

# Expectations: The Basic Tools

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# Introduction

- In Lecture 1 about history of Macro, we emphasized that since the 1970s economist pay special attention to the role of expectations.
- In this lecture we introduce the basic tools.
- In the next few lectures, we analyze how expectations affect:
  - financial markets (Lecture 4).
  - consumption and investment (Lecture 5)
  - output and macroeconomic policy (Lecture 6)
- This topic is very important, because many economic decisions depend not only on what is happening now, but also on **what people expect about the future.**

Example 1:

Decisions that depend on  
expectations about the future

- A consumer: “Can I afford a loan to pay for a new car?”
- A company manager: “Sales have increased in past few years. Will they keep this trend in the near future? Should I buy more machines?”
- A pension fund manager: “The stock market is plummeting. Is it going to rebound soon? Should I divest and look for safe assets?”

# Nominal versus Real Interest Rates

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# Nominal versus real interest rates

- Interest rates expressed in terms of dollars (or, more generally, in units of the national currency) are called **nominal interest rates**.
- Interest rates expressed in terms of a basket of goods are called **real interest rates**.

In what follows:

$i_t$  nominal interest rate for year  $t$ .

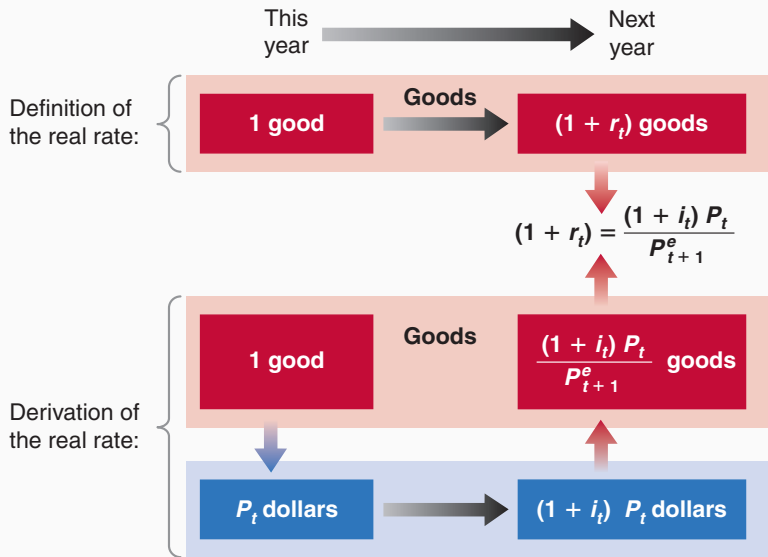
$r_t$  real interest rate for year  $t$ .

$1 + i_t$  lending one dollar this year yields  $(1 + i_t)$  dollars next year. Alternatively, borrowing one dollar this year implies paying back  $(1 + i_t)$  dollars next year.

$P_t$  price of basket of goods this year.

$P_{t+1}^e$  expected price next year.

# How nominal and real interest rates are related





## A useful approximation

- Given  $1 + r_t = (1 + i_t) \frac{P_t}{P_{t+1}^e}$ , and knowing that  $\frac{P_{t+1}^e}{P_t} = 1 + \pi_{t+1}^e$ , then

$$1 + r_t = \frac{1 + i_t}{1 + \pi_{t+1}^e}$$

- If the nominal interest rate and the expected rate of inflation are not too large, a simpler expression is:

$$r_t \approx i_t - \pi_{t+1}^e$$

- The real interest rate is (approximately) equal to the nominal interest rate minus the expected rate of inflation.

## Real vs nominal interest rate: some implications

$$r_t \approx i_t - \pi_{t+1}^e$$

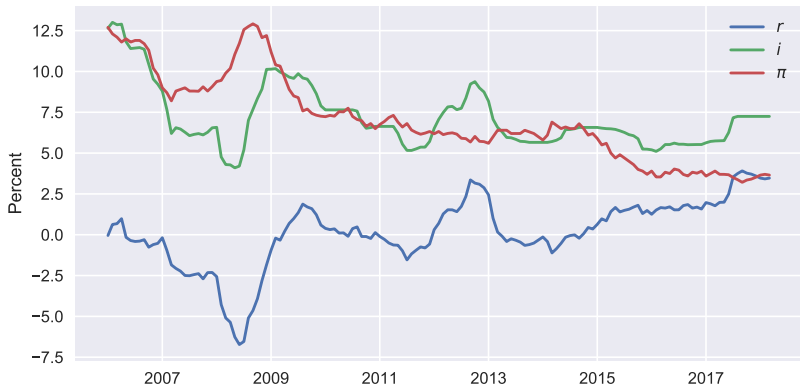
Here are some of the implications of the relation above:

- If  $\pi_{t+1}^e = 0$ , then  $i_t = r_t$
- If  $\pi_{t+1}^e > 0$ , then  $i_t > r_t$
- If  $\bar{i}_t$  is constant, then  $\uparrow \pi_{t+1}^e$  implies  $\downarrow r_t$

Example 2:

Nominal and real interest rates  
in Costa Rica

Real interest rate  $r$ , Nominal interest rate  $i$ , and Expected inflation  $\pi$   
Costa Rica 2006-2017



Source: Banco Central de Costa Rica (2018), charts 696 ( $i$ ) and 761 ( $\pi$ )

Although the nominal interest rate has declined during the last decade, the real interest rate was actually higher in 2016 than in 2006.

## Which interest rate should enter the IS relation?

- Consumers and investors base their decisions on the **real interest rate**.
- This has a straightforward implication for monetary policy.
- Although the central bank **chooses the nominal rate**, it **cares about the real interest rate** because this is the rate that affects spending decisions.
- To set the real interest rate it wants, it thus has to take into account expected inflation.

## Setting the policy interest rate

- If, for example, it wants to set the real interest rate equal to  $r$ , it must choose the nominal rate  $i$  so that, given expected inflation,  $\pi^e$ , the real interest rate,  $r = i - \pi^e$ , is at the level it desires.
- For example, if it wants the real interest rate to be 4%, and expected inflation is 2%, it will set the nominal interest rate,  $i$ , at 6%.
- So, we can think of the central bank as choosing the real interest rate.

# The Zero Lower Bound and Deflation

- The **zero lower bound** implies that  $i \geq 0$ ; otherwise people would not want to hold bonds.
- This implies that the  $r \geq -\pi^e$ .
- So long as  $\pi^e > 0$ , this allows for negative real interest rates.
- But if  $\pi^e$  turns negative, **if people anticipate deflation**, then the lower bound on  $r$  is positive and can turn out to be high.
- This may not be low enough to increase the demand for goods by much, and the economy may remain in recession.
- The zero lower bound turned out to be a serious concern during the 2008 crisis.

# Risk and Risk Premia

- Until now, we assumed there was only one type of bond.
- Bonds however differ in a number of ways. For example, maturity, risk.
- Some bonds are risky, with a non-negligible probability that the borrower will not be able or willing to repay.
- To compensate for the risk, bond holders require a risk premium.



# What determines this risk premium?

## 1: The probability of default itself.

- The higher this probability, the higher the interest rate investors will ask for.
- More formally, let  $i$  be the nominal interest rate on a riskless bond, and  $i + x$  be the nominal interest rate on a risky bond, which is a bond which has probability,  $p$ , of defaulting. Call  $x$  the **risk premium**.
- Then, to get the same expected return on the risky bonds as on the riskless bond, the following relation must hold:

$$1 + i = (1 - p)(1 + i + x) + (p)(0) \quad \Rightarrow \quad x = \frac{(1 + i)p}{1 - p}$$

- So for example, if  $i = 4\%$ , and  $p = 2\%$ , then the risk premium required to give the same expected rate of return as on the riskless bond is equal to 2.1%.

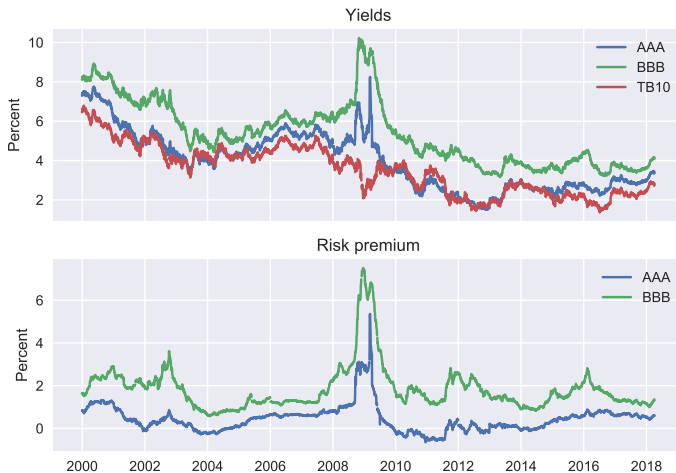
# What determines this risk premium?

