Lecture Notes
Expectations

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1. Expectations: The Basic Tools

We introduce two important variables here-

1 The real interest rate.

2 The expected present discounted value.

1.1 Nominal Versus Real Interest Rate

Any real variable is nothing but the nominal variable *minus* inflation. So, if you were asked to build a relationship between the real and the nominal interest rate, it should be simple:

$$r_t = i_t - \pi^e_{t+1} \tag{1}$$

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You might be stumped by the presence of expected inflation rather than *actual* inflation. Remember that repayments are realized in future. Therefore, we must include the expectations. What does equation 1 tell us?

- If the expected inflation rate (π^e_{t+1}) is zero, there is no difference between the real and the nominal interest rates.
- For any given nominal interest rate (i_t): $\uparrow \pi^e_{t+1} \Rightarrow \downarrow r_t$

You must now be able to argue why negative inflation (**deflation**) might have some damaging consequences for economy.

1.2 Interest Rates, and the $IS-LM$ Model

- The IS Curve
  - Focus on investments. Investments depend upon borrowing and repayments.
  - Repayments involve not the interest rate but also shifts in price level of goods.
  - Investments depend upon the *real interest rates*.
  - We can modify the IS equation:

$$Y \equiv C(Y-T) + I(Y,r) + G \tag{2}$$

- The LM Curve
  - The decision to hold/do away with money has a more immediate reason.

– Also, bonds pay a nominal interest rate i.

– Therefore, Money demand depends upon the *nominal interest rate*.

– The LM relation remains the same:

$$\frac{M}{P} = YL(i) \tag{3}$$

- Implications:

1 The RBI sets nominal rates. Therefore, monetary policy impacts the nominal interest rate.

2 The real interest rate,OTOH, has implications for investments.

3 The effect of monetary policy on GDP is no longer straightforward, and is confounded by how the real interest rate moves in response to changes in the nominal rate.

1.3 Monetary Policy and Interest Rates

In short,

- In the short run, $\uparrow$ *money supply* $\Rightarrow \uparrow$ *money growth* $\Rightarrow \downarrow i$ and $\downarrow r$.

- In the medium run, $\uparrow$ *money supply* $\Rightarrow \uparrow$ *money growth* $\Rightarrow \uparrow i$ and $\leftrightarrow r$.

- Over time, monetary growth is accounted for by change in the price level.

- Recall Equation 1. Let's modify that.

$$i = r + \text{money growth} \tag{4}$$

  - We are able to write Equation 4 because we know that money growth = inflation in the medium run.
  - We also know that the real interest rate is unaffected by money growth.
  - Therefore, a 1% increase in money growth $\Rightarrow$ 1% rise in inflation $\Rightarrow$ 1% rise in the nominal interest rate.
  - This is known as the Fisher Hypothesis.
  - You must look at the evidence on the Fisher hypothesis.

1.4 Present Discounted Value

PDV can be best understood via an example. Consider an investment of ₹100 in 2018 at an annual interest rate of 5%. Come 2019, you will end up receiving ₹105.

$$\underbrace{₹100}_{2018} \Rightarrow \overbrace{₹105}^{2019}$$

$$\Downarrow$$

$$\underbrace{₹100}_{2019} \Rightarrow \overbrace{₹\frac{100}{105}}^{2018}$$

Now, turn this thing around. What is the value of ₹100 that you are going to receive in 2019 this year (2018)? The answer is ₹$\frac{100}{105}$ = ₹95.2. So, ₹95.2 is the present discounted value of the hundred rupees that you may receive in 2019. The term $\frac{1}{105}$ is the discount factor. In general: the discount factor is $\frac{1}{1+i}$. Now, we will compute the expected present discounted value when the interest rates are not known.

Expected payments in future: z^e_{t+1}, z^e_{t+2}

Expected interest rate: i^e_{t+1}

The expected present discounted value is given by

$$V_t = z_t + \frac{1}{(1+i_t)} z^e_{t+1} + \frac{1}{(1+i_t)(1+i^e_{t+1})} z^e_{t+2}$$

You do not have to worry about the maths here. There are two simple points.

