or equation that provides a direct and explicit expression for a particular economic relationship. This means that the solution is expressed using standard mathematical operations, such as addition, subtraction, multiplication, division, and exponentiation.

2 Lecture 2

Q1: How do we differentiate if the equation is an identity equation or a normal equation, for example, $Y_d = Y - T$?

Ans:

An identity equation is an equation that is true for all values of the variable(s) within its domain. In other words, if you replace the variable(s) with any real number or expression, the equation remains true. The identity equation $Y_d = Y - T$ always holds because this is how we define the variable disposable income Y_d.

On the other hand, a normal equation is an equation that is true only for specific values of the variable(s). When you solve a normal equation, you find specific values or solutions that satisfy the equation. $Y = Z$ is a normal equation, and it holds only at the goods market equilibrium. Graphically, the equation holds at the intercept of the 45 degree line and the ZZ demand curve.

Q2: Why is money stock a liability?

Ans:

Money in circulation is considered a liability to the central bank because it represents a financial obligation. When a central bank issues currency, it essentially generates a form of money for which it is indebted to the holders of that currency. The central bank bears the responsibility of ensuring the stability and value of the currency it issues, and it must be prepared to redeem that currency for other forms of money or assets upon demand by the public.

In the context of balance sheets, the principle of balance requires that assets equal liabilities. For instance, consider a scenario where a commercial bank approaches the central bank seeking cash. While the central bank provides the cash, it concurrently requests some of the commercial bank's loans or government bonds in exchange. Subsequently, the central bank holds these loans or government bonds as assets and the cash as liabilities. The cash is considered a liability because if the commercial bank returns to the central bank and surrenders the cash, the central bank is obligated to return the loans or government bonds in kind. This relationship ensures the central bank's balance sheet is balanced.

Q3: If H^d is the demand for Central Bank money, why is it equal to the reserve ratio*overall money demand?

Ans: In Lecture 2 Case 1, we assume that the central bank directly supplies money to the economy, and the consumers hold the currency and no checkable deposits. The commercial bank plays no role here. In this situation, the central bank's money supply equals the economy's market demand. But in reality, many commercial banks, a primary type of financial intermediaries, facilitate the money supply process. In Lecture 2 Case 2, we assume there is no currency. Consumers only have checkable deposits and use them for transactions. M^d is the consumer's demand for checkable deposits to pay for transactions. Checkable deposits are the liabilities of commercial banks. By government regulation, commercial banks must keep θ fraction of the checkable deposits as reserves and keep the reserves in the central bank. Then if something wrong occurs, the commercial bank can use the reserves to give

back the money to the depositor. The value of reserves is the demand for central bank money or the demand for the monetary base. Or we can think about it in the opposite direction. By satisfying the commercial banks' demand for reserves as H^d, which equals to $\theta * M^d$, the central bank satisfies the economy's need for money M^d.

Q4: What distinguishes the equilibrium of overall money from the equilibrium of central bank money?
Ans: In Case 1, where the central bank directly manages the overall money supply, the relationship holds: $M^s = M = H^s = H$. Nevertheless, in practice, (commercial) banks significantly contribute to money creation. The demand for overall money arises from people's transactional needs. Conversely, the demand for central bank money or reserves is driven by (commercial) banks to fulfill reserve requirements for checkable deposits. In the money market equilibrium, the following relationship consistently holds:

$$M^s = \$YL(i).$$

In Case 2, we incorporate banks into the model to facilitate our comprehension of open market operations and the federal funds rate. When we attain equilibrium for central bank money or reserves:

$$H^s = H = H^d = \theta\$YL(i).$$

By dividing θ on both sides, we also get the equilibrium for the overall money:

$$M^s = M = \theta\frac{\$YL(i)}{\theta} = \$YL(i).$$

In the situation with banks, money markets equilibrium or the equilibrium for the financial markets implies:

$$H^s = H = H^d = \theta\$YL(i), M^s = M = M^d = \$YL(i)$$

$\frac{M^s}{H^s}$ is the money multiplier, and it is $\frac{1}{\theta}$.