## 2: The degree of risk aversion of the bond holders

- Even if the expected return on the risky bond was the same as on a riskless bond, the risk itself will make them reluctant to hold the risky bond.
- Thus, they will ask for an even higher premium to compensate for the risk.
- How much more will depend on their degree of **risk aversion**.
- And, if they become more risk averse, the risk premium will go up even if the probability of default itself has not changed.

# Yields on 10-Year U.S. Government Treasury, AAA, and BBB Corporate Bonds, since 2000

In September 2008, the financial crisis led to a sharp increase in the rates at which firms could borrow.



# Nominal and Real Interest Rates and the IS-LM Model

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## Nominal and real interest rates and the IS–LM model

- When deciding how much investment to undertake, firms care about real interest rates. Then, the IS relation must read:

$$Y = C(Y - T) + I(Y, i + x - \pi^e) + G$$

- The central bank still controls the nominal interest rate:

$$i = \bar{i}$$

- The real interest rate is:

$$r = i - \pi^e$$

## Writing the IS and LM in terms of the same interest rate

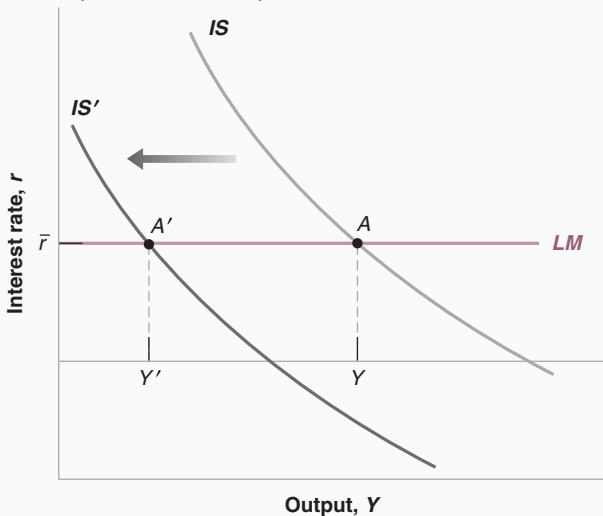
- Although the central bank formally chooses the nominal interest rate, it can choose it in such a way as to achieve the real interest rate it wants (this ignores the issue of the zero lower bound).
- Thus, we can think of the central banks as choosing the real policy rate directly and rewrite the two equations as:

$$Y = C(Y - T) + I(Y, r + x) + G \quad (\text{IS})$$

$$r = \bar{r} \quad (\text{LM})$$

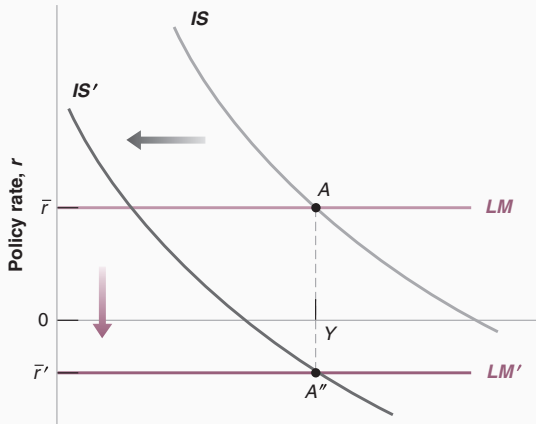
# Financial shocks and output

An increase in  $x$  leads to a shift of the IS curve to the left and a decrease in equilibrium output.



# Financial shocks and policies

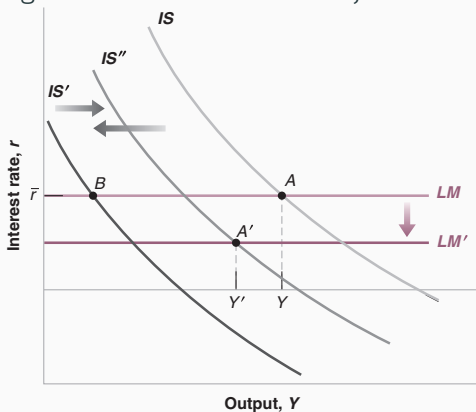
If sufficiently large, a decrease in the policy rate can in principle offset the increase in the risk premium. The zero lower bound may however put a limit on the decrease in the real policy rate.