- $\uparrow$ expected interest rates $\Rightarrow \downarrow V_t$
- $\uparrow$ expected payment $\Rightarrow \uparrow V_t$.
- Check what happens when interest rate is constant over time.
- Check also what happens when there are fixed payments and the interest rate is constant over time.

2. Financial Markets and Expectations

2.1 Bond Prices and Bond Yields

There are two variables which determine the nature of bonds:

- Default risk
- Maturity (the time taken for the realization of payment)

You should also know that, typically, the yield curve (the interest rate plotted against the maturity) is upward sloping. (Aside: It shouldn't be too steep (think why?) for a healthy economy.)

2.2 Bond Prices, and the Arbitrage Condition

2.2.1 Arbitrage

Let us begin with simple bonds- a one-year bond that promises ₹100 next year, and a two-year bond which promises to pay ₹100 in two years.

- Let the price of the one-year bond be P_{1t}. This will be nothing but the present discounted value of ₹100 that you are going to receive next year. Assume that the current year nominal interest rate is i_{1t}.

$$P_{1t} = \frac{100}{1 + i_{1t}} \tag{5}$$

- Let the price of the two-year bond be P_{2t}. Here, the time horizon has increased. So, not only would you need the one-year rate, but also the expected one-year rate for the next year (let's call it i_{1t+1}).

$$P_{2t} = \frac{100}{(1 + i_{1t})(1 + i^e_{1t+1})} \tag{6}$$

Arbitrage: price of a two-year bond today is the present value of the expected price of the bond next year. We can say something more than this (for theoretical exposition, of course). The expected one-year return for the two bonds must be the same. Now, let's see what happens when this condition doesn't hold. If expected returns for a year on one-year bonds are lower than that for two-year bonds, the market for one-year bonds should vanish. We do not want this to happen. Therefore, the expected return condition (or the "arbitrage" condition) must hold.

2.2.2 Bond Yields

We can derive the relationship between the two-year interest rate, the current one-year interest rate, and the future expected one-year interest rate using Equation 6 and the generic condition for the price of two-year bond in Equation 7.

$$P_{2t} = \frac{100}{(1+i_{2t})^2} \tag{7}$$

Let's get rid of P_{2t} from the two equations. Some mathematical trick will yield[1].

$$i_{2t} = \frac{1}{2}(i_{1t} + i^e_{1t+1}) \tag{8}$$

While the math may seem intimidating in equation 8, the underlying concept is pretty intuitive. Long-term interest rate depend upon current and future expected short-term interest rates. Furthermore, you now have a handy

[1]The idea is simple: When you equate equations 6 and 7, you get $(1+i_{2t})^2 = (1+i_{1t})(1+i^e_{1t+1})$. Now, the math trick here is the following. All of these interest rates are numbers way less than 1. This means that I can use a roundabout function: $[(1+x)^n = (1+nx)]$. So, we can rewrite the above condition as: $(1+2i_{2t}) = (1+i_{1t}+i_{1t+1})$. Now, you can eliminate 1 from both sides to get equation 8.

future expected short-term interest rate calculator. How? Just turn things around in equation 8.

$$i^e_{1t+1} = 2i_{2t} - i_{1t} \tag{9}$$

2.3 Yield Curve and Economic Activity

Let us try to understand the relationship between the yield curve and the economy using the episode of 2001 recession in the U.S.

- Late 2000
  - Unexpected downturn: IS curve moves to the left (much more than expected).
  - IS moves leftwards ⇒ ↓ Short term interest rate.
- Early 2001
  - The Fed chose to respond to the downturn: expansionary monetary policy.
  - LM curve moves downwards.
- Draw the IS and the LM curves, and the two movements.
- Notice two things:
  - larger than expected fall in the interest rate.
  - Smaller than expected decline in the output.
- June 2001: the yield curve was upward-sloping. Why?

- Once recovery had started coupled by tax-break in 2001, consumption spending was up.
- What happens to the IS curve? IS curve shifts to the right.
- Now, the expected short-term interest rate should go up.
- The financial market expected that the Fed would respond by tight monetary policy.
- This prediction didn't come true.