3 Lecture 3

Q1: Why $i = \bar{i}$ is the LM relation? How to get from $\frac{M}{P} = YL(i)$ to this equation? Why is LM curve horizontal? It is different from the LM curve I see online.
Ans:
It is true that in older textbooks or the IS-LM model taught many years ago, the LM curve was often represented using the equation $\frac{M}{P} = YL(i)$ and people draw the LM curve corresponds to this equation. However, in recent textbook versions, authors adhere to the current practice of central banks, where the interest rate is chosen directly, and the money supply is adjusted to achieve the target interest rate. In $\frac{M}{P} = YL(i)$, the left-hand side denotes real money supply, while the right-hand side represents real money demand. The equation $i = \bar{i}$ is a simple expression indicating that the value of the interest rate is fixed at $\bar{i}$. The money market equilibrium condition holds behind the idea of this equation.

When $i = \bar{i}$, $L(i)$ function is fixed at the value $L(\bar{i})$. In the short run, the price level P remains constant. Consequently, in the money market equilibrium, an increase in output Y implies an increase

in money supply M. On the LM curve, when we move from the left to the right by increasing output Y, since the interest rate is unchanged, it must be true that the money supply M keeps increasing to satisfy the money market equilibrium. Later you will see that having this simple form of the LM curve makes the analysis more straightforward and accessible.

Q2: Why is the slope of ZZ curve smaller than 45 degree?
Ans:
It must be true that the slope of ZZ curve is smaller than 45 degrees, such that we have a unique equilibrium in the goods market. Production meets the need of total demand. If we make assumptions of the consumption function and the investment function such that the slope of ZZ curve is larger than 45 degrees, there is no equilibrium point in the model. The model will be useless and contradict reality. It also means an increase in output leads to a more significant increase in demand, so the production will never be able to meet the need of demand.

Q3: If IS curve represents the goods market equilibrium, then what is the production and demand figure? Can you explain more about how to derive the downward sloping IS curve?
Ans:
As shown in the lecture slides, any point along the downward sloping IS curve corresponds to an equilibrium in the goods market. Therefore, the IS curve represents a collection of goods market equilibria, with each equilibrium having distinct interest rates and output levels.

In the production and demand figure, we start with the goods market equilibrium, resembling the one introduced in Lecture 1. Holding income or output constant, an increase in the interest rate leads to a reduction in investment demand. Higher interest rates discourage firms from investing due to increased borrowing costs. Consequently, the ZZ curve shifts downward, reflecting the impact on total demand. The new intercept is the new equilibrium point, indicating a decrease in equilibrium output.

This process can be iterated by further increasing the interest rate, causing additional downward shifts in the ZZ curve and successive reductions in equilibrium output.

This relationship between interest rate and output is summarized in a separate figure, where the interest rate i is represented on the vertical axis, and the output Y on the horizontal axis. We will plot a curve which is downward sloping, and since this curve is derived from the goods market equilibrium, we call it IS curve.

Q4: Can you explain why the quantity supplied of bonds equals the quantity demanded of bonds.
Ans:
In the money market, bonds are considered an alternative to holding money. Remember when we talk about the wealth, bonds are one of the ways people hold wealth, with money being the other. When the money market reaches equilibrium, it implies that the financial markets are also in equilibrium. The role of bonds in this equilibrium is determined by the relative attractiveness of holding bonds versus holding money, which is influenced by prevailing interest rates. Notably, interest rates themselves are derived from the equilibrium in the bonds market. In the multiple choice question, suppose the economy is operating on both the LM curve and the IS curve, it means we have both goods market equilibrium and financial markets equilibrium.

Q5: What is the difference between IS and LM?

Ans:

IS relation is derived from the goods market equilibrium. We impose the equilibrium condition production equals demand ($Y = Z$) to get the equation. Originally, economists employed the equality of investment (I) and saving (S) to derive this equation, hence the term "IS relation" to describe the relationship emerging from goods market equilibrium. Output and the interest rate are the two variables we want understand using the IS-LM model. If we draw a figure with interest rate i on the vertical axis and output Y on the horizontal axis, various combinations of Y and i are captured by plotting IS relations. These relations, plotted as an IS curve, portray the varying values of Y and i, and provide a visual representation of the relationship between interest rates and output in the goods market equilibrium.

The LM relation is derived from the equilibrium of financial markets. In our model, financial market equilibrium means we have equilibrium in both the money and bond markets. The LM curve represents different interest rates chosen by the central bank. The money market is in equilibrium for each point on the horizontal LM curve. When output Y is larger, with the same interest rate and price level fixed in the short run, the money supply is also larger. The "LM" in the LM curve stands for "Liquidity-Money." When the money market equilibrium was derived, "L" represents the demand for money or liquidity preference, and "M" stands for the money supply. In the equilibrium, money demand equals money supply, so we get the LM relation.

