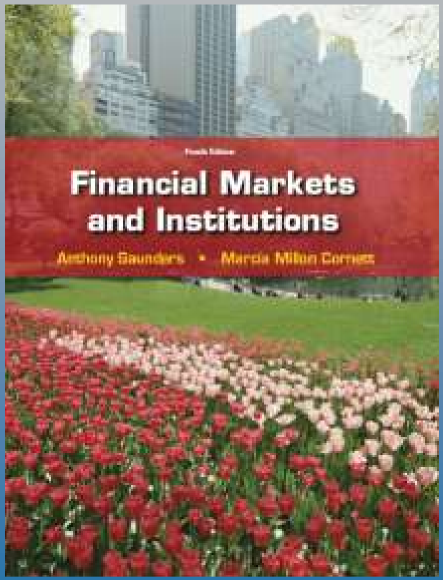
Chapter Two

Determination of Interest Rates



Interest Rate Fundamentals

- **Nominal interest rates: the interest rates actually observed in financial markets**
  - affect the values (prices) of securities traded in money and capital markets
  - affect the relationships between spot and forward FX rates

Time Value of Money and Interest Rates

- **The time value of money is based on the notion that a dollar received today is worth more than a dollar received at some future date**
  - **Simple interest:** interest earned on an investment is not reinvested
  - **Compound interest:** interest earned on an investment is reinvested

Present Value of a Lump Sum

- **Discount future payments using current interest rates to find the present value (PV)**

