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SKU: 9781259919718-SOLUTIONS

Answers to Chapter 2
Questions:

1. The suppliers of loanable funds are the household sector (i.e., consumers), the business sector, governmental agencies, and foreign investors.

The household sector (consumers) is one of the largest supplier of loanable funds. Households supply funds when they have excess income or want to reinvest a part of their wealth. For example, during times of high growth households may replace part of their cash holdings with earning assets. As the total wealth of the consumer increases, the total supply of funds from that household will also generally increase. Households determine their supply of funds not only on the basis of the general level of interest rates and their total wealth, but also on the risk of securities investments. The greater a security's risk, the less households are willing to invest at each interest rate. Further, the supply of funds provided from households will depend on immediate spending needs. For example, near-term educational or medical expenditures will reduce the supply of funds from a given household.

Higher interest rates will also result in higher supplies of funds from the business sector. When businesses mismatch inflows and outflows of cash to the firm, they have excess cash that can be invested for a short period of time in financial assets. In addition to interest rates on these investments, the expected risk on financial securities and the business' future investment needs will affect the supply of funds from businesses.

Loanable funds are also supplied by some government units that temporarily generate more cash inflows (e.g., taxes) than they have budgeted to spend. These funds are invested until they are needed by the governmental agency. Additionally, the federal government (i.e., the Federal Reserve) implements monetary policy by influencing the availability of credit and the growth in the money supply, as seen in the most recent economic recession.

Finally, foreign investors increasingly view U.S. financial markets as alternatives to their domestic financial markets. When interest rates are higher on U.S. financial securities than on comparable securities in their home countries, foreign investors increase the supply of funds to U.S. markets. Indeed, the high savings rates of foreign households has resulted in foreign market participants functioning as major suppliers of funds in U.S. financial markets. Similar to domestic suppliers of loanable funds, foreign suppliers assess not only the interest rate offered on financial securities, but also their total wealth, the risk on the security, and their future spending needs. Additionally, foreign investors alter their investment decisions as financial conditions in their home countries change relative to the U.S. economy.

2. The demanders of loanable funds are households, businesses, governments, and foreign participants (households, business, as well as governments).

Households (although they are net suppliers of funds) borrow funds in financial markets. The demand for loanable funds by households comes from their purchases of homes, durable goods (e.g., cars, appliances), and nondurable goods (e.g., education expenses, medical expenses). In addition to the interest rate on borrowed funds, the greater the utility the household receives from the purchased good, the higher the demand for funds. Nonprice conditions and requirements affect a household's demand for funds at every level of interest rates.

Businesses often finance investments in long-term (fixed) assets (e.g., plant and equipment) and in short-term assets (e.g., inventory and accounts receivable) with debt and other financial instruments. When interest rates are high (i.e., the cost of loanable funds is high), businesses prefer to finance investments with internally generated funds (e.g., retained earnings) rather than through borrowed funds. Further, the greater the number of profitable projects available to businesses, or the better the overall economic conditions, the greater the demand for loanable funds.

Governments also borrow heavily in financial markets. State and local governments often issue debt to finance temporary imbalances between operating revenues (e.g., taxes) and budgeted expenditures (e.g., road improvements, school construction). Higher interest rates cause state and local governments to postpone such capital expenditures. Similar to households and businesses, state and local governments' demand for funds vary with general economic conditions. The federal government is also a large borrower partly to finance current budget deficits (expenditures greater than taxes) and partly to finance past deficits.

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Finally, foreign participants might also borrow in U.S. financial markets. Foreign borrowers look for the cheapest source of dollar funds globally. Most foreign borrowing in U.S. financial markets comes from the business sector. In addition to interest costs, foreign borrowers consider nonprice terms on loanable funds, as well as economic conditions in their home country and overall attractiveness of the U.S. dollar relative to their domestic currency.

3. Factors that cause the supply curve of loanable funds to shift include the wealth of fund suppliers, the risk of the financial security, near-term spending needs, monetary policy objectives, and economic conditions.

Wealth. As the total wealth of financial market participants (households, business, etc.) increases the absolute dollar value available for investment purposes increases. Accordingly, at every interest rate, the supply of loanable funds increases, or the supply curve shifts down and to the right. The shift in the supply curve creates a disequilibrium in this financial market. As competitive forces adjust, and holding all other factors constant, the increase in the supply of funds due to an increase in the total wealth of market participants results in a decrease in the equilibrium interest rate, and an increase in the equilibrium quantity of funds loaned between suppliers and demanders.

Conversely, as the total wealth of financial market participants decreases, the absolute dollar value available for investment purposes decreases. Accordingly, at every interest rate the supply of loanable funds decreases, or the supply curve shifts up and to the left. The shift in the supply curve, again, creates a disequilibrium in the financial market. As competitive forces adjust, and holding all other factors constant, the decrease in the supply of funds due to a decrease in the total wealth of market participants results in an increase in the equilibrium interest rate and a decrease in the equilibrium quantity of funds traded (loaned).

Risk. As the risk of a financial security decreases, it becomes more attractive to supplier of funds. Accordingly, at every interest rate the supply of loanable funds increases, or the supply curve shifts down and to the right. The shift in the supply curve creates a disequilibrium in this financial market. As competitive forces adjust, and holding all other factors constant, the increase in the supply of funds due to a decrease in the risk of the financial security results in a decrease in the equilibrium interest rate, and an increase in the equilibrium quantity of funds traded.

Conversely, as the risk of a financial security increases, it becomes less attractive to supplier of funds. Accordingly, at every interest rate the supply of loanable funds decreases, or the supply curve shifts up and to the left. The shift in the supply curve creates a disequilibrium in this financial market. As competitive forces adjust, and holding all other factors constant, the decrease in the supply of funds due to an increase in the financial security's risk results in an increase in the equilibrium interest rate, and a decrease in the equilibrium quantity of funds traded.

Near-Term Spending Needs. When financial market participants have few near-term spending needs, the absolute dollar value of funds available to invest increases. Accordingly, at every interest rate the supply of loanable funds increases, or the supply curve shifts down and to the right. The financial market, holding all other factors constant, reacts to this increased supply of funds by decreasing the equilibrium interest rate, and increasing the equilibrium quantity of funds traded.

Conversely, when financial market participants have near-term spending needs, the absolute dollar value of funds available to invest decreases. At every interest rate the supply of loanable funds decreases, or the supply curve shifts up and to the left. The shift in the supply curve creates a disequilibrium in this financial market that, when corrected results in an increase in the equilibrium interest rate, and a decrease in the equilibrium quantity of funds traded.

Monetary Expansion. One method used by the Federal Reserve to implement monetary policy is to alter the availability of credit and thus, the growth in the money supply. When monetary policy objectives are to enhance growth in the economy, the Federal Reserve increases the supply of funds available in the financial markets. At every interest rate the supply of loanable funds increases, the supply curve shifts down and to the right, and the equilibrium interest rate falls, while the equilibrium quantity of funds traded increases.

Conversely, when monetary policy objectives are to contract economic growth, the Federal Reserve decreases the supply of funds available in the financial markets. At every interest rate the supply of loanable funds decreases, the supply curve shifts up and to the left, and the equilibrium interest rate rises, while the equilibrium quantity of funds traded decreases.

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Economic Conditions. Finally, as economic conditions improve in a country relative to other countries, the flow of funds to that country increases. The inflow of foreign funds to U.S. financial markets increases the supply of loanable funds at every interest rate and the supply curve shifts down and to the right. Accordingly, the equilibrium interest rate falls, and the equilibrium quantity of funds traded increases.

Conversely, when economic conditions in foreign countries improve, domestic and foreign investors take their funds out of domestic financial markets (e.g., the United States) and invest abroad. Thus, the supply of funds available in the financial markets decreases and the equilibrium interest rate rises, while the equilibrium quantity of funds traded decreases.

4. Factors that affect the demand for funds curve to shift include utility derived from the asset purchased with borrowed funds, the restrictiveness of nonprice conditions of borrowing, and economic conditions.

Utility Derived from Assets Purchased With Borrowed Funds. As the utility derived from an asset purchased with borrowed funds increases the willingness of market participants (households, business, etc.) to borrow increases and the absolute dollar value borrowed increases. Accordingly, at every interest rate the demand for loanable funds increases, or the demand curve shifts up and to the right. The shift in the demand curve creates a disequilibrium in this financial market. As competitive forces adjust, and holding all other factors constant, the increase in the demand for funds due to an increase in the utility from the purchased asset results in an increase in the equilibrium interest rate, and an increase in the equilibrium quantity of funds traded.

Conversely, as the utility derived from an asset purchased with borrowed funds decreases the willingness of market participants (households, business, etc.) to borrow decreases and the absolute dollar value borrowed decreases. Accordingly, at every interest rate the demand of loanable funds decreases, or the demand curve shifts down and to the left. The shift in the demand curve again creates a disequilibrium in this financial market. As competitive forces adjust, and holding all other factors constant, the decrease in the demand for funds due to a decrease in the utility from the purchased asset results in a decrease in the equilibrium interest rate, and a decrease in the equilibrium quantity of funds traded.