Why do we care about the case when both markets are in equilibrium? If one of the markets is not in equilibrium, the supply of goods does not equal the demand for goods, or the money supply does not equal money demand. The economy is not stable and is in a dynamic process. The economy will converge to the point when both markets are in equilibrium, and things will not change after reaching the equilibrium if there are no exogenous changes.

4 Lecture 4

Q1: For today's lecture on financial markets, you mentioned that when a bank is "still solvent but it is more at risk than it was before," the bank can either 1) ask investors to provide more funds or 2) call back their loans. Can I clarify if they can solve this issue with option one so that they have more funds to increase their asset value (by buying bonds etc.) so they are still solvent? And with Option two, is it because they increase their capital and decrease the leverage ratio?

Ans:

When the asset value decreases, the liabilities of the bank are fixed, so the value of capital decreases with the same amount, leading to a higher value of leverage ratio. The bank is still solvent as long as the capital value is positive. This risk is higher because an additional decrease in the asset value will more likely draw the value of capital down to zero. When the capital value is negative, the bank is insolvent. If the owners of the bank do not want to suffer more loss, they will choose to default.

Option 1: the investors, here the owners of the bank, in particular, can provide more funds from their pockets. By doing this, the assets increase, and the value of capital increases. Initially, this is

just the additional money from the owners. The leverage ratio will decrease. (e.g., asset is 100, capital is 20, leverage ratio is 5. Increase the capital by 20, asset increased by 20 up to 120, and the leverage ratio decreases as $120/40 = 3$). The larger the capital value is, the more room for the value of assets to decrease before getting insolvent.

Option 2: Call back their loans $\Rightarrow$ ask the borrowers to pay back the money lent by the bank $\Rightarrow$ use the money to pay some of the liabilities, then both values of assets and liabilities decrease, with the capital value fixed $\Rightarrow$ leverage ratio decreases.

Q2: Why does a higher leverage ratio imply a higher expected profit rate?
Ans:
Ans: It is because leverage magnifies the returns on a firm's assets. The economic idea behind leverage refers to the use of debt or other financial instruments to finance a firm's or banks' investments, and a higher leverage ratio means that the firm/bank has a greater amount of debts/liabilities relative to its equity/capital. There are different terms with similar meanings. So here when a bank uses leverage, it can earn a return on its liabilities as well as on its own capital. With a same amount of assets and expected total profits to be earned from the assets, the expected profit rate is higher when capital is smaller. Note that the expected profits divided by the capital is the expected profit rate.

5 Lecture 5

Q1: You mentioned the Medium Run in today's lecture. What are the differences between the Short Run and the Medium Run? How does the the Medium Run we learn in this module differ from the Long Run we learn in HE2001 Macro I?
Ans:
You can refer to Chapter 2 Section 5 of the textbook. It introduces the three concepts around which the book is organized.
- The short run: What happens to the economy from year to year.
- The medium run: What happens to the economy over a decade or so.
- The long run: What happens to the economy over a half century or longer.

In the short run, say, a few years, the first answer is the right one. Year-to-year movements in output are primarily driven by movements in demand. Changes in demand, perhaps as a result of changes in consumer confidence or other factors, can lead to a decrease in output (a recession) or an increase in output (an expansion).

In the medium run, say, a decade, the second answer is the right one. Over the medium run, the economy tends to return to the level of output determined by supply factors: the capital stock, the level of technology, and the size of the labor force. And, over a decade or so, these factors move sufficiently slowly that we can take them as given.

In the long run, say, a few decades or more, the third answer is the right one. To understand why China has been able to achieve such a high growth rate since 1980, we must understand why both the capital stock and the level of technology in China are increasing so fast. To do so, we must look at factors like the education system, the saving rate, and the role of the government.

In our textbook, Chapter 3 to 6 are about the Short Run, Chapter 7 to 9 are about the Medium Run, and Chapter 10 to 13 are about the Long Run.

In Lecture 9 of HE1002 Macro I, you learned aggregate demand, aggregate supply and the AS-AD model. There is a Long-run aggregate supply (LRAS) curve which is a vertical line showing the economy's potential output Y^*. We will learn IS-LM-PC model to characterize the Medium Run equilibrium in HE2002 so that $Y = Y_n$. The concept of Long Run in Macro I is similar to the concept of the Medium Run in HE2002 Macro II. We keep the term "the Long Run" only when we think about the economic growth in HE2002.