$$PV = FV_t[1/(1 + r)]^t = FV_t(PVIF_{r,t})$$

PV = present value of cash flow

FV_t = future value of cash flow (lump sum) received in t periods

r = interest rate per period

t = number of years in investment horizon

$PVIF_{r,t}$ = present value interest factor of a lump sum

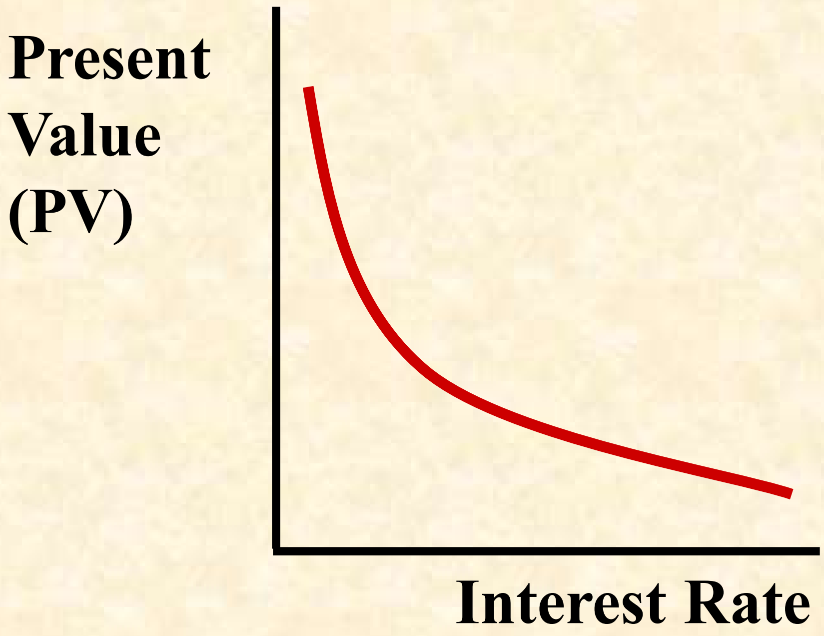
Future Value of a Lump Sum

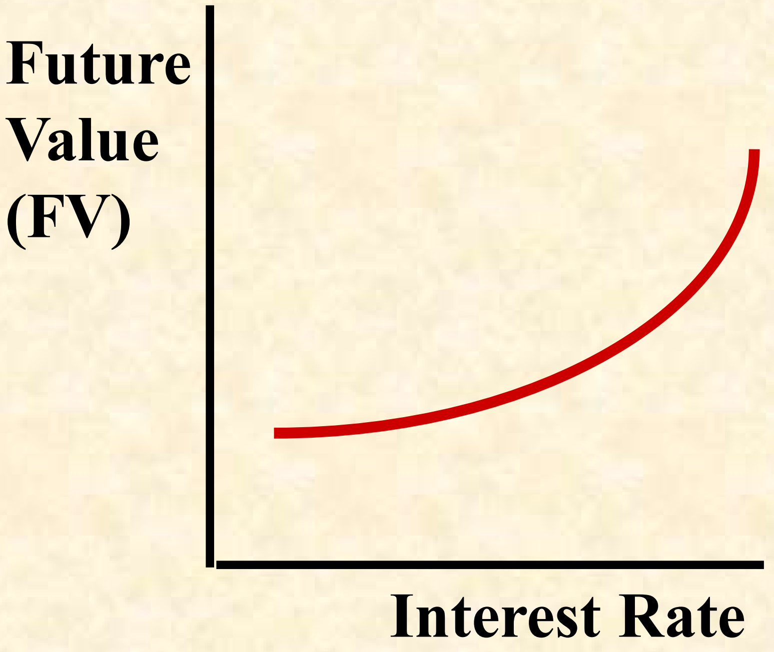
- **The future value (FV) of a lump sum received at the beginning of an investment horizon**

$$FV_t = PV(1 + r)^t = PV(FVIF_{r,t})$$

$FVIF_{r,t}$ = future value interest factor of a lump sum

Relation between Interest Rates and Present and Future Values





Present Value of an Annuity

- **The present value of a finite series of equal cash flows received on the last day of equal intervals throughout the investment horizon**

$$PV = PMT\sum_{j=1}^{t}[1/(1+r)]^{j} = PMT(PVIFA_{r,t})$$

$\boldsymbol{PMT}$ = periodic annuity payment

$\boldsymbol{PVIFA_{r,t}}$ = present value interest factor of an annuity

Future Value of an Annuity

- **The future value of a finite series of equal cash flows received on the last day of equal intervals throughout the investment horizon**

$$FV_t = PMT\sum_{j=0}^{t-1}(1+r)^j = PMT(FVIFA_{r,t})$$

$\boldsymbol{FVIFA_{r,t}}$ = future value interest factor of an annuity

Effective Annual Return

- **Effective or equivalent annual return (*EAR*) is the return earned or paid over a 12-month period taking compounding into account**

$$EAR = (1 + r)^c - 1$$

c = the number of compounding periods per year

Financial Calculators

- **Setting up a financial calculator**
  - Number of digits shown after decimal point
  - Number of compounding periods per year
- **Key inputs/outputs (solve for one of five)**

  N = number of compounding periods

  I/Y = annual interest rate

  PV = present value (i.e., current price)