Restrictiveness on Nonprice Conditions on Borrowed Funds. As the nonprice restrictions put on borrowers as a condition of borrowing decrease the willingness of market participants to borrow increases and the absolute dollar value borrowed increases. Accordingly, at every interest rate the demand of loanable funds increases, or the demand curve shifts up and to the right. The shift in the demand curve again creates a disequilibrium in this financial market. As competitive forces adjust, and holding all other factors constant, the increase in the demand for funds due to a decrease in the restrictive conditions on the borrowed funds results in an increase in the equilibrium interest rate, and an increase in the equilibrium quantity of funds traded.

Conversely, as the nonprice restrictions put on borrowers as a condition of borrowing increase, market participants willingness to borrow decreases and the absolute dollar value borrowed decreases. Accordingly, at every interest rate the demand for loanable funds decreases, or the demand curve shifts down and to the left. The shift in the demand curve results in a decrease in the equilibrium interest rate, and a decrease in the equilibrium quantity of funds traded.

Economic Conditions. When the domestic economy is experiencing a period of growth, market participants are willing to borrow more heavily. Accordingly, at every interest rate the demand of loanable funds increases, or the demand curve shifts up and to the right. As competitive forces adjust, and holding all other factors constant, the increase in the demand for funds due to economic growth results in an increase in the equilibrium interest rate, and an increase in the equilibrium quantity of funds traded.

Conversely, when economic growth is stagnant market participants reduce their borrowings increases. Accordingly, at every interest rate the demand for loanable funds decreases, or the demand curve shifts down and to the left. The shift in the demand curve results in a decrease in the equilibrium interest rate, and a decrease in the equilibrium quantity of funds traded.

5. Factors that affect the nominal interest rate on any particular security include inflation, the real risk-free rate, default risk, liquidity risk, special provisions, and the security's term to maturity.

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6. The nominal interest rate on a security reflects its relative liquidity, with highly liquid assets carrying the lowest interest rates (all other characteristics remaining the same). Likewise, if a security is illiquid, investors add a liquidity risk premium (LRP) to the interest rate on the security.

7. Explanations for the yield curve's shape fall predominantly into three categories: the unbiased expectations theory, the liquidity premium theory, and the market segmentation theory.

According to the unbiased expectations theory of the term structure of interest rates, at any given point in time, the yield curve reflects the *market's current expectations of future short-term rates*. The second popular explanation—the liquidity premium theory—builds on the unbiased expectations theory. The basis of the liquidity premium theory is as follows: investors will hold long-term maturities only if these securities with longer term maturities are offered at a premium to compensate for future uncertainty in the security's value. The liquidity premium theory states that long-term rates are equal to geometric averages of current and expected short-term rates (like the unbiased expectations theory), plus liquidity risk premiums that increase with the security's maturity (this is the extension of the liquidity premium added to the unbiased expectations theory). The market segmentation theory does not build on the unbiased expectations theory or the liquidity premium theory, but rather argues that individual investors and FIs have specific maturity preferences, and convincing them to hold securities with maturities other than their most preferred requires a higher interest rate (maturity premium). The main thrust of the market segmentation theory is that investors do not consider securities with different maturities as perfect substitutes. Rather, individual investors and FIs have distinctly preferred investment horizons dictated by the dates when their liabilities will come due.

8. According to the unbiased expectations theory, the one-year interest rate one year from now is expected to be less than the one-year interest rate today.

9. The liquidity premium theory is an extension of the unbiased expectations theory. It based on the idea that investors will hold long-term maturities only if they are offered at a premium to compensate for future uncertainty in a security's value, which increases with an asset's maturity. Specifically, in a world of uncertainty, short-term securities provide greater marketability (due to their more active secondary market) and have less price risk (due to smaller price fluctuations for a given change in interest rates) than long-term securities. As a result, investors prefer to hold shorter term securities because they can be converted into cash with little risk of a loss of capital, i.e., short-term securities are more liquid. Thus, investors must be offered a liquidity premium to get them to but longer term securities. The liquidity premium theory states that long-term rates are equal to geometric averages of current and expected short-term rates (as under the unbiased expectations theory), plus liquidity risk premiums that increase with the maturity of the security. For example, according to the liquidity premium theory, an upward-sloping yield curve may reflect investor' expectations that future short-term rates will be flat, but because liquidity premiums increase with maturity, the yield curve will nevertheless be upward sloping.

10. A forward rate is an expected or "implied" rate on a short-term security that is to be originated at some point in the future.

11. The present value of an investment decreases as interest rates increase. Also as interest rates increase, present values decrease at a decreasing rate. This is because as interest rates increase, fewer funds need to be invested at the beginning of an investment horizon to receive a stated amount at the end of the investment horizon. This inverse relationship between the value of a financial instrument—for example, a bond—and interest rates is one of the most fundamental relationships in finance and is evident in the swings that occur in financial asset prices whenever major changes in interest rates arise. Further, because of the compounding of interest rates, the inverse relationship between interest rates and the present value of security investments is neither linear nor proportional.

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Problems:

1. The fair interest rate on a financial security is calculated as

$$i^* = IP + RFR + DRP + LRP + SCP + MP$$
$$8\% = 1.75\% + 3.5\% + DRP + 0.25\% + 0\% + 0.85\%$$

Thus, DRP = 8% - 1.75% - 3.5% - 0.25% - 0% - 0.85% = 1.65%

2. a. IP = i* – RFR = 3.25% - 2.25% = 1.00%

b. $i_j^* = 1.00\% + 2.25\% + 1.15\% + 0.50\% + 1.75\% = 6.65\%$

3. 8.00% = 1.75% + 3.50% + DRP + 0.25% + 0.85%
   => DRP = 8.00% - (1.75% + 3.50% + 0.25% + 0.85%) = 1.65%

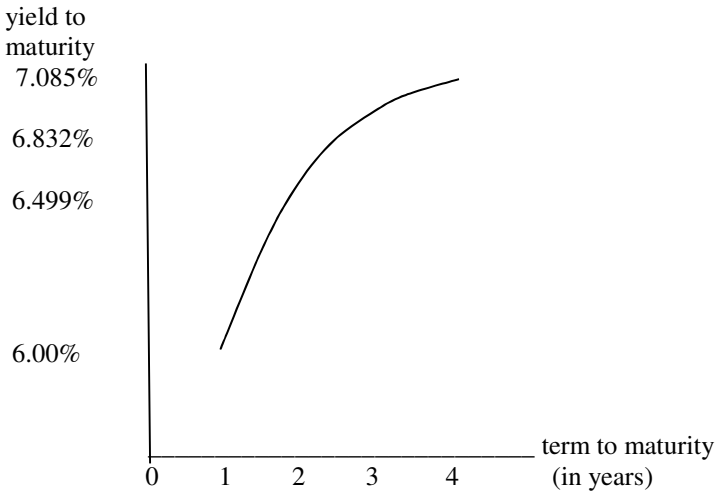
4. 1.94% = 0.50% + 1.00% + 0.00% + 0.00% + MP
   => MP = 1.94% - (0.50% + 1.00% + 0.00% + 0.00%) = 0.44%

5. 8.25% = 2.25% + 3.50% + 0.80 + LRP + (0.75% + (0.04% x 10))
   => LRP = 8.25% - (2.25% + 3.50% + 0.80% + (0.75% + (0.04% x 10))) = 0.55%

6. 6.05% = 1.00% + 2.10% + DRP + 0.25% + (0.10% + (0.05% × 8))
   => DRP = 6.05% - (1.00% + 2.10% + 0.25% + (0.10% + (0.05% x 8))) = 2.20%

7. $_1R_2 = [(1 + 0.052)(1 + 0.058)]^{1/2} - 1 = 5.50\%$

8. $_1R_1 = 6\%$
   $_1R_2 = [(1 + 0.06)(1 + 0.07)]^{1/2} - 1 = 6.499\%$
   $_1R_3 = [(1 + 0.06)(1 + 0.07)(1 + 0.075)]^{1/3} - 1 = 6.832\%$
   $_1R_4 = [(1 + 0.06)(1 + 0.07)(1 + 0.075)(1 + 0.0785)]^{1/4} - 1 = 7.085\%$



9. $_1R_2 = [(1 + 0.0345)(1 + 0.0365)]^{1/2} - 1 = 3.55\%$

10. $1 + {}_1R_2 = \{(1 + {}_1R_1)(1 + E({}_2r_1))\}^{1/2}$
    $1.10 = \{1.08(1 + E({}_2r_1))\}^{1/2}$
    $1.21 = 1.08\ (1 + E({}_2r_1))$
    $1.21/1.08 = 1 + E({}_2r_1)$
    $1 + E({}_2r_1) = 1.1204$
    $E({}_2r_1) = 0.1204 = 12.04\%$

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11. $1.12 = \{(1 + {}_1R_1)(1 + E({}_2r_1))(1 + E({}_3r_1))\}^{1/3}$
$1.12 = \{(1 + {}_1R_1)(1.08)(1.10)\}^{1/3}$
$1.4049 = (1 + {}_1R_1)(1.08)(1.10)$
${}_1R_1 = 1.4049/\{(1.08)(1.10)\}$
${}_1R_1 = 0.1826 = 18.26\%$

12. ${}_1R_5 = \{(1 + {}_1R_4)^4(1 + E({}_5r_1))\}^{1/5}$
$1.0615 = \{(1.056)^4(1 + E({}_5r_1))\}^{1/5}$
$(1.0615)^5 = (1.056)^4 (1 + E({}_5r_1))$
$(1.0615)^5/(1.056)^4 = 1 + E({}_5r_1)$
$1 + E({}_5r_1) = 1.08379$
$E({}_5r_1) = 8.379\%$

An alternative method for solving is shown below.