Q2: The catch-all variable z captures things like unemployment insurance and employment protection. They will lead to higher wages in wage determination equation. Does z capture things that may lead to lower wages?

Ans: Yes, it does. But the catch-all variable z is introduced in this way so that there is a positive relation between z and W. You can think about the removal of unemployment insurance and minimum wages that reduces wages. We can define the changes in a way such that the relation is positive. Here are some other factors that can lead to lower wages in wage determination: 1) globalization: Increased global competition can exert downward pressure on wages; 2) flexible employment contracts: the prevalence of part-time, temporary, or gig economy jobs may contribute to lower wages, as these types of employment often lack the job security and benefits associated with full-time positions; 3) skill mismatch: when there is fundamental change in the economy and there is a gap between the skills demanded by employers and the skills possessed by workers, it can result in lower wages.

Q3: Could u explain to me more about what is markup and why firms set their price according to a markup?

Ans: Markup refers to the difference between the cost of production or purchasing a product or service and its selling price. It is typically expressed as a percentage of the cost. The markup represents the profit margin that a business adds to the cost of goods or services to cover operating expenses and generate a profit. This is the definition of markup. And in our simple model, labor is the only input, and wage W reflects the input cost. P is the selling price of products. In theoretical Macro papers, the economists usually assume a fixed markup of about 20% to 30%. The actual markups differ for different products, companies, and industries. Firms set their price according to a markup to make profits. If they set a very high markup, then customers may not want to buy the goods and the competitor can steal the customers by setting a lower markup.

6 Questions in Online Questionnaire

Q1: The Phillips curve and its evolving perception over the years have been somewhat confusing for me to understand. I find myself confused by the different equations associated with the Phillips curve, unsure of which one to use.

Ans: To understand the Phillips curve, it is better to follow the sequence in which it was introduced in class. Macroeconomics is a field about the aggregate economy and economists figure out the correlations between different variables and they try hard to understand why. During the 1960s, some economists found that there is a negative relation between the inflation rate and the unemployment rate. Some economists believed this was something always true. However, in the 1970s, this negative relationship disappeared. Some economists delved into the data and found that the change in the inflation rate was negatively correlated with the unemployment rate during that period. They started to build economic models to understand the phenomena. By using the economic ideas in the labor market equilibrium model, we can derive the equation:

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

Economists find that this equation is powerful and can explain different cases. Things change over time because people's expectations of the inflation rate can change! When you observe a huge increase in the price level over time, you may believe that the inflation rate is not fixed, and it can become larger and larger. Then your expectation is deanchored. But if the economy is relatively stable, the central bankers continuously tell you that they will try their best to keep the inflation rate at around 2%, and you also see the actual inflation rate is indeed around 2%. You tend to expect the inflation rate to be relatively stable, and your expectation is anchored. Which version of the Phillips curve we use depends on the assumption of θ, the time period (e.g., 1960s, 1970s, after 1990s). However, in the IS-LM-PC model, we consider the economy to be a well-managed economy, and the central bank has an inflation target. It indeed commits to keeping the inflation rate at the target level. That is why the vertical axis in the IS-LM-PC model is $\pi_t - \bar{\pi}$.

Economics is a subject about society and people. People can change, and society evolves. Theories can change, and they are also simple representations of the real world, with many things ignored. You need to pay attention to this when you study economics.

Q2: Effect of savings on capital per worker and output per worker in the short and long run

Ans: Great question. In our short-run and medium-run analyses within the IS-LM and IS-LM-PC models, our focus is primarily on output (Y), rather than about capital per worker and output per worker. The concept of saving equals investment serves as an alternative method to establish goods market equilibrium, where both private and public saving contribute to national saving.

However, it seems the student may be referencing the effect of changing the saving rate (s) within the growth model. This model indeed studies capital per worker and output per worker dynamics, particularly in the long run where the economy reaches a steady state. In the absence of technological progress, we compare steady state values over time. In lectures and problem sets, we often illustrate this with specific production functions and steady state values for capital and output per worker. Additionally, we use graphs to demonstrate how adjusting the saving rate (s) shifts the investment per

worker curve, ultimately determining the new steady state.
During this adjustment process, as the saving rate changes and we are not at the steady state, observing the slope and direction of change of capital per worker provides insights into the evolution of both capital and output per worker over time.

