

Chapter6. Interest Rates

*Money Rates

- Interest rate: price (=cost) of money (p.163) today in terms of money tomorrow= compensation for making an investment today, would like to have more money back in the future!
- Exchange rate: relative value of two currencies = (\$) price of a FC (that is, how many \$s for one unit of the FC), Aside) price is an exchange rate, too.

* How to compute interest rate or Rates of return

= (End Balance – Beg Balance + Holding Period Income)/Beg Balance

= $(P_t - P_{t-1} + C)/P_{t-1}$, C=dividend, interest, rent, - -

$P_{t-1}=\$100$, $P_t=\$110$, $C=\$5$, $R_t = (110 - 100 + 5)/100 = .15$ or 15%

Aside) Gains from the price change ($P_t - P_{t-1}$) or the appreciation of the value of investment is called Capital Gains. Sometimes, the value of the investment could depreciate and you may have a capital loss.

* Interest rates = rate of return

1) Interest Rate has an Inverse relationship with PV (Present Value) or Price => you pay more, you get less in return (assuming the future value and the income being the same).

2) The Components of interest rates (Irving Fisher) ~ what are the factors determining the required rate of security k (e.g., Kellogg Company)?

$R_k = \text{Real risk free rate} + \text{Expected inflation rate (IP)} + \text{Risk premium (for security k)}$

Return(interest rate for) on security k is determined by the 3 factors - -

(1) Make sense? Yes, return is a compensation for 1) giving up my purchasing power today, 2) for losing value of money, and 3) for taking the risk.

(2) Real risk free rate determinants: how patient consumers are, how productive the economy is. If the economy is more patient (impatient) and/or less (more) productive => real interest rates should be lower (higher). Real=Purchasing Power of real goods/services.

Note: I need to add expected inflation rate to protect me against an erosion of the purchasing power of money due to inflation.

(3) Ex-post (after the fact) vs. ex-ante (before the realization of the event) ~ what we talk about here is ex-ante in the sense how much you should ask for when you make an investment.

However, what you really get from the investment is determined ex-post based on your decision and your luck!

(4) Nominal risk free=T-Bill (short-term government security) rate, risk pm for this is ZERO. T-Bill, however, is not risk free as the real return varies depending on the future inflation rate.

(5) The first two (real risk free rate and inflation premium) are common to all investments, while the risk premium is investment specific as different investment as different amount of risk.

(6) Three major risks (maturity risk, default risk, and liquidity risk).

Default risk can be measured by some private ratings agencies including Moody's, S&P's, etc. AAA, AA, A, BBB (Baa), BB, B, - -

(7) Interest rates in different countries

Aside) Once the required rate of return for K is determined by this equation ($2\%+3\%+5\%=10\%$), you can compare this required return with the projected return (say, 12.7%) and make an investment decision. In this example, you want to invest in K, since the projected return is higher than the required return.

3) Term Structure of Interest Rates (p.175 – p.176) = relationship between interest rates and (time to) maturity. Snapshot at any given point in time. A table is a way to describe.

Example: BOA Today's CD rates. Note that the interest rates quoted are APRs (annualized percentage rates).

Today's CD rates

6 months 3%

1 year 4%

2 years 4.5%

3 years 4.7%

5 years 4.8%

Questions) What are actual returns? Why APRs? (10% for 1 year vs. 6.5% for 6 months)

(1) WSJ example

(2) Yield curve p.175 A graphical representation of term structure of interest rates.

(3) Three theories (or hypotheses) trying to explain what determines the shape of the yield curve, i.e., the relationship between long-term and short-term interest rates. In other words, why we sometimes have rising (normal), declining (inverted), flat, or humped yield curves?

a) (Pure) Expectations hypothesis: says that our expectation of future interest rates has an impact on the long-term interest rates in such a way that if we expect a higher interest rates in the future, then the long-term rates (say, 10 year CD) tend to be higher than short-term rates (say, 1 or 2 year CD). Why? If the market is competitive, short-term rollover and long-term strategies are expected to produce the same overall returns.

That is, approximately, $oR_1 + E({}_1R_2) = oR_2 + oR_2 = 2*oR_2 \Rightarrow$ the two year CD rate, $oR_2 =$ average of current short-term and expected short-term future rates. If $E({}_1R_2) > oR_1$, then $oR_2 > oR_1 \Rightarrow$ rising (normal) yield curve. $\Rightarrow (1+E({}_1R_2))*(1+oR_1) = (1+oR_2)^2$ Exact equation in the book. You can use an approximation to answer this type of question.

Example: If $oR_1=4\%$, $oR_2=5\%$, What is $E({}_1R_2)$? $4\% + X = 5+5=10\% \Rightarrow X=? 6\%$

$1+E({}_1R_2) = (1.05)^2/1.04 = 1.06009 \Rightarrow E({}_1R_2) = 0.06009$ or 6.009%

Question) Based on the BOA's CD term structure, can you figure out the market's expected return on the future 1 year CD rate, that is, $E({}_1R_2)$? $4\% + E({}_1R_2) = 4.5\% + 4.5\% = 9\%$. $E({}_1R_2)=5\%$.