${}_Nf_1 = [(1 + {}_1R_N)^N / (1 + {}_1R_{N-1})^{N-1}] - 1$
${}_5f_1 = [(1 + 0.0615)^5 / (1 + 0.056)^4] - 1 = 8.379\%$

13. ${}_1R_4 = \{(1 + {}_1R_3)^3(1 + E({}_4r_1))\}^{1/4}$
$1.026 = \{(1.0225)^3(1 + E({}_4r_1))\}^{1/4}$
$(1.026)^4 = (1.0225)^3(1 + E({}_4r_1))$
$(1.026)^4/(1.0225)^3 = 1 + E({}_4r_1)$
$1 + E({}_4r_1) = 1.03657$
$E({}_4r_1) = 3.657\%$

${}_1R_5 = \{(1 + {}_1R_4)^4(1 + E({}_5r_1))\}^{1/5}$
$1.0298 = \{(1.026)^4(1 + E({}_5r_1))\}^{1/5}$
$(1.0298)^5 = (1.026)^4 (1 + E({}_5r_1))$
$(1.0298)^5/(1.026)^4 = 1 + E({}_5r_1)$
$1 + E({}_5r_1) = 1.04514$
$E({}_5r_1) = 4.514\%$

${}_1R_6 = \{(1 + {}_1R_5)^5(1 + E({}_6r_1))\}^{1/6}$
$1.0325 = \{(1.0298)^5(1 + E({}_6r_{1)})\}^{1/6}$
$(1.0325)^6 = (1.0298)^5(1 + E({}_6r_1))$
$(1.0325)^6/(1.0298)^5 = 1 + E({}_6r_1)$
$1 + E({}_6r_1) = 1.04611$
$E({}_6r_1) = 4.611\%$

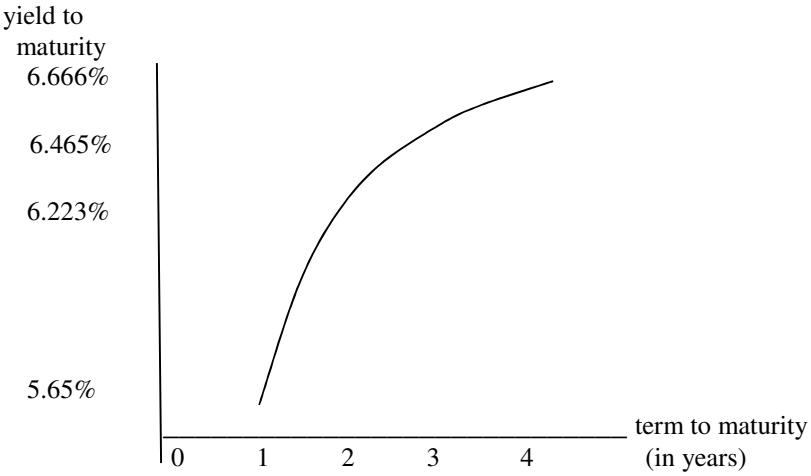
Again, an alternative method for solving is shown below.

${}_Nf_1 = [(1 + {}_1R_N)^N / (1 + {}_1R_{N-1})^{N-1}] - 1$

${}_4f_1 = [(1.026)^4 / (1.0225)^3] - 1 = 3.657\%$
${}_5f_1 = [(1.0298)^5 / (1.026)^4] - 1 = 4.514\%$
${}_6f_1 = [(1.0325)^6 / (1.0298)^5] - 1 = 4.611\%$

14. ${}_1R_1 = 5.65\%$
${}_1R_2 = [(1 + 0.0565)(1 + 0.0675 + 0.0005)]^{1/2} - 1 = 6.223\%$
${}_1R_3 = [(1 + 0.0565)(1 + 0.0675 + 0.0005)(1 + 0.0685 + 0.0010)]^{1/3} - 1 = 6.465\%$
${}_1R_4 = [(1 + 0.0565)(1 + 0.0675 + 0.0005)(1 + 0.0685 + 0.0010)(1 + 0.0715 + 0.0012)]^{1/4} - 1 = 6.666\%$

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15. $(1 + {}_1R_2) = \{(1 + {}_1R_1)(1 + E({}_2r_1) + L_2)\}^{1/2}$
$1.14 = \{(1.10)\ (1 + 0.18 + L_2)\}^{1/2}$
$1.2996 = (1.10)\ (1 + 0.18 + L_2)$
$1.2996/1.10 = 1 + 0.18 + L_2$
$1.18145 = 1 + 0.18 + L_2$
$L_2 = 0.00145 = 0.145\%$

16. $1 + {}_1R_4 = \{(1 + {}_1R_3)(1 + E({}_4r_1) + L_4)\}^{1/4}$
$1.0550 = \{(1.0525)^3(1 + 0.0610 + L_4)\}^{1/4}$
$(1.0550)^4 = (1.0525)^3(1 + 0.0610 + L_4)$
$(1.0550)^4/(1.0525)^3 = 1 + 0.0610 + L_4$
$(1.0550)^4/(1.0525)^3 - 1.0610 = L_4 = .001536 = 0.1536\%$

17. ${}_1R_2 = 0.065 = [(1 + 0.055)(1 + {}_2f_1)]^{1/2} - 1$
$\Rightarrow [(1.065)^2/(1.055)] - 1 = {}_2f_1 = 7.51\%$

This may also be solved using the following formula: ${}_Nf_1 = [(1 + {}_1R_N)^N / (1 + {}_1R_{N-1})^{N-1}] - 1$.

18. ${}_1R_3 = 0.09 = [(1 + 0.065)^2(1 + {}_3f_1)]^{1/3} - 1$
$\Rightarrow [(1.09)^3/(1.065)^2)] - 1 = {}_3f_1 = 14.18\%$

This may also be solved using the following formula: ${}_Nf_1 = [(1 + {}_1R_N)^N / (1 + {}_1R_{N-1})^{N-1}] - 1$.

19. ${}_2f_1 = [(1 + {}_1R_2)^2/(1 + {}_1R_1)] - 1 = [(1 + 0.0495)^2/(1 + 0.0475)] - 1 = 5.15\%$
${}_3f_1 = [(1 + {}_1R_3)^3/(1 + {}_1R_2)^2] - 1 = [(1 + 0.0525)^3/(1 + 0.0495)^2] - 1 = 5.85\%$
${}_4f_1 = [(1 + {}_1R_4)^4/(1 + {}_1R_3)^3] - 1 = [(1 + 0.0565)^4/(1 + 0.0525)^3] - 1 = 6.86\%$

20. ${}_4f_1 = [(1 + {}_1R_4)^4/(1 + {}_1R_3)^3] - 1 = [(1 + 0.0635)^4/(1 + 0.06)^3] - 1 = 7.41\%$
${}_5f_1 = [(1 + {}_1R_5)^5/(1 + {}_1R_4)^4] - 1 = [(1 + 0.0665)^5/(1 + 0.0635)^4] - 1 = 7.86\%$
${}_6f_1 = [(1 + {}_1R_6)^6/(1 + {}_1R_5)^5] - 1 = [(1 + 0.0675)^6/(1 + 0.0665)^5] - 1 = 7.25\%$

21. ${}_1R_1 = 4.5\%$
${}_1R_2 = 5.25\% = [(1 + 0.045)(1 + {}_2f_1)]^{1/2} - 1 \Rightarrow {}_2f_1 = 6.01\%$
${}_1R_3 = 6.50\% = [(1 + 0.045)(1 + 0.0601)(1 + {}_3f_1)]^{1/3} - 1 \Rightarrow {}_3f_1 = 9.04\%$

22. a. $PV = \$5{,}000/(1+0.06)^5 = \$5{,}000\ (0.747258) = \$3{,}736.29$
b. $PV = \$5{,}000/(1+0.08)^5 = \$5{,}000\ (0.680583) = \$3{,}402.92$
c. $PV = \$5{,}000/(1+0.10)^5 = \$5{,}000\ (0.620921) = \$3{,}104.61$

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d. PV = $5,000/(1+0.05)^{10} = $5,000 (0.613913) = $3,069.57
e. PV = $5,000/(1+0.025)^{20} = $5,000 (0.610271) = $3,051.35

From these answers we see that the present values of a security investment decrease as interest rates increase. As rates rose from 6 percent to 8 percent, the (present) value of the security investment fell $333.37 (from $3,736.29 to $3,402.92). As interest rates rose from 8 percent to 10 percent, the value of the investment fell $298.31 (from $3,402.92 to $3,104.61). This is because as interest rates increase, fewer funds need to be invested at the beginning of an investment horizon to receive a stated amount at the end of the investment horizon. Also as interest rates increase, the present values of the investment decrease at a decreasing rate. The fall in present value is greater when interest rates rise from 6 percent to 8 percent compared to when they rise from 8 percent to 10 percent. The inverse relationship between interest rates and the present value of security investments is neither linear nor proportional.