Q3: How do I know which curve applies to which curve.
Ans: Curves are drawn in the diagrams. Curves play a crucial role in economics, serving as visual representations of underlying economic concepts. In the first lecture, I emphasized the importance of understanding all three methods in macroeconomics. Numerical methods offer precision in deriving exact results, while graphical methods provide intuitive ideas, facilitating quick qualitative analyses and predictions. However, it is relatively imprecise.
Each curve corresponds to a specific economic function derived from economic ideas or concepts and model derivations. For instance, the ZZ curve represents total demand, the IS curve indicates the combination of interest rate (i) and output (Y) that achieves goods market equilibrium, the LM curve reflects money market equilibrium and the interest rate determined by the central bank, and the PC curve illustrates the Phillips curve equation derived from labor market equilibrium.
In the long-run growth model without technological progress, one curve represents investment while another represents depreciation. When investment equals depreciation, the economy reaches a steady state, resulting in no change in the capital-labor ratio (K/N).
Behind each curve lies a function or relationship with parameters that can influence its position. Changes in these parameters lead to shifts in the curves. Therefore, a comprehensive understanding of the equations, functions, and economic models behind each curve is essential for a thorough understanding of macroeconomic concepts.

Q4: What is the natural interest rate, TA say includes risk premium x but textbook say including risk premium is for borrowing rate.
Ans: The natural interest rate, denoted as r_n, shows the real interest rate that aligns output (Y) with potential output and maintains the unemployment rate at the natural rate of unemployment. Changes in parameters such as the risk premium (x) can lead to changes in the natural interest rate (r_n).
Initially, the solutions provided on NTULearn were incorrect. I revised the answer by clarifying that the borrowing rate is $r + x$, while the real interest rate is simply r. Additionally, when referencing the interest rate faced by firms, it remains $r + x$, as this reflects the rate firms face when seeking to borrow money. I suggest reviewing the updated version of the solution.

Q5: Capital Accumulation
Ans: In economics, capital refers to assets such as property, plants, equipment, and other productive resources. These assets are subject to depreciation, meaning their value declines over time as they age or become outdated. To increase capital, investment is necessary; this involves acquiring new machinery, equipment, and plants to expand the stock of capital available for production. Because of the existence of these forces, economists use a simple capital accumulation function to describe how capital evolves or changes over time:

$$K_{t+1} = (1 - \delta)K_t + I_t$$

Q6: Computing the PV is a bit hard for me conceptually.

Ans:

Present value is an super important concept in economics and finance. With same face value, we tend to consider money today is more valuable to money in the future. For example, 1000 dollars today vs. 1000 dollars 10 years later. You always have ways to increase the nominal value of the 1000 dollars today to be a higher nominal value 10 years later. Like saving the money in the saving accounts or buying the risk-free government bonds. Different assets or financial investment opportunities give you different cash flow in different period. How can we compare them and select our choice, a simple way is to calculate the present value of the choices and choose the one that give you high present discount value (sometime you need to minus to cost of getting the assets or investment opportunity)

The issue is about what discount value we should use to discount the future value. Sometimes we just assume a fixed interest rate i or r. We also discuss the cases that we need to distinguish bonds and stocks, and we need to consider the risks of holding bonds and stocks. So when we discount these assets, we need to include the risk premium associated. Better to memorize the equations and do some exercise. The key thing is that for a one-year bond, you will receive the face value in a year with no risk or uncertainty, So in this special case, we discount the future payment using the interest rate directly, with no risk premium.

The concept of present value is of significant importance in both economics and finance. When comparing money received today with money received in the future, we typically consider money received today as more valuable. For instance, consider \$1000 received today versus \$1000 received 10 years later. Over time, there are ways to increase the nominal value of \$1000 today to a higher nominal value 10 years later, such as saving it in a savings account or investing in risk-free government bonds. However, different assets or financial investment opportunities offer varying cash flows over different periods. To compare and select among them, a simple method involves calculating the present value of each choice and select the one with the highest present discount value (sometimes taking the cost of acquiring the assets or investment opportunity into consideration).

The critical issue arises in determining the appropriate discount rate to use when discounting future values. In some cases, a fixed interest rate (i or r) is assumed. However, we also need to consider situations where we must distinguish between bonds and stocks, taking into account the associated risks of holding each. Therefore, when discounting these assets, it's essential to incorporate the relevant risk premium.

It's beneficial to memorize the equations and do practice exercises to improve your understanding. One crucial consideration is that for a one-year bond, where you receive the face value with no risk or uncertainty, we discount the future payment using the interest rate directly, without a risk premium.