Conclusion) If the market expects a higher (short-term) interest rate in the future, the long-term rate (here, oR_2 , two year CD rate) is higher than the short-term rate (one year CD rate, oR_1) \Rightarrow rising yield curve. Conversely, a rising yield curve is indicative of market's expectation of a higher future interest rate.

b) Liquidity preference hypothesis: Other things being the same, people do not want to make a long-term investment. This means that the long-term rate should be higher (this is called Maturity Risk Pm) to make it equally attractive.

Example: MP=1%,

From the equation for the expectations hypothesis, we have

$$(1+E({}_1R_2))*(1+oR_1) = (1+oR_2-MP)^2$$

$$\Rightarrow (1.04)*(1+E({}_1R_2)) = (1+0.05 - 0.01)^2 = (1.04)^2 \Rightarrow E({}_1R_2) = 4\%$$

Or

$$oR_1 + E({}_1R_2) = 2*(oR_2-MP)$$

$$\Rightarrow 4\% + E({}_1R_2) = 2*(5\%-1\%)=8\%$$

Aside) What is oR_2 , if $oR_1 = E({}_1R_2) = 4\%$?

According to the expectations hypothesis, $oR_1 + E({}_1R_2) = 2*oR_2$. That is, $4\% + 4\% = 2*oR_2$, and $oR_2=4\%$ as well. Since $oR_1=oR_2=4\%$, we have a flat yield curve. Since the future interest rates are expected to be the same as the current (short-term) interest rates, the long-term rate, which is an average of current and future (short-term) interest rates, should be the same.

According to liquidity hypothesis with MP=0.5%, $oR_1 + E({}_1R_2) = 2*(oR_2-MP)$. That is, $4\% + 4\%$

= $2 \times (oR_2 - 0.5\%)$, and $oR_2 = 4.5\%$. Since $oR_1 = 4\%$ and $oR_2 = 4.5\%$, we have a normal rising yield curve. The current long-term interest rate is higher than the current short-term interest rate as the long-term rate include the maturity premium as a compensation for investors to invest long-term (as they would not do that otherwise without such an incentive). With that extra incentive, people may find both investment strategies (long-term vs. short-term rollover) equally attractive. In this case, we cannot conclude that a rising yield curve is indicative of people's expectation of an increase in the future interest rates.

c) **Market segmentation:** short-term markets and long-term markets are segmented. => two different markets. Therefore, short-term and long-term interest rates are independently determined. For example, pension funds are investing only in long-term securities.

4) Risk types (p.168 – p.174)

- (1) Default risk & premium
- (2) Liquidity risk & premium
- (3) Maturity risk & premium (Interest rate risk, Reinvestment risk, and Call risk)

Now,

$$R_k = r^* + IP + RP_k = r^* + IP + DRP_k + LP_k + MRP_k$$

Example: 2 year AA (DRP=0.5% from Moody's) rated bond with $MRP=0.3\% \times (t)$, $LP=0.6\%$, $IP=3\%$ this year and 4% next year, with $r^*=2\%$? $R_k = 2\% + (3+4)/2 + 0.5 + 0.6 + 0.3 \times 2 = 2 + 3.5 + 1.7 = 7.2\%$, required rate of return. If somebody offers 7.4% for this security, then what would you do? Take it.

5) Tax considerations

- (1) Before-tax and after-tax returns

$R_a = R_b \times (1-t)$, $R_b=10\%$, you are in a 30% tax bracket? $R_a?$ 7%

If $R_a=14\%$ and $t=30\%$, what is R_b ? $14\% = R_b \times (1-0.3) \Rightarrow R_b=20\%$

- (2) Tax equivalent before-tax rate of return?

Basically, determining the R_b , given R_a

Municipal bonds (bonds issued by State or Local governments) or Muni(s) – interest income from munis are tax exempt. Return on muni is basically R_a and we may want to know what would be the return on a taxable security's R_b to have the same return as the muni.

Aside) Which one (munis vs. taxable securities) do you think would have a lower return (R_b)?

* Exchange rates

- 1) American (price, direct) vs. European (quantity, reciprocal) quotations

$\$/FC$ =American term => how many \$ s would be equivalent to one unit of a FC, just like a price of Twinkie. $FC/\$$ = How many units of FC for one \$, just like how many twinkies for one \$.

An inverse relationship between them. $\$/TW=0.5 \Rightarrow$ you can get 2 twinkies for one dollar.

- 2) WSJ
- 3) Cross rates
- 4) Spot and Forward rates
- 5) Exchange rate risk exposures

Tips for Aplia Questions

2. A tighter monetary policy would result in a shift in the supply curve to the left, resulting in a higher equilibrium interest rate. Short-term interest rates respond to erratic current economic conditions and tend to be more volatile. Long-term rates respond to more fundamental changes.

3. Nominal risk free rate = $r^* + IP$