From the above answers, we also see that the greater the number of compounding periods per year, the smaller the present value of a future amount. This is because, the greater the number of compounding periods the more frequently interest is paid and thus, a greater amount of interest that is paid. Thus, to get to a stated amount at the end of an investment horizon, the greater the amount that will come from interest and the less the amount the investor must pay up front.

23. a. FV = $5,000 $(1+0.06)^5$ = $5,000 (1.338226) = $6,691.13
b. FV = $5,000 $(1+0.08)^5$ = $5,000 (1.469328) = $7,346.64
c. FV = $5,000 $(1+0.10)^5$ = $5,000 (1.610510) = $8,052.55
d. FV = $5,000 $(1+0.05)^{10}$ = $5,000 (1.628895) = $8,144.47
e. FV = $5,000 $(1+0.025)^{20}$ = $5,000 (1.638616) = $8,193.08

From these answers we see that the future values of a security investment increase as interest rates increase. As rates rose from 6 percent to 8 percent, the (future) value of the security investment rose to $655.51 (from $6,691.13 to $7,346.). As interest rates rose from 8 percent to 10 percent, the value of the investment rose to $705.91 (from $7,346.64 to $8,052.55). This is because as interest rates increase, a stated amount of funds invested at the beginning of an investment horizon accumulates to a larger amount at the end of the investment horizon. Also as interest rates increase, the future values of the investment increase at an increasing rate. The rise in present value is greater when interest rates rise from 8 percent to 10 percent compared to when they rise from 6 percent to 8 percent. The positive relationship between interest rates and the future value of security investments is neither linear nor proportional. From the above answers, we also see that the greater the number of compounding periods per year, the greater the future value of a future amount. This is because, the greater the number of compounding periods the more frequently interest is paid and thus, a greater amount of interest that is paid. The greater the amount of interest paid and the greater the future value of a present amount.

24. a. PV = $5,000$\{[1 - (1/(1 + 0.06)^5)]/0.06\}$ = $5,000 (4.212364) = $21,061.82
b. PV = $5,000$\{[1 - (1/(1 + 0.015)^{20})]/0.015\}$ = $5,000 (17.168639) = $85,843.19
c. PV = $5,000$\{[1 - (1/(1 + 0.06)^5)]/0.06\}(1 + .06)$ = $5,000 (4.212364)(1 + .06) = $22,325.53
d. PV = $5,000$\{[1 - (1/(1 + 0.015)^{20})]/0.015\}(1 + .015)$ = $5,000 (17.168639)(1.015) = $87,130.84

25. a. FV = $5,000$\{[(1 + 0.06)^5 - 1]/0.06\}$ = $5,000 (5.637092) = $28,185.46
b. FV = $5,000$\{[(1 + 0.015)^{20} - 1]/0.015\}$ = $5,000 (23.123667) = $115,618.34
c. FV = $5,000$\{[(1 + 0.06)^5 - 1]/0.06\}(1 + 0.06)$ = $5,000 (5.637092)(1 + .06) = $29,876.59
d. FV = $5,000$\{[(1 + 0.015)^{20} - 1]/0.015\}(1 + 0.015)$ = $5,000 (23.123667)(1.015) = $117,352.61

26. FV = 123\{[(1 + 0.13)^{13} - 1]/0.13\}$ = $3,688.12
FV = 123\{[(1 + 0.13)^{13} - 1]/0.13\}$ (1 + 0.13/1) = $4,167.57

FV = $4,555$\{[(1 + 0.08)^8 - 1]/0.08\}$ = $48,449.84
FV = $4,555$\{[(1 + 0.08)^8 - 1]/0.08\}(1 + 0.08/1)$ = $52,325.83

FV = $74,484$\{[(1+0.10)^5-1]/0.10\}$ = $454,732.27
FV = $74,484$\{[(1+0.10)^5-1]/0.10(1 + 0.10/1)$ = $500,205.50

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FV = $167,332{[(1 + 0.01)^{9} - 1]/0.01} = $1,567,654.40
FV = $167,332{[(1 + 0.01)^{9} - 1]/0.01}(1 + 0.01/1) = $1,583,330.95

27. PV = $678.09{[1 - (1/(1 + 0.13)^{7})]/0.13} = $2,998.93
PV = $678.09{[1 - (1/(1 + 0.13)^{7})]/0.13}(1 + 0.13/1) = $3,388.79

PV = $7,968.26{[1 - (1/(1 + 0.06)^{13})]/0.06} = $70,540.48
PV = $7,968.26{[1 - (1/(1 + 0.06)^{13})]/0.06}(1 + 0.06/1) = $74,772.91

PV = $20,322.93{[1 - (1/(1 + 0.04)^{23})]/0.04} = $301,934.55
PV = $20,322.93{[1 - (1/(1 + 0.04)^{23})]/0.04}(1 + 0.04/1) = $314,011.94

PV = $69,712.54{[1 - (1/(1 + 0.31)^{4})]/0.31} = $148,519.49
PV = $69,712.54{[1 - (1/(1 + 0.31)^{4})]/0.31}(1 + 0.31/1) = $194,560.54

28. FV = $500 (1.06)^{3} = $595.51. So, the interest portion is $95.51 = $595.51 − $500.

29. PV = $2,000/(1.08)^{4} = $1,470.06

30. PV = -$1,200 = $2,000/(1.075)^{t}
=> Using a financial calculator, I = 7.5, PV= -1,200, PMT = 0, FV = 2,000, then compute N = 7.06 years

31. FV = $1,000{[(1 + 0.10)^{6} - 1]/0.10}(1 + 0.10) = $8,487.17
or using a financial calculator, N = 6, I = 10, PV = 0, PMT = -1,000, then compute FV = $7,715.61, then multiply $7,715.61 x (1+0.10) = $8,487.17.

32. PV = $180,000 = PMT{[1 - (1/(1 + 0.08/12)^{15x12})]/(0.08/12)} = $1,720.17
or using a financial calculator, N = 15x12 = 180, I = 8÷12 = .66667, PV = -180,000, FV = 0, then compute PMT = $1,720.17

Chapter Two
Determinants of Interest Rates

I. Chapter Outline

1. Interest Rate Fundamentals: Chapter Overview
2. Loanable Funds Theory
   a. Supply of Loanable Funds
   b. Demand for Loanable Funds
   c. Equilibrium Interest Rate
   d. Factors that Cause the Supply and Demand Curves for Loanable Funds to Shift
3. Movement of Interest Rates over Time
4. Determinants of Interest Rates For Individual Securities
   a. Inflation
   b. Real Risk Free Interest Rates
   c. Default or Credit Risk
   d. Liquidity Risk
   e. Special Provisions or Covenants
   f. Term to Maturity
5. Term Structure of Interest Rates
   a. Unbiased Expectations Theory
   b. Liquidity Premium Theory
   c. Market Segmentation Theory
6. Forecasting Interest Rates
7. Time Value of Money and Interest Rates
   a. Time Value of Money
   b. Lump Sum Valuation
   c. Annuity Valuation

II. Learning Goals

1. Know who the main suppliers of loanable funds are.
2. Know who the main demanders of loanable funds are.
3. Understand how equilibrium interest rates are determined.
4. Examine factors that cause the supply and demand curves for loanable funds to shift.
5. Examine how interest rates change over time.
6. Know what specific factors determine interest rates.
7. Examine the different theories explaining the term structure of interest rates.
8. Understand how forward rates of interest can be derived from the term structure of interest rates.
9. Understand how interest rates are used to determine present and future values.

