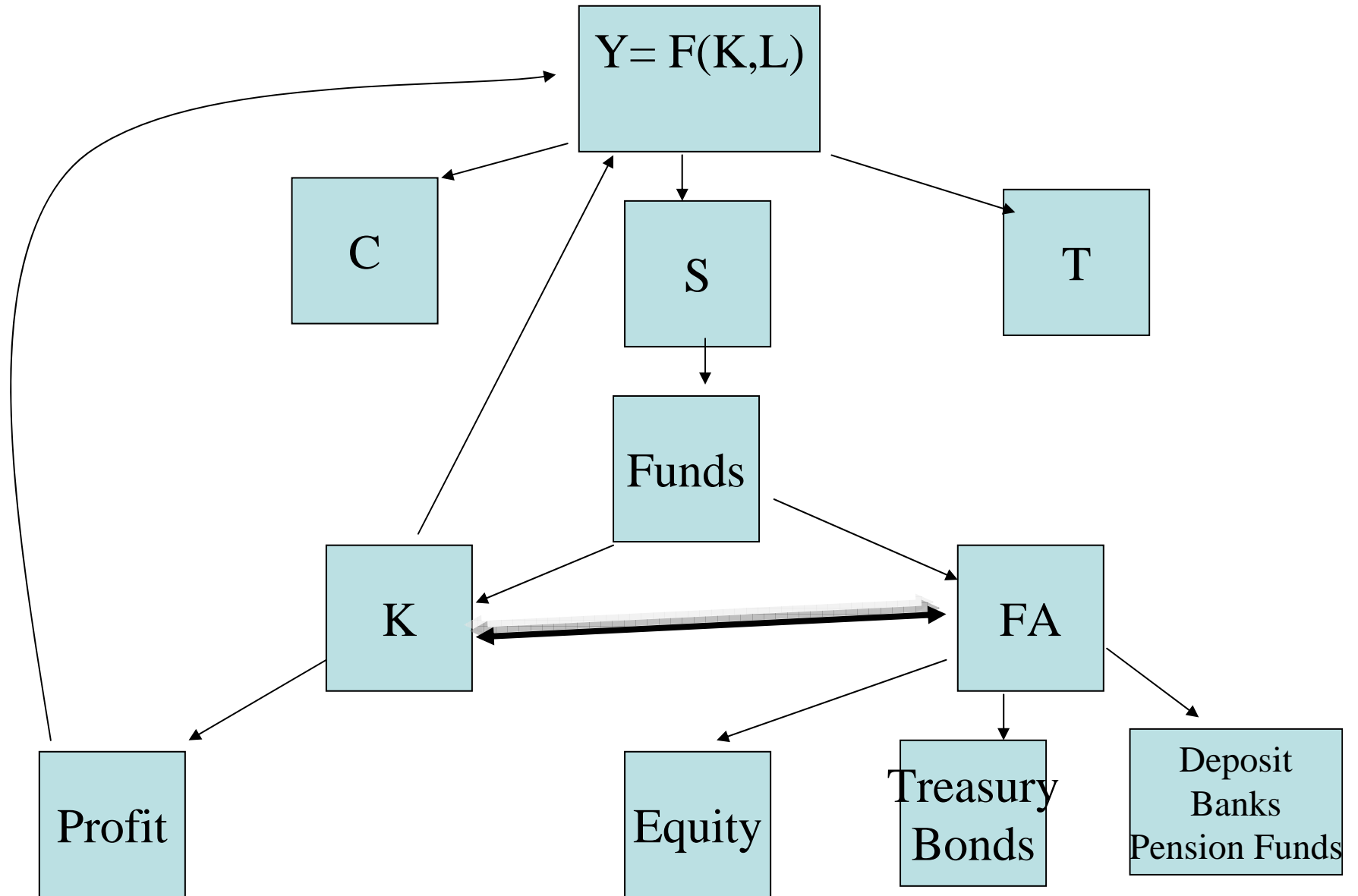


Economic Modelling

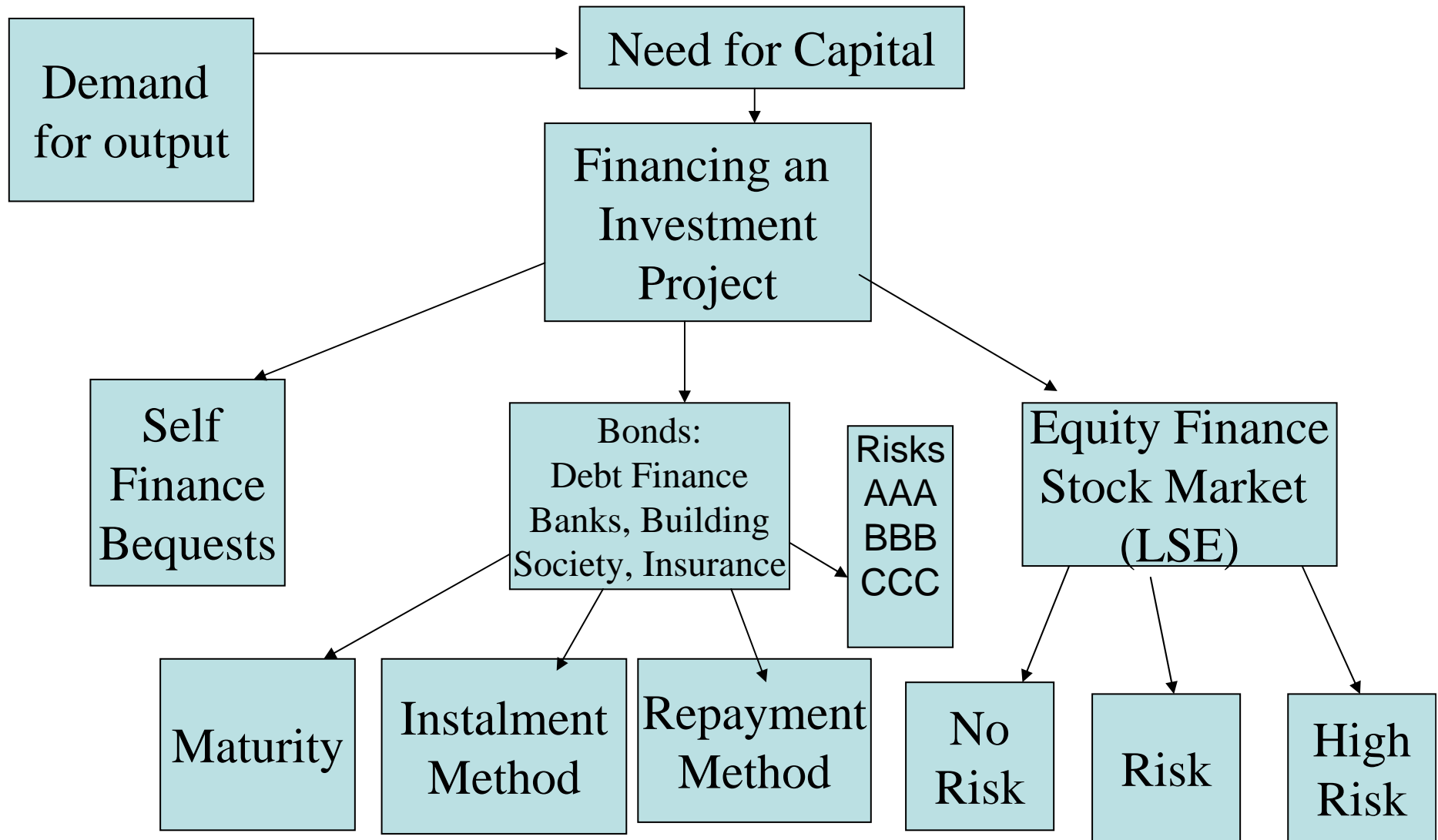
Lecture 8

Financial Market: Value of Bonds and Stocks

Link Between Financial System and the Economy



Financing of an Investment Project



Three Sources of Financing an Investment Project

- Self-financing
 - Depends on retained earning
 - Personal savings
- Bonds
 - Various maturities and risks
- Stocks
 - Market signals and equity prices

Investor Care about the Real Return: Fisher equation

Gross nominal return

Time	today	Tomorrow
Amount	P_t	$(1+i)P_t$.

Gross real return (take account of inflation)

Time	Today	Tomorrow
Amount	P_t	$(1+r) = (1+i) \frac{P_t}{P_{t+1}^e}$
Approximation	P_t	$(1+r) = \frac{1+i}{1+\pi^e} \approx (1+i - \pi^e)$

$$\frac{P_t}{P_{t+1}^e} = \frac{1}{1+\pi_t^e} \quad \text{and} \quad \pi_t^e = \frac{P_{t+1}^e - P_t}{P_t}.$$

Fisher Approximation Rule is Good only for Small Interest Rates

If $i=4\%$ and $\pi^e = 2\%$ $r \approx i - \pi$

$$r = 4\% - 2\% \cong 2\%$$

$$(1+r) = \frac{1+i}{1+\pi^e} = \frac{1+0.04}{1+0.02} = 1.01961$$

$$\implies r = 1.961\% \cong 2\%$$

But the $r \approx i - \pi$ not good for large r , i and π

$$r = 84\% - 54\% \cong 30\%$$

$$(1+r) = \frac{1+i}{1+\pi} = \frac{1+0.84}{1+0.54} = 1.195 \implies r = 19.5\%$$

Key Points about Prices Financial Assets

Prices depend on

- Expected earnings from these assets
 - Expected returns from bonds
 - Expected stream of dividends from stocks
- Expected interest rates
 - Interest rates discount future earnings to present values
- Expected resale values of those assets
 - short run vs. long run
- Arbitrage implies investors reshuffle assets until the rate of return equalise s in every asset

Market Price of a bond (console)

What is the market price (value) of a console that pays 100 each year forever at the interest rate, r ?