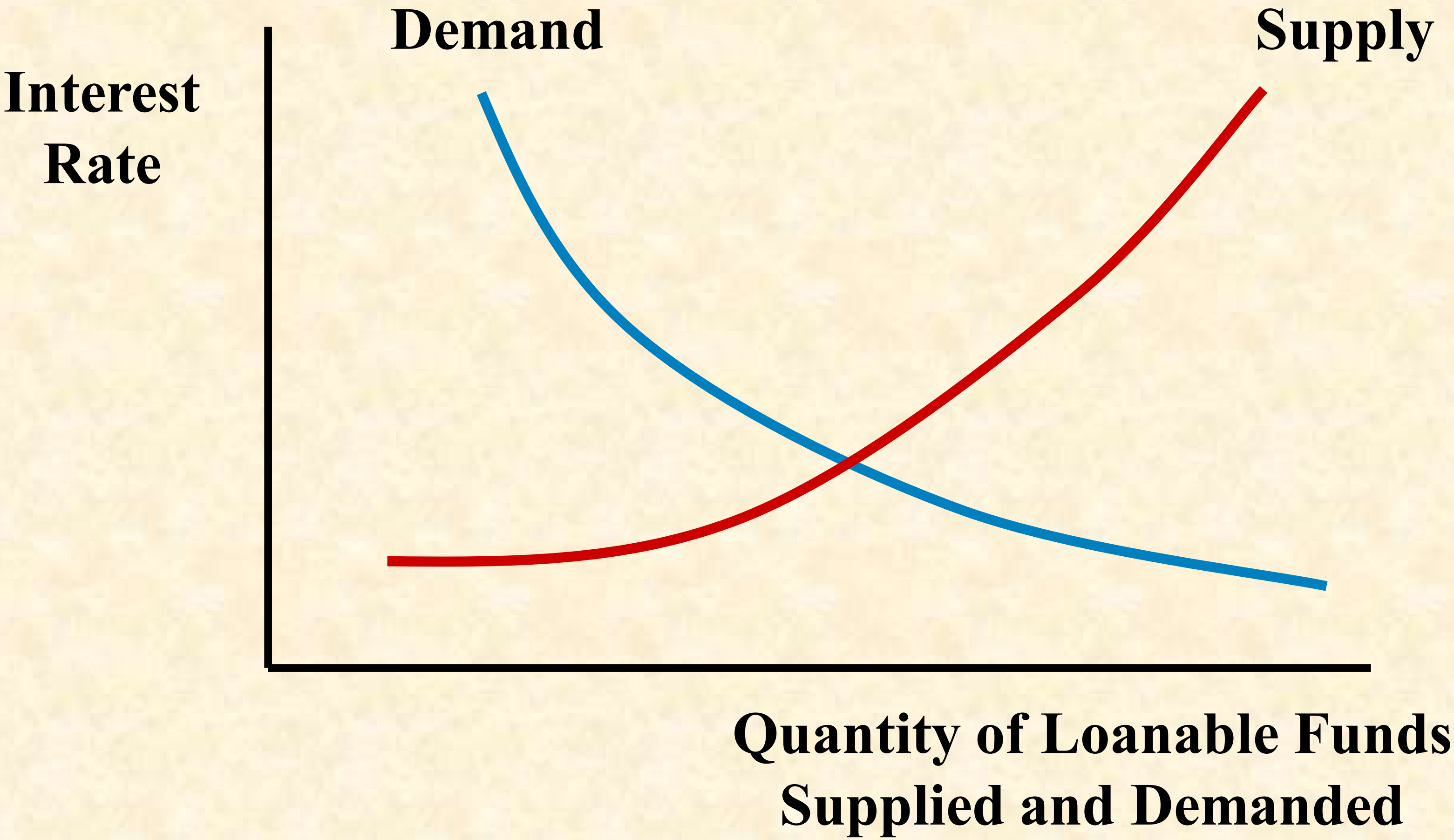
  PMT = a constant payment every period

  FV = future value (i.e., future price)

Loanable Funds Theory

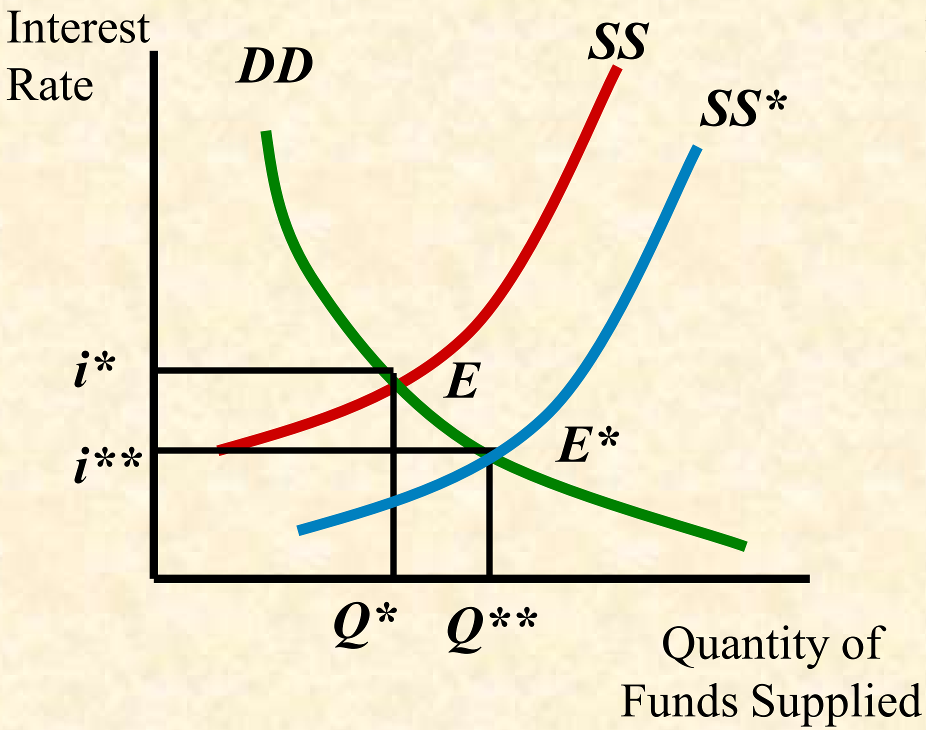
- Loanable funds theory explains interest rates and interest rate movements
- Views level of interest rates in financial markets as a result of the supply and demand for loanable funds
- Domestic and foreign households, businesses, and governments all supply and demand loanable funds