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III. Chapter in Perspective

This is the first of several chapters that familiarize students with the determinants of valuation of bonds and related securities. In this chapter the authors first focus on the economic determinants of interest rates using the flow of funds theory of interest rates. Subsequently, unique characteristics of securities that give rise to different interest rates are discussed followed by a discussion of the term structure theories and a review of the time value of money. This chapter has four major sections. The first major topic covers interest rate formation in a 'loanable funds' framework. The loanable funds theory is the most basic explanation of real risk free interest rate formation in the economy and is easily understood by students. The loanable funds theory describes general economic forces in the economy that determine the opportunity cost of funds which may be thought of as the real, riskless rate. This is an excellent introduction to monetary policy impacts that follow later in the text. The next section explains why individual investments have different interest rates because of their unique characteristics. The effect of maturity on interest rates is explained in greater detail in the term structure discussion. Three of the main theories of the term structure are presented. The chapter then provides a brief example of using term structure mathematics to forecast interest rates. The final section provides a review of basic time value calculations. Recall that the sixth edition of the text dropped the discussion of calculating the effective annual rate that had been in prior editions.

IV. Key Concepts and Definitions to Communicate to Students

Real riskless rates vs nominal riskless rates	Inflation
Compound and simple interest	Default risk premiums
Supply of funds	Demand for funds
Annuity	Liquidity risk premiums
Unbiased expectations	Term structure
Liquidity premiums	Maturity premiums
Market segmentation	Future value and present value
Forward rates	Safe haven

V. Teaching Notes

1. Interest Rate Fundamentals: Chapter Overview

The interest rates that you actually see quoted are **nominal** interest rates; as a result, nominal rates are sometimes called 'quoted rates.' The purpose of the chapter is to examine the components of the nominal interest rate. They are a) the real riskless rate of interest that is compensation for the pure time value of money, b) an expected inflation premium that is time dependent and c) a risk premium for liquidity, default and interest

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rate risk.

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2. Loanable Funds Theory

The interaction of supply and demand of funds sets the basic opportunity cost rate (real riskless interest rate) in the economy. The Federal Reserve estimates supply and demand of funds from households, business, government and foreign sources through its flow of funds accounts. Flows of funds tables are available at the Federal Reserve website at www.federalreserve.gov. The Federal Reserve (Fed) pushed short term interest rates to near record lows in order to stimulate the economy and pursued a policy of quantitative easing (purchasing government and mortgage debt by creating money) in an additional attempt to encourage spending and investment. In mid-2013 the Fed announced it would begin gradually tapering its bond purchases although interest earned continued to be reinvested in long term securities. In December 2015 the Fed raised interest rates, but did not do so again until December 2016. In 2017 the Fed raised interest rates slightly. In June 2017 the Federal Reserve raised the target Fed Funds rate to between 1.00 and 1.25 percent and indicated it may raise the target Fed Funds rate a total of three times in 2017 depending on economic data.

a. Supply of Loanable Funds

Source Federal Reserve Flow of Funds Matrix Year 2015 data	Net Supply in Billions of Dollars
Households & NPOs	$895
Business Nonfinancial	117
State & Local Govt.	-211
Federal Government	-514
Financial Sector	168
Foreign	79

The predominant suppliers of loanable funds are households. Household savings rates have increased since the financial crisis. The second largest net supplier of funds is the foreign sector. The U.S. remains highly reliant on foreign sources of funds to meet our funds' demands. This reliance becomes increasingly problematic with the continued long term fall in the value of the dollar.

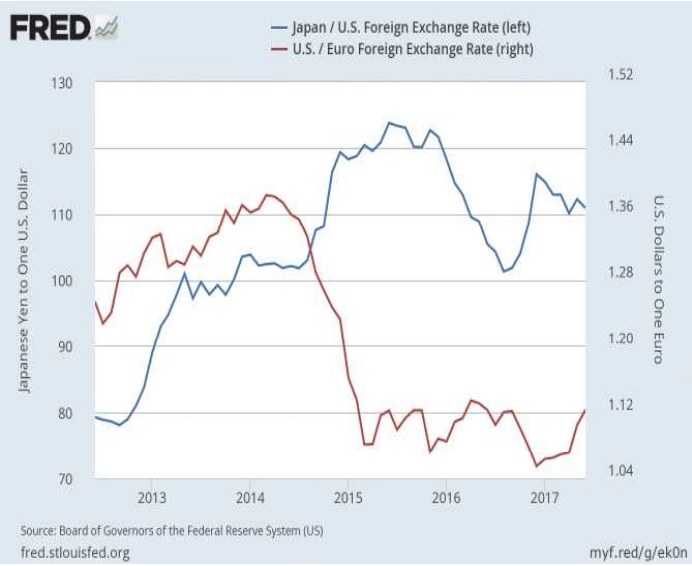
Household savings increase with higher interest rates and the supply curve is upward sloping with respect to interest rates. However, the main determinants of household savings are 1) income and wealth, the greater the wealth or income, the greater the amount saved, 2) attitudes about saving versus borrowing, 3) credit availability, the greater the amount of easily obtainable consumer credit the lower the need to save, 4) job security and belief about safety of the Social Security system and 5) tax policy. In the U.S. tax policy favors borrowing but taxes virtually all savings (except retirement savings). As a result, the supply curve is steeper than one might expect. The instructor may wish to explain that at higher interest rates, savers do not have to save as much to hit specified future values, so savings are not that sensitive to interest rates. Where consumers put their savings is sensitive to interest rates, they move out of liquid accounts

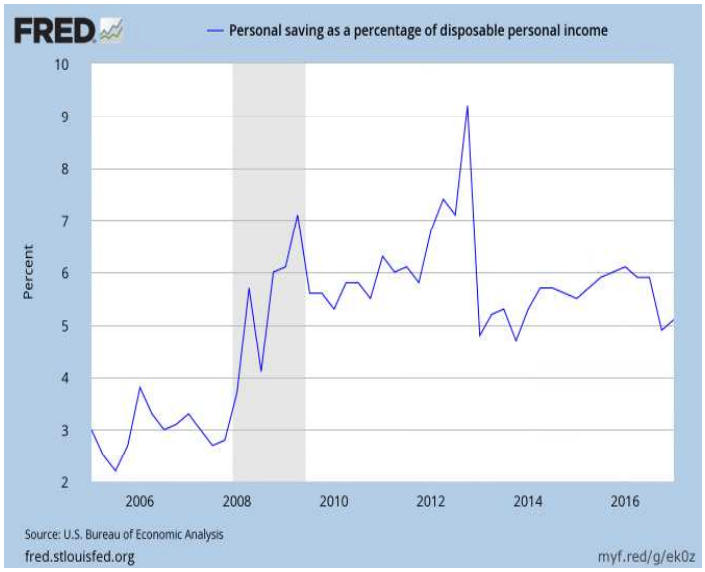
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as interest rates rise (as the price of foregoing higher rates of return to maintain liquidity rises).

Households apparently try to smooth consumption patterns over different levels of income. As income falls they save less to maintain consumption, as income rises households save more. Other factors include the perceived riskiness of investments, near





Source: FRED data, Federal Reserve Bank of St. Louis

term spending needs, Federal Reserve policy and general economic conditions. Favorable economic conditions also increase savings by increasing income and wealth. Note that on net the foreign sector is the second largest supplier of funds. Foreign funds suppliers examine the same factors as U.S. suppliers except that they must also factor in expected changes in currency values, global interest rates, different tax rates and sovereign risk. There is typically some built in demand for U.S. investments however because the U.S. is considered a **safe haven,** i.e., a country with relatively low political and economic risk and a stable currency.

The dollar is used to price many commodities, including oil and gold; the dollar is the primary foreign currency reserve asset for many central banks and many exports are dollar denominated even if the ultimate destination is not the U.S. Some feel that the dollar will lose its reserve status eventually if China continues to grow and dominate Asia *and* if Europe increases its commitment to growth policies while continuing to deconstruct some of their increasingly expensive social welfare programs. The time frame required for a major shift away from the dollar may be ten to twenty years or even much longer however, because China will remain far too risky for quite a while and Europe must demonstrate a commitment to growth and solve its sovereign debt problems. China has made several moves lately to free up yuan trading. China now allows exporters to sell some of their foreign currency earnings, allows limited individual trading in its currency and allows yuan financing in international markets. China still maintains capital controls however.