2.4 Stock Market and Economic Activity

We will first define the **stock price** as a function of current and future dividends and interest rates. Formally, *the stock price is the expected present discounted value of future nominal dividends, discounted by current and future nominal interest rates.*

$$Q_t = \frac{D^e_{t+1}}{(1+i_{1t})} + \frac{D^e_{t+2}}{(1+i_{1t})(1+i^e_{1t+1})} + \dots. \tag{10}$$

You do not have to worry about equation 10. You need to remember two important points:

1 ↑ expected future dividends ⇒ ↑ higher stock price.

2 ↑ expected future interest rates ⇒ ↓ stock price.

How do different policies impact the stock market?

1 Monetary Policy

  - The answer is surprisingly simple: if monetary policy surprises the market by slashing the interest rate, the stock price would go up. Had this policy change been on expected lines, the market would not have moved.

2 Rise in Consumer Spending

  - This would mean ↑ output.
  - ↑ Output ⇒ ↑ Dividends.
  - ↑ Dividends ⇒↑ Stock Price.
  - Hang on. The IS curve shifts right. So, you should expect rise in interest rate.
  - The change in stock price will depend upon the relative strength of rising dividends and hike in the interest rate.

In case of rising consumer spending, we should also factor in the response of the central bank. Let us list all the possible cases.

1 Expansionary monetary policy:

  - The LM curve would move downwards
  - The interest-rate hike could be offset.
  - Impact on stock price: +ve

2 The RBI decides to do nothing

  - The interest rate is higher.

- Output is also higher.
- Impact on stock price: uncertain

3 Contractionary Monetary Policy:

- Fearing future inflation, the RBI decides to adopt tight monetary policy.
- The output remains unchanged, but the interest rate is still higher.
- Impact on stock price: -ve

2.5 Risk, Fads, and Bubbles

All stock market activity is dependent upon how risk averse people are, but insofar we have said nothing about it. Let's throw it in and see how equation 10 changes. To do so, let's attach a value (θ) as a parameter of riskiness. This is also known as as the equity premium in case of stocks.

$$Q_t = \frac{D^e_{t+1}}{(1+i_{1t}+\theta)} + \frac{D^e_{t+2}}{(1+i_{1t}+\theta)(1+i^e_{1t+1}+\theta)} + \ldots \tag{11}$$

What happens when stock prices are mispriced? In particular,what if stock prices are overpriced? This often doesn't end well. The question arises: why do bubbles happen?

Three distinctive features of markets may give rise to bubbles:

1 *Resale value*: A person may buy a house both for the rental income and also to make gains by holding on to the house and reselling it later.

2 *Ease of trading*: You can switch between being a buyer and being a seller.

3 *Ease of borrowing to finance purchases*: If market participants can borrow to increase their demand for an asset that they believe will increase in price, well, we are staring at a possible bubble.

3. Consumption and Investment

3.1 Consumption

3.1.1 Keynesian Consumption Function

Recall the consumption function from pre-midterm discussions.

$$C = c_0 + b(Y - T)$$

What are its properties?

- $0 < b < 1$ (In English, the marginal propensity of consume is less than 1).
- As income goes up, the ratio $C/Y = APC$ declines.
  - Example: $C = 100 + 0.8(Y - T)$.
  - If $Y = 100$ and $T = 0$, $APC = \frac{100+0.8(100-0)}{100} = 1.8$.
  - If $Y = 200$ and $T = 0$, $APC = \frac{100+0.8(200-0}{200} = 1.3$
- Problem: It works only in the short run.

3.1.2 Life Cycle Hypothesis

Consumption decision not only depends upon current income, but also depends upon many other variables such as a permanent pool of wealth, future expected interest rate, etc. Let us focus on wealth for now.

- We can define: $C = \alpha W + \beta Y$. (W: wealth; Y: current income)
- $C/Y = \alpha(W/Y) + \beta$
- Over time, if $\uparrow W$ and $\uparrow Y$, C/Y will not change.

The departure that we have made here from the original discussion on consumption can be summarized as:

- A person makes consumption decision on current income as well as expected future income.
  - If she expects a transient fall in income, she may not reduce her consumption today.
  - If she thinks that the decline in income is permanent, the reduction in consumption will match the fall in income.

3.2 Investment

Investments depend upon profits, future expected profits, depreciation, and expected interest rate.