Supply and Demand of Loanable Funds

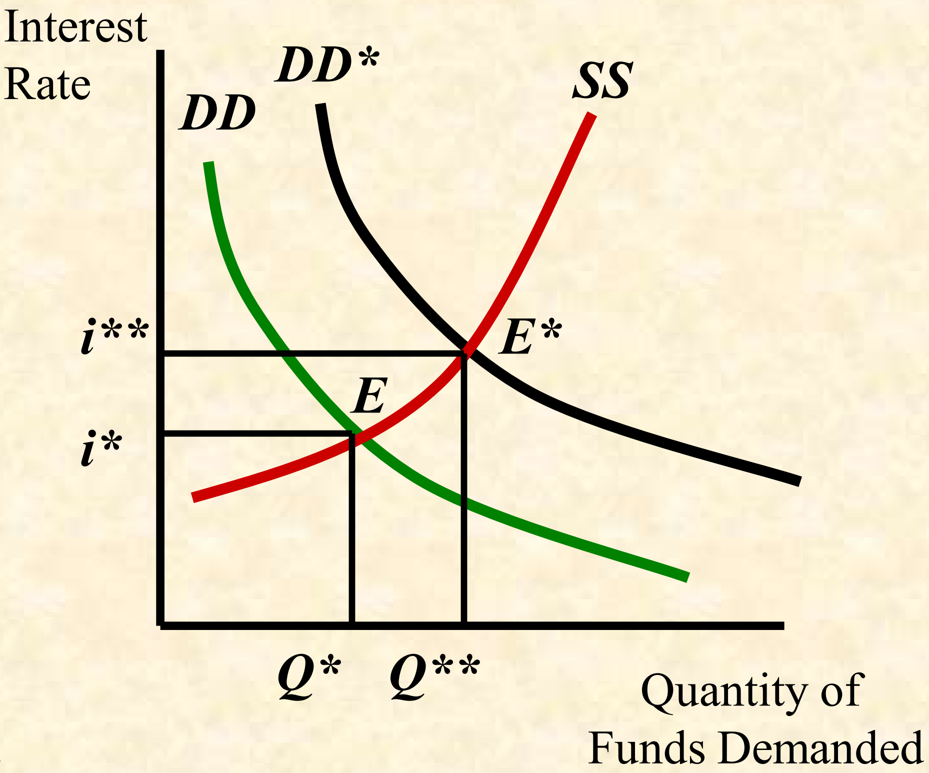


Shifts in Supply and Demand Curves change Equilibrium Interest Rates

Increased supply of loanable funds



Increased demand for loanable funds



Determinants of Interest Rates for Individual Securities

- $i_j^* = f(IP, RIR, DRP_j, LRP_j, SCP_j, MP_j)$
- **Inflation (*IP*)**

  $IP = [(CPI_{t+1}) - (CPI_t)]/(CPI_t) \times (100/1)$
- **Real Interest Rate (*RIR*) and the Fisher effect**

  $RIR = i - \text{Expected } (IP)$

Determinants of Interest Rates for Individual Securities (cont'd)