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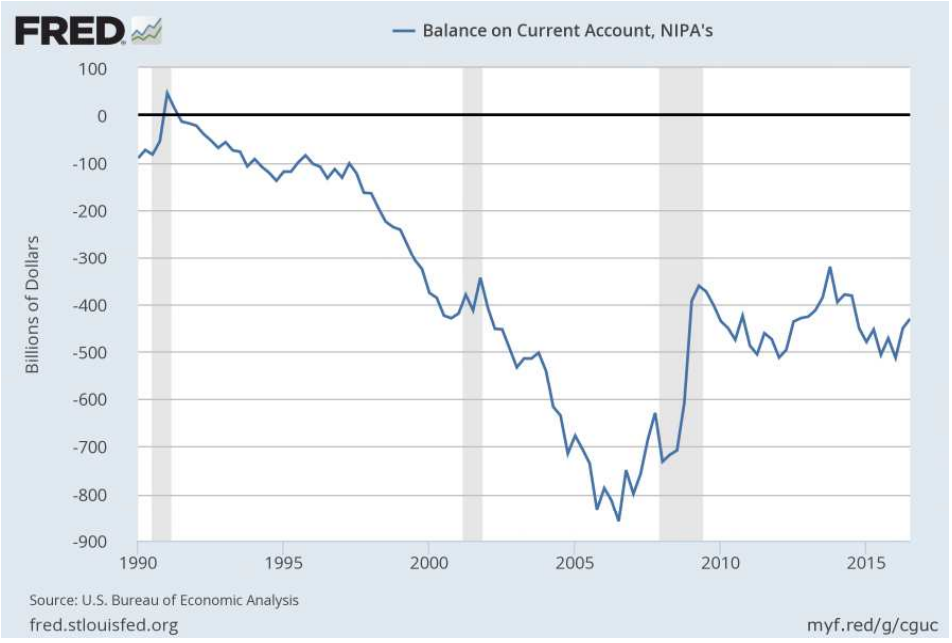
Foreign central banks hold a large amount of foreign currency reserves, the bulk of which are in dollars (about 60% of foreign currency reserves are in dollars).

Country	Foreign Currency Reserves (all $ in billions)
China	$3,030
Saudi Arabia	538
Russia	385
Taiwan	437
S. Korea	371

Source: Economist 2016

These high levels of reserves are indicative of foreign central bank activity to limit the growth in the value of their currencies against the dollar. This may be done to stimulate their export sectors. The dollars are often reinvested in the U.S., typically in Treasuries. This provides an additional source of financing to the U.S. and helps remove a market discipline from U.S. borrowers. Since the money is more or less automatically rechanneled into the U.S., U.S. interest rates don't rise as much as they would have otherwise when U.S. entities spend more than their income and need to borrow the difference from overseas. This promotes overspending by U.S. entities and can result in asset price bubbles similar to what happened in stocks in the later 1990s and housing in the 2000s.

The negative balance on the U.S. current account (see below) represents excess importing over exporting, or similarly, excess spending over income. The balance has to be financed with capital account transactions or offset by changes in official reserves to prevent the dollar from declining. For the most part the balance is maintained by borrowing from overseas (and net selling of U.S. assets to foreigners). The U.S. net indebtedness to the rest of the world was about $4.46 trillion in 2013 (about 27% of GDP).



Source: St. Louis Federal Reserve FRED data

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Whether or not this is a serious problem depends on how much money is reinvested in the U.S. and how we use the money reinvested. It certainly points out the U.S. dependence on foreign funds.

b. Demand for Loanable Funds

The quantity of loanable funds demanded is greater at lower interest rates. Businesses prefer to finance internally when interest rates are high. The demand for loanable funds by households for big ticket items is quite sensitive to interest rates as these items comprise a large percentage of their budget (homes, autos, boats, etc). The Federal government's demand for funds is relatively insensitive to interest rates, but not wholly so because much of the interest owed on the Federal debt is financed by borrowing. As interest rates rise, the Federal government has to borrow more to pay off the interest on the existing debt. The Federal budget is likely to remain in deficit for the next 10 years at least.

State and local government financing is also quite sensitive to interest rates. New municipal offerings drop when interest rates rise. Not surprisingly, government entities that cannot print money (or raise taxes) are more sensitive to financing costs! Many states are now in financial difficulty because many are required to balance their budgets under state laws, and the recession has decreased the amount of tax revenues and increased state spending on assistance programs. Moreover, the weaker economy has highlighted the overly generous pension benefits promised to state workers that now look unaffordable as federal stimulus money ends.

c. Equilibrium Interest Rate

It is the job of the 12 Federal Reserve banks to estimate aggregate supply and demand of funds from the various sectors at different interest rates and then build the aggregate supply and demand curves. In free capital markets the interest rate observed will tend toward equilibrium at the rate that intersects the supply and demand curves for each traded instrument.

d. Factors that Cause the Supply and Demand Curves for Loanable Funds to Shift

Increase in	Affect on Supply	Affect on Demand
Wealth & income	Increase	N/A
	As wealth and income increase, funds suppliers are more willing to supply funds to markets. Result: lower interest rates	
Risk	Decrease	Decrease
	As the risk of an investment decreases, funds suppliers are less willing to purchase the claim. All else equal, demanders of funds would be less willing to borrow as well. Result: higher interest rates	
Near term spending needs	Decrease	N/A
	As current spending needs increase, funds suppliers are less willing to invest. Result: higher interest rates	
Monetary expansion	Increase	N/A
	As the central bank increases the supply of money in the economy, this directly increases the supply of funds available for lending. Result: lower interest rates	

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Economic growth Increase Increase
With stronger economic growth, wealth and incomes rise, increasing the supply of funds available. As U.S. economic strength improves relative to the rest of the world, foreign supply of funds is also increased. Business demand for funds increases as more projects are profitable. Result: indeterminate effect on interest rates, but at more rapid growth rates interest rates tend to rise.

Utility derived from assets Decrease Increase
As utility from owning assets increases, funds suppliers are less willing to invest and postpone consumption whereas funds demanders are more willing to borrow. Result: higher interest rates

Restrictive covenants Increase Decrease
As loan or bond covenants become more restrictive, borrowers reduce their demand for funds. Result: lower interest rates

Tax Increase Decrease Increase
Taxes on interest and capital gains reduce the returns to savers and the incentive to save. The tax deductibility of interest paid on debt increases borrowing demand. Result: Higher interest rates

Currency Appreciation Increase N/A
Foreign suppliers of funds would earn a higher rate of return if the currency appreciates and a lower rate of return measured in their own currency if the dollar depreciates. Foreign central banks often buy U.S. Treasury securities as part of their attempts to prevent their currency from appreciating against the dollar. Result: Lower interest rates

Expected inflation Decrease Increase
An increase in expected inflation implies that suppliers will be repaid with dollars that will have less purchasing power than originally anticipated. Suppliers lose purchasing power and borrowers gain more than originally anticipated. This implies that supply will be reduced and demand increased. Result: Higher interest rates

The marginal propensity to consume (MPC) and the marginal propensity to save (MPS) affect household choices of how much of their income they wish to spend and save respectively. The MPC had increased (and the MPS decreased) inter-generationally in the U.S. before the financial crisis. This change probably came about because of reduced stigma associated with debt and increased availability of credit. Since the crisis the amount of consumer credit to riskier individuals has declined, along with income growth, and one would thus expect savings rates to be higher than during the boom years.

3. Movement of Interest Rates Over Time

Interest rates fluctuate in a nearly continuous manner due to the actions of traders. In a free market (capitalist) society, governments do not set prices. Interest rates are the price of borrowing money associated with a specific instrument or claim. Actions to buy, sell and issue securities affect interest rates. In turn, demand and supply of funds fluctuate daily as current and expected macro and instrument specific conditions evolve.

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4. Determinants of Interest Rates For Individual Securities

a. Inflation

b. Real Riskless Interest Rates & Fisher Effect

Inflation is the rate of change in the overall price level. The **Consumer Price Index (CPI)** is the most commonly quoted measure of inflation. The CPI purports to measure the price level of a market basket of goods and services purchased by the typical urban consumer.

The **Fisher effect** states that nominal riskless rates equal real riskless rates plus a premium for expected inflation. This relationship is the basis for the term structure. Differences in annual expected inflation rates cause differences in bond rates with different maturities.

The nominal interest rate is the additional dollars earned from an investment. The real interest rate is the additional purchasing power earned from an investment. The real interest rate refers to the marginal gain in units purchased rather than in dollars.

Teaching Tip: Sometimes we think that ex-ante real rates cannot be negative, but they can because of the convenience yield of liquidity. They have been negative in recent years in both the U.S. and Japan.

The Fisher Effect relates nominal and real interest rates.
The approximate Fisher effect is given as
i = RIR + Expected (IP)
where i = nominal riskless interest rate, RIR = real riskless interest rate and Expected (IP) = expected inflation.
The actual Fisher Effect is given as
(1+i) = (1+RIR)*(1+Expected(IP))
The following example illustrates why the actual Fisher Effect is multiplicative:

Suppose "It" originally cost you $1. You have $10 so could buy 10 of "it."
If inflation is 5%, in one year "it" will cost $1 + .05 =$1.05.
If you invest your $10 and earn 10% + 5% = 15% (the approximate Fisher Effect) you will get back $10 * 1.15 = $11.50.
Can you buy $10% more of "it?" I.E. can you now buy 10 * 1.1 or 11 of "it?"
11 * $1.05 = $11.55; so you are short 5 cents.
In order to buy 10% more of it you must earn an interest rate equal to (1.10 * 1.05) - 1 = 1.155 - 1 = 15.5% nominal interest.
Then your $10 will grow to $10 * 1.155 = $11.55 and you CAN buy 10% more of it!
Since both P & Q are rising, the rate charged must reflect the increments to both P and Q.
The difference matters little if inflation is low and/or the time period under consideration is not very long. In international investing environments where inflation is much higher than the U.S. is currently experiencing, the difference can be material.