# The Financial Crisis, and the Use of Financial, Fiscal, and Monetary Policies

The financial crisis led to a shift of the IS to the left. Financial and fiscal policies led to some shift back of the IS to the right. Monetary policy led to a shift of the LM curve down. Policies were not enough however to avoid a major recession.



Note an immediate implication of these three relations:

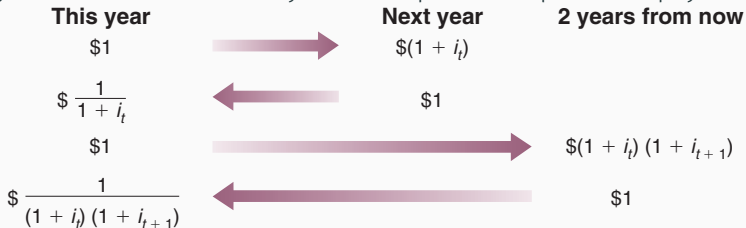
- The interest rate directly affected by monetary policy is the nominal interest rate.
- The interest rate that affects spending and output is the real interest rate.
- So, the effects of monetary policy on output depend on how movements in the nominal interest rate translate into movements in the real interest rate.

## Expected Present Discounted Values

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# The value of money over time

The expected present discounted value of a sequence of future payments is the value today of this expected sequence of payments.



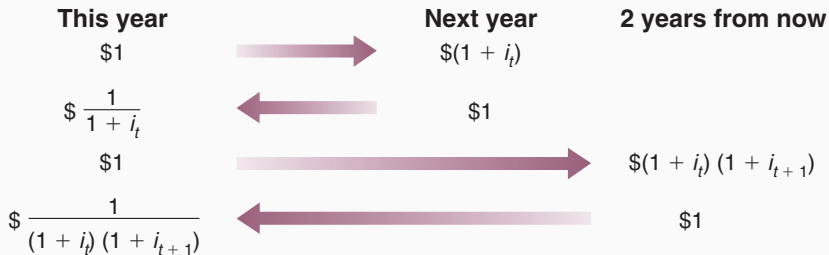
(a) One dollar this year is worth  $1 + i_t$  dollars next year.

(b) If you lend/borrow  $\frac{1}{1+i_t}$  dollars this year, you will receive/repay  $\frac{1}{1+i_t}(1 + i_t) = 1$  dollar next year.

(c) One dollar is worth  $(1 + i_t)(1 + i_{t+1})$  dollars two years from now.

(d) The present discounted value of a dollar two years from today is equal to  $\frac{1}{(1+i_t)(1+i_{t+1})}$

# Discount factors



The word “discounted” comes from the fact that the value next year is discounted, with  $(1 + i_t)$  being the **discount factor**. The 1-year nominal interest rate,  $i_t$ , is sometimes called the **discount rate**.

## Computing expected present discounted values

- The present discounted value of a sequence of payments, or value in today's dollars equals:

$$V_t = z_t + \frac{1}{1+i_t} z_{t+1} + \frac{1}{(1+i_t)(1+i_{t+1})} z_{t+2} + \dots$$

- When future payments or interest rates are uncertain, then:

$$V_t = z_t + \frac{1}{1+i_t} z_{t+1}^e + \frac{1}{(1+i_t)(1+i_{t+1})} z_{t+2}^e + \dots$$

- Present discounted value, or present value are another way of saying “expected present discounted value.”

## Some general results

This formula has these implications:

- Present value depends positively on today's actual payment and expected future payments.
- Present value depends negatively on current and expected future interest rates.

### Constant Interest Rates

To focus on the effects of the sequence of payments on the present value, assume that interest rates are expected to be constant over time, then:

$$V_t = z_t + \frac{z_{t+1}^e}{1+i} + \frac{z_{t+2}^e}{(1+i)^2} + \dots$$



### Constant Interest Rates and Payments

When the sequence of payments is equal –called them  $z$ , the present value formula simplifies to:

$$V_t = \left[ 1 + \frac{1}{1+i} + \frac{1}{(1+i)^2} + \cdots + \frac{1}{(1+i)^{n-1}} \right] z$$

The terms in the expression in brackets represent a geometric series. Computing the sum of the series, we get:

$$V_t = \frac{1 - \left(\frac{1}{1+i}\right)^n}{1 - \frac{1}{1+i}} z$$

# References

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-  Banco Central de Costa Rica (2018). *Indicadores Econonómicos*.  
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-  Blanchard, Olivier, Alessia Amighini, and Francesco Giavazzi (2012). *Macroeconomía*.