- **Default Risk Premium (*DRP*)**

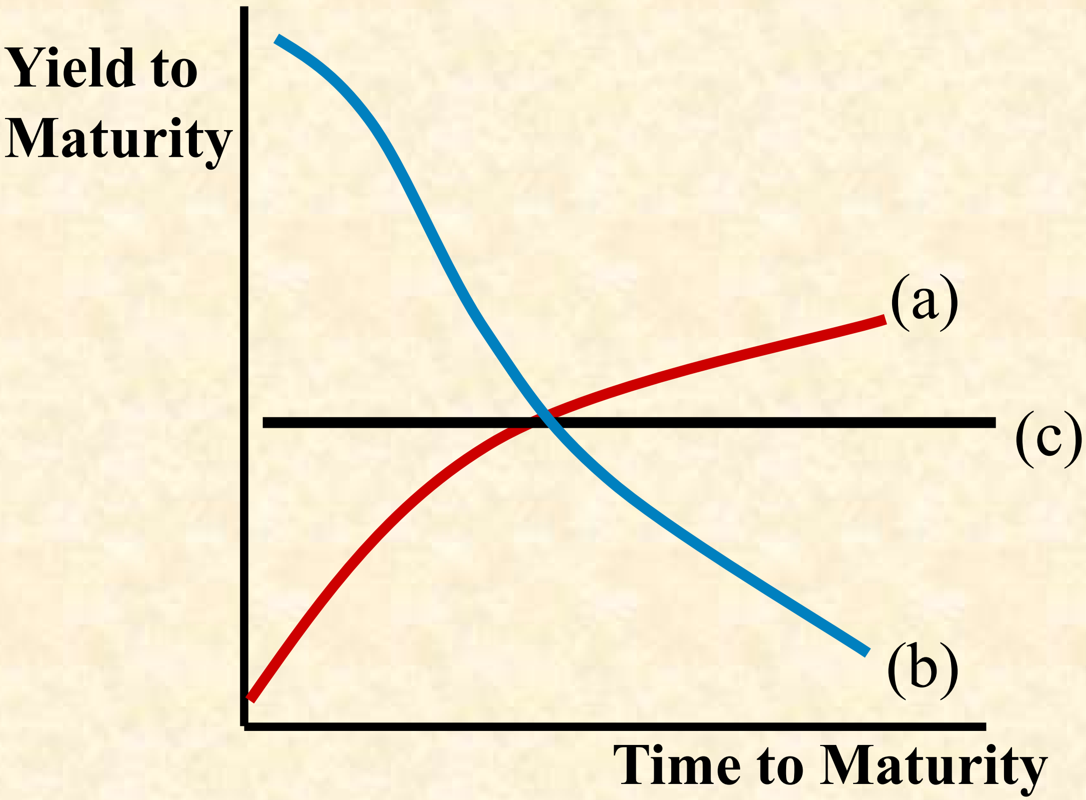
$$DRP_j = i_{jt} - i_{Tt}$$

i_{jt} = interest rate on security j at time t

i_{Tt} = interest rate on similar maturity U.S. Treasury security at time t

- **Liquidity Risk (*LRP*)**
- **Special Provisions (*SCP*)**
- **Term to Maturity (*MP*)**

Term Structure of Interest Rates: the Yield Curve



(a) Upward sloping
(b) Inverted or downward sloping
(c) Flat

Unbiased Expectations Theory

- **Long-term interest rates are geometric averages of current and expected future short-term interest rates**

$$_1R_N = [(1+{}_1R_1)(1+E({}_2r_1))\ldots(1+E({}_Nr_1))]^{1/N} - 1$$

$\boldsymbol{_1R_N}$ = actual N-period rate today

N = term to maturity, N = 1, 2, …, 4, …

$\boldsymbol{_1R_1}$ = actual current one-year rate today

$\boldsymbol{E(_ir_1)}$ = expected one-year rates for years, $\boldsymbol{i}$ = 1 to N

Liquidity Premium Theory

- **Long-term interest rates are geometric averages of current and expected future short-term interest rates plus liquidity risk premiums that increase with maturity**

$$ {}_1R_N = [(1 + {}_1R_1)(1 + E({}_2r_1) + L_2)\ldots(1 + E({}_Nr_1) + L_N)]^{1/N} - 1 $$

$\boldsymbol{L_t}$ = liquidity premium for period $\boldsymbol{t}$

$\boldsymbol{L_2 < L_3 < \ldots < L_N}$

Market Segmentation Theory

- Individual investors and FIs have specific maturity preferences
- Interest rates are determined by distinct supply and demand conditions within many maturity segments
- Investors and borrowers deviate from their preferred maturity segment only when adequately compensated to do so

Implied Forward Rates

- A forward rate (f) is an expected rate on a short-term security that is to be originated at some point in the future
- The one-year forward rate for any year N in the future is:

$$_N f_1 = [(1 + {}_1R_N)^N / (1 + {}_1R_{N-1})^{N-1}] - 1$$