As of this writing, core inflation measures have increased but remain controlled.

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Nevertheless food prices have increased. Even though measured inflation, particularly core inflation which excludes food and energy, remains tame, prices of high frequency purchases such as food have increased. Thus, there seems to be more inflation than the CPI numbers indicate. Moreover, the practice of 'hedonics' in inflation calculations adds some uncertainty about the validity of actual inflation numbers.[1] Rising oil prices may also reduce economic growth. Sustained high oil prices drive up the cost of production and act as a tax on consumers.

c. Default or Credit Risk

Default risk premiums (**DRP**s) are increases in required yield needed to offset the possibility the borrower will not repay the promised interest and principle in full or as scheduled. According to the Wall Street Journal Online, credit risk premiums on Aa rated corporate debt relative to Treasuries between March 2010 and March 2011 ranged between 86.6 and 150 basis points and on Baa rated debt ranged between 172 and 237 basis points. DRPs on high yield debt ranged between 453 and 728 basis points over Treasuries. DRPs are cyclical, and rise in periods of weak economic conditions such as the U.S. has been experiencing in recent years. The FRED graph below contains the yields on the Bank of America Merrill Lynch US Corporate BBB Effective Yield and the 20 year Treasury Constant Maturity Rate. Notice the large increase in the spread during the recession.



Source: St. Louis Federal Reserve

Liquidity risk premiums are increases in required or promised yields designed to offset the risk of not being able to sell the asset in timely fashion at fair value. These are similar to, but not the same as, the liquidity premiums in the term structure discussion. Liquidity risk can be more significant for some debt instruments than for stocks as many bonds trade in thin markets.

e. Special Provisions of Covenants

[1] Hedonics is the 'art' of adjusting prices for quality differences over time. For instance, a TV purchased today that costs the same as a TV purchased several years ago has more features. The price of the new TV is adjusted downward to reflect the additional technology.

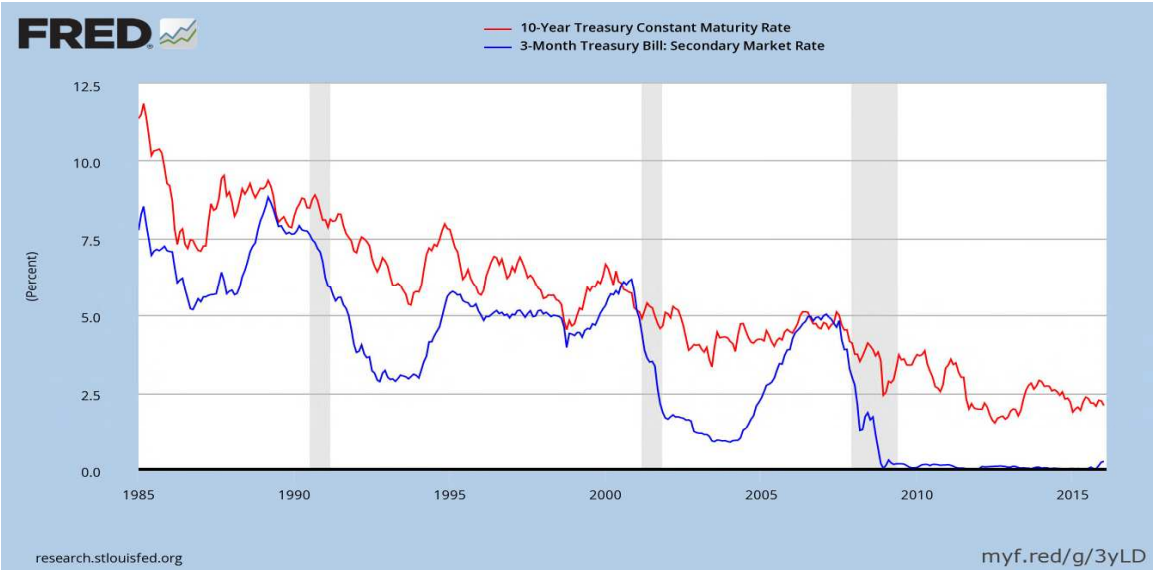
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- Municipal bond (Muni) rates are lower than similar corporate bonds because interest (but not capital gains) is exempt from federal taxation. In most states the holder of a muni bond issued in that state is also exempt from state taxes.
  Teaching Tip: Ask students why munis are granted special tax status. What do they think about industrial development bonds which allow private corporations to issue tax advantaged munis for certain projects? Note that usage of IDBs has been restricted in recent years due to over usage by private firms seeking to exploit the tax advantage of municipals.
  Callable bonds have higher required yields than straight bonds because the issuer will normally call them when rates have dropped, forcing the bondholders to reinvest at lower interest rates. Although it varies with interest rate expectations the premium on a callable bond might be 30 to 50 basis points.
- Convertible bonds have lower yields than straight bonds because the bondholder has the right to convert them to preferred or common stock at their choice. Offering a conversion feature may save 100 to 200 basis points, ceteris paribus. In most cases however, the stock has to appreciate 15% to 25% over the at issue price in order to make conversion attractive.

f. Term to Maturity

The **term structure** depicts the relationship between maturity and yields for bonds identical in all respects except maturity. In practice, 'identical' means same rating, liquidity and hopefully the same coupon (or differential tax effects will be present). The graph of the term structure can take on any shape, but upward sloping is most common (meaning longer term bonds promise higher nominal yields). The yield curve was inverted in Nov 2000 and in parts of 2006 and 2007. Note that for Treasuries, '**on the run**' (newly issued) securities often carry price premiums over '**off the run**' (previously issued) securities.
In the graph below one can see that long term rates are normally above short term rates, although the relationship may change ahead of recessions (depicted by the shaded bars).



Source: St. Louis Federal Reserve

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g. Summary

i_j* = f(Riskless real rate, Expected inflation, Default risk premium, Liquidity risk premium, Special covenant premium, Maturity risk premium)

The maturity risk premium is explained in Section 5 where it is defined as the premium for holding a price volatile asset (confusingly called a liquidity premium).

5. Term Structure of Interest Rates

a. Unbiased Expectations Theory (UET)

The UET states that the long term interest rate is the geometric average of the current and expected future short term rates. A simple arbitrage proof can be used to show this **when** interest rates are known with certainty under perfect markets:

If the expected one year rates are 6%, 7% and 8% for the next three years respectively, and the three year rate is 5%, how could one make money on this relationship?
Using the text's terminology: 0R1 = 6%, 1R1=7% and 2R1 = 8% but 0R3=5%
The average of the short term one year rates is 7%, but the three year rate is only 5%. One could borrow any given amount such as $1000 for the full three years and invest that money one year at a time and rolling over the investment for three years. The borrowing cost per year is 5% and the average rate of return is 7%. This is a riskless arbitrage under the given assumptions that would force the three year rate and the average of the one year rates to converge.

The instructor may wish to show this relationship first using simpler arithmetic averages as above since students often seem to struggle with the concept of geometric averages. Geometric averages are used to account for compounding; for examples of two or three years where the rates are similar, the use of arithmetic averages will give almost identical results if the returns are similar to one another.

For a series of holding period returns (HPRs) the geometric average can be found as:

$$Geometric\ Average = \left[\prod_{T=1}^{N}(1+HPR_T)\right]^{1/N} - 1$$

For example if we have a time series of three returns of 10%, -15% and 12% the arithmetic and geometric averages are 2.33% and 1.55% respectively:

$$Arithmetic\ Average = \frac{(10\% + -15\% + 12\%)}{3} = 2.33\%$$

$$Geometric\ Average = [1.10 \times 0.85 \times 1.12]^{1/3} - 1 = 1.55\%$$

Interpreting the UET

The UET has different possible interpretations.[2] It can imply that the return over a given time horizon should be the same regardless of the bond maturity chosen. For example, for a 5 year investment horizon the realized rate of return should be the same regardless of whether a 5 year bond or a 10 year bond is held for 5 years. A second interpretation may be termed the 'local expectations' form of the UET. This version holds that realized returns will be the same regardless of the bond maturity chosen only for short term holding periods such as 6 months. The third interpretation is that under the UET an

[2] This section is drawn from F. Fabozzi, The Handbook of Fixed Income Securities, 8th ed., McGraw-Hill, 2012.