$$PV = \frac{100}{(1+r)^1} + \frac{100}{(1+r)^2} + \frac{100}{(1+r)^3} + \dots + \frac{100}{(1+r)^n}$$

$$PV = \frac{100}{(1+r)^1} \left[\frac{1 - \frac{1}{(1+r)^{n+1}}}{1 - \frac{1}{1+r}} \right] \quad \text{as } n \rightarrow \infty \quad \frac{1}{(1+r)^{n+1}} \rightarrow 0$$

$$PV = \frac{100}{(1+r)^1} \left[\frac{1+r}{r} \right] = \frac{100}{r} = \frac{100}{0.1} = 1000.$$

Market Prices of Bonds By Maturity

One Period Bond:
$$P_{1,t} B = \frac{\text{Face value}}{\left(1+i_{1,t}\right)}$$

Two Period Bond:
$$P_{2,t} B = \frac{\text{Face value}}{\left(1+i_{1,t}\right)\left(1+i_{1,t+1}^e\right)}$$

Derivation

$$P_{2t} = \frac{P_{1,t+1}^e}{1+i_{1,t}}$$

$$P_{1,t+1}^e = \frac{1}{1+i_{1,t+1}^e}$$

$$P_{2t} B = \frac{P_{1,t+1}^e (\text{Face value})}{1+i_{1,t}} = \frac{\text{Face value}}{\left(1+i_{1,t}\right)\left(1+i_{1,t+1}^e\right)}$$

Yield to maturity on Bonds

Face Value 100 Maturity 2 years

Market Price $P_{2t}^B = 90$

$$\left(1 + i_{2t}\right) = \sqrt{100/90} = 1.054$$

Yield to maturity 5.4%

Note

$$P_{2t}^B = \frac{\text{Face value}}{\left(1 + i_{2t}\right)^2} = \frac{100}{\left(1 + i_{2t}\right)^2}$$

Arbitrage Between Short and Long Run Yields

Long Term

Short term

$$(1 + i_{2t})^2 = (1 + i_{1t})(1 + i_{1,t+1}^e)$$

Approximations:

$$(1 + 2i_{2t}) = (1 + i_{1t} + i_{2t}^e) \Rightarrow i_{2t} = \frac{1}{2}(i_{1t} + i_{2t}^e)$$

$$i_{nt} = \frac{1}{n}(i_{1t} + i_{2t}^e + i_{3t}^e + \dots + i_{nt}^e)$$

Long-term interest rate (yield) is average of expected short run interest rates.

Market Price of Stocks

Arbitrage between bonds and stock: $(1+i_{1,t}) = \frac{D_{t+1}^e + P_{S,t+1}^e}{P_{S,t}}$

By Rearranging: $P_{S,t} = \frac{D_{t+1}^e}{(1+i_{1,t})} + \frac{P_{S,t+1}^e}{(1+i_{1,t})}$

Stock Price depends on expected stream of dividends and resale:
(by iterating forward the above equation)

$$P_{S,t} = \frac{D_{t+1}^e}{(1+i_{1,t})} + \frac{D_{t+2}^e}{(1+i_{1,t})(1+i_{1,t}^e)} + \dots + \frac{D_{t+n}^e}{(1+i_{1,t})(1+i_{1,t}^e) \dots (1+i_{n,t}^e)}$$

$$+ \frac{P_{S,t+n}^e}{(1+i_{1,t})(1+i_{1,t}^e) \dots (1+i_{n,t}^e)}$$

Price of a Stock: An example

$$P_{Share} = \left(\frac{D}{r - g + x} \right)$$

P_{Share} = Price of a Stock

D = expected Dividend

r = interest rate

g = growth rate of dividend

x = risk premium

D = 1000 and r = 5% and g = 3% has a risk x = 0;

$$P_{Share} = \left(\frac{1000}{0.05 - 0.03 + 0} \right) = \frac{1000}{0.02} = 50,000$$

If r = 8%

$$P_{Share} = \left(\frac{1000}{0.08 - 0.03 + 0} \right) = \frac{1000}{0.05} = 20,000$$

Price of Stock with Risks: An example

D =1000 and r =5% and g=3% has a risk x =8%

$$P_{Share} = \left(\frac{D}{r-g+x} \right) = 1000 \left(\frac{1}{0.05-0.03+0.08} \right) = \frac{1000}{0.1} = 10000$$

when r=8%

$$P_{Share} = \left(\frac{D}{r-g+x} \right) = 1000 \left(\frac{1}{0.08-0.03+0.08} \right) = \frac{1000}{0.13} = 7692.31$$

Observations From the above Analysis of Stock Markets

- Lower the market interest rate, higher is the value of stock. Because future earnings are discounted at lower rate.
- Higher the growth rate of dividend higher the value of stock. As dividend grows earning from the share rises and hence price rise.
- Higher the risk premium lower is the value of the share. A decrease in the risk premium will increase the market value of a stock.
- Arbitrage implies same rate of risk adjusted returns in both stocks and bonds.
- (in the short run) Higher the resale value of the stock higher is its price.

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