Assuming that future expected profits and interest rate (r) remain constant (depreciation is δ), the present value of profits can be written as

$$V(\Pi_t^e) = \frac{\Pi_t}{r+\delta} \tag{12}$$

Investment is a function of the present value of expected profit.

$$I_t = I\left(\frac{\Pi_t}{r+\delta}\right) \tag{13}$$

While the numerator in equation 13 is clear, how about $(r+\delta)$? We would call it the rental cost of capital. Let's break this up.

- If the firm makes borrowing, they pay interest rate r.
- If they don't, r represents the opportunity cost to buy capital.
- δ represents decline in the value of machinery over time.

3.2.1 Tobin's q

- We can also explain investments using stock prices.
  - $\uparrow$ Price $\Rightarrow \uparrow$ investment.
  - $\downarrow$ Price $\Rightarrow \downarrow$ investment.
- Tobin's q:

$$q = \frac{\text{Market value of capital}}{\text{Replacement value of capital}} \tag{14}$$

- q represents the ratio of market value to book value.
  - $q < 1 \Rightarrow$ don't invest

- $q > 1 \Rightarrow$ invest

- This is very much like comparing the expected future profits to the user cost of capital, but Tobin's q, by the virtue of including stock prices, take care of future expectations of costs and benefits as well.

4. Expectations, Output, and Policy

In the light of all these changes to consumption and investment functions, we now revisit the $IS-LM$ model.

4.1 Expectations and the IS Relation

- We define aggregate private spending as:

$$A(Y,T,r) = C(Y-T) + I(Y,r) \tag{15}$$

- Output now depends upon current and expected future parameters

$$Y = A(Y,T,r,Y^e,T^e,r^e) + G \tag{16}$$

- A fall in current interest rate does not have much impact on spending.
  - A fall in current interest rate doesn't shift the present value.
  - Firms are not likely to change their investment plans until the expectations shift.

- The multiplier is going to be smaller.

4.2 *LM* Curve Revisited

Decision to hold money is a myopic one. Your transaction level today determine the money demand. Similarly, the opportunity cost of holding money depends upon the current nominal interest rate. Let us summarize this. The money demand:

- Depends upon current income and current interest rate.
- Doesn't depend upon future expected nominal interest rate.

4.3 Monetary Policy Revisited

- Money supply goes up $\Rightarrow$ Output shift may be larger. Why?
- The answer depends upon what firms and consumers expect.
  - If expectations revise such that firms increase investments and consumer spending rise, output will increase.
  - If expectations don't change, the effect of loose monetary policy on the output will be smaller.

4.4 Liquidity Trap, QE, and Expectations

Three channels through which QE may affect the economy.

1 Arbitrage may not hold. By buying assets, the central bank can replace risk-averse investors.

  - The price of the asset rise (interest rate falls).
  - The central bank may even finance some of the borrowers

2. Expectations of future nominal interest rates.
  - If expansionary monetary policy signals future expansionary policies, signal may be +ve.
  - Future nominal rates go up $\Rightarrow$ Spending goes up.

3. Expectations of inflation.
  - Higher expected inflation $\Rightarrow \downarrow$ current (and future) expected real interest rates.

4.5 Deficit Reduction Revisited

When we sketched the basic $IS-LM$ and $AS-AD$ models, we learnt the following about budget deficits:

- Short run: $\downarrow (G-T) \Rightarrow \downarrow$ Output
- Medium run: $\downarrow (G-T) \Rightarrow \uparrow$ Output.

What if the current decline in budget deficit signals decline in future deficits?

- In the medium run, output remains unchanged.
- Output = Spending.
- Therefore, $\downarrow$ public spending $\Rightarrow \downarrow$ private spending. (Spending = Public + Private)

- Higher private spending requires lower interest rates.
- The expected future interest rate goes down, stimulating spending and increasing output.

The above is what would happen (theoretically) in the medium run. Let's go back to the short run.

- $\downarrow G \Rightarrow IS$ curve shifts to the left.
- Because current interest rate goes down, people expect the future interest to be lower.
- Result: expected future output goes up (IS curve shifts to the right)
- The answer to our question: whether budget deficit will lead to a fall in output will depend upon:
  - The size of deficit reduction and its impact on current output.
  - The size of interest rate change and its signal for the future interest rate.