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investor is indifferent between how one arrives at an N year investment by choosing any bond maturity less than or equal to N and rolling the investment over as needed. For example, one would be indifferent between investing for N years all at once, or investing for 1 year and rolling the investment over N-1 times. All three interpretations ignore interest rate volatility and market imperfections such as transactions costs.

b. Liquidity Premium Theory

If investors prefer shorter maturities to long, they will require a premium to invest for N years all at once instead of investing for 1 year and rolling the investment over N-1 times. In other words, the long term rate **cannot** be the average of the expected short term rates. The long term rate must equal the average of the short term rates plus what is illogically called a 'liquidity premium.' (It is an illiquidity premium.) The rationale for the shorter maturity preference is that with uncertainty about future rates, it is riskier to invest long term rather than investing for a shorter time and rolling the investment over because it is harder to forecast rates further in the future and longer term investments are more price volatile. This is a modification of the UET, but it does not invalidate the logic of the UET. It does imply that long term rates are biased forecasters of expected future short term rates. We don't know very much about the size of the liquidity premiums. They increase with maturity, and probably do not get much over 100 to 200 basis points.[3]

c. Market Segmentation Theory

The market segmentation theory claims that there are two or three distinct maturity segments (the segments are ill-defined) and market participants will not venture out of their preferred segment, even if favorable rates may be found in a different maturity. A less extreme version posits that a sufficient interest rate premium may induce investors to switch maturity segments. The idea behind segmentation is that institutions naturally have liabilities of a distinct maturity, e.g., life insurers have long term liabilities, so they will not invest short term. Hence, there is no or only a very weak relationship between interest rates of different maturities and supply and demand of a given maturity sets the individual interest rates. By inference, there is no reason to construct a term structure as there is no relationship between long term rates and expected future short term rates. This is unlikely to strictly hold because it suggests that opportunities to take advantage of mispricing of securities will not be exploited. For example if the 10 year bond rate is much higher than warranted by expectations, one could buy the 10 year bond and short a 9 year bond. If the rates on different maturities are far enough out of line with expectations, some entity will seek to exploit the profit opportunity. If existing investors will not exploit the opportunity, new investors will emerge to do so in a capitalist system. In fact this is a typical hedge fund strategy. On the other hand, daily changes in supply and demand and changes in non-price conditions can certainly cause long term rates to diverge from the average of expected future short term rates. These create profit

[3] Although this is not in the text, the **preferred habitat theory** posited by Modigliani and Sutch, Innovations in Interest rate Policy, *American Economic Review*, May 1966, pp.178-197, suggests it is possible for liquidity premiums to be negative. If investors have long investment horizons it is actually less risky for them to hold long duration bonds (as opposed to short duration) to minimize their interest rate risk. If the majority of investors have long time horizons then it would be riskier to hold short term, low duration investments. This could make long term investments preferable to short term, implying that the liquidity premium would have to be negative.

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opportunities for astute bond traders. If bond markets are reasonably efficient, these profit opportunities should not persist long.

6. Forecasting Interest Rates

A **forward rate** is a rate that can be imputed from the existing term structure. It is a mathematical tautology that given a set of long term **zero coupon spot rates** one can find the set of individual one year forward rates. For instance using the books terminology:
$(1+{}_1R_6)^6 = (1+{}_1R_5)^5 * (1+{}_5F_1)$
$(1+{}_1R_5)^6 = (1+{}_1R_4)^4 * (1+{}_4F_1)$ …
where ${}_1R_6$ and ${}_1R_5$ are the long term zero coupon spot rates from today to year 6 and 5 respectively and F stands for a forward rate. The first subscript refers to the loan origination date, but the textbook confusingly uses 1 instead of 0 as is normal to represent today. The second subscript refers to the term to maturity. Since all the spot rates are known one can construct the full set of forward rates, ${}_iF_{1,}$ from them.

Teaching Tip: The text implies that the Treasury issues zero coupon bonds across the maturity structure but this is not true. Most Treasuries beyond one year pay coupons, although a strip program exists. One can calculate the series of zero coupon spot rates implied by the Treasury yields via a process called **bootstrapping**. The zero coupon rates are called spot rates. Not all spot rates are available because the Treasury does not issue every possible maturity. Newly issued securities are preferred because they are more liquid. The missing spot rates can be inferred through interpolation. The bootstrapping process is illustrated in the source mentioned in footnote 2.

Teaching Tip: The text's terminology is very confusing to me and to students. I use ${}_0R_N$ to mean a spot rate on a loan originated today at time 0 and maturing in year N so that the loan term is N-0. Forward rates such as ${}_4F_6$ are then understood to be the implied rate on a 2 year loan originated in time period 4 that matures in time period 6. Students have no trouble grasping my terminology. The test bank responses use this terminology as well.

Interpreting the forward rates If the UET strictly holds then forward rates are an unbiased estimate of expected future annual rates. If there are liquidity premiums, one should subtract the liquidity premium from the forward rate before using it as an estimate of the expected future spot rate. If segmentation strictly holds, the forward rate has no economic meaning.

7. Time Value of Money and Interest Rates

a. Time Value of Money

b. Lump Sum Valuation

c. Annuity Valuation

The **real riskless rate** of interest is the additional compensation required to forego current consumption. This is the essence of the time value of money. That is, the value we place on money depends upon when the money is received (paid) and the time preference for consumption. **Simple interest** is earned if the investor spends the interest earnings each period; **compound interest** assumes the interest earned per period is reinvested. Present and future values of lump sums and **annuities** are covered and the

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closed form formulas for the annuities are presented in this edition. The closed form versions are summarized below:

		FV	PV
Lump Sum	Annual Compound Interest	$FV = PV \times (1+i)^t$	$PV = \frac{FV}{(1+i)^t}$
	Non-Annual Compound Interest	$FV = PV \times (1+ i/c)^{t \times c}$	$PV = \frac{FV}{(1+ i/c)^{t \times c}}$
Annuity	Annuity Annual Compound Interest	$FV = PMT \times \left[\frac{(1+i)^t - 1}{i}\right]$	$PV = PMT \times \left[\frac{1-(1+i)^{-t}}{i}\right]$
	Annuity Non-Annual Compound Interest	$FV = PMT \times \left[\frac{(1+ i/c)^{t \times c} - 1}{i/c}\right]$	$FV = PMT \times \left[\frac{1-(1+ i/c)^{-t \times c}}{i/c}\right]$

PV = Present value FV = Future value
i = nominal rate PMT = annuity payment
t = number of years c = number of compounding periods per year

Comparative statics for lump sum and annuity calculations are discussed in the text.

VI. Web Links

http://www.ft.com/	Financial Times, won two Espy awards for best new site and best non U.S. news site. Outstanding coverage of global events and markets
http://www.wsj.com/	The Wall Street Journal website has excellent data sources and articles on finance and economics. The Wall Street Journal's international coverage is also outstanding.
http://www.ustreas.gov/	Treasury data on U.S. national debt
http://www.federalreserve.gov/	Board of Governors of the Federal Reserve System homepage, breaking news, monetary policy data and careers with the Fed
http://www.moodys.com/	A leading provider of independent credit ratings, research and financial information to the capital markets

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http://www.standardandpoors.com/	A leading provider of independent credit ratings, research and financial information to the capital markets

VII. Student Learning Activities

1. Go to the *Wall Street Journal Online* Treasury data bank and obtain the current term structure of interest rates for 10 years. Using these numbers construct next year's expected term structure. Will it be correct? Why or why not?

2. Go to the following Texas Lottery page: http://www.txlottery.org/export/sites/default/index.html and try to determine how much money you could immediately take home if you won the Lotto Texas jackpot. Is this fair to the public?
   Suppose you could also receive payments over 25 years. How would the payment amount over 25 years be calculated? What is the withholding tax?

3. Go to the following Federal Reserve site and find the latest report in the Beige Book: http://www.federalreserve.gov/monetarypolicy/beigebook/default.htm. What is projected for supply and demand for funds by the various segments discussed in the text? What should be the effects of the changes on interest rates?

4. In June 2017 the Federal Reserve announced an increase in the target Fed Funds rate. The stock market responded positively to this announcement. Explain these results using the supply and demand of loanable funds framework.

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Chapter Two

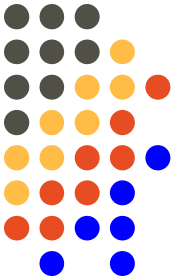
Determinants of Interest Rates



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Interest Rate Fundamentals

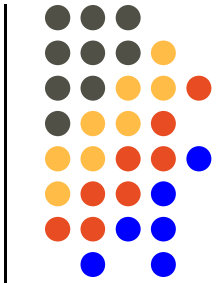


Nominal interest rates: the interest rates actually observed in financial markets.

- Used to determine fair present value and prices of securities.
- Two components:
  - Opportunity cost.
  - Adjustments for individual security characteristics.

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Real Riskless Interest Rates



Additional purchasing power required to forego current consumption.

- What causes differences in nominal and real interest rates?
- If you wish to earn a 3% real return and prices are expected to increase by 2%, what rate must you charge?
- Irving Fisher first postulated that interest rates contain a premium for expected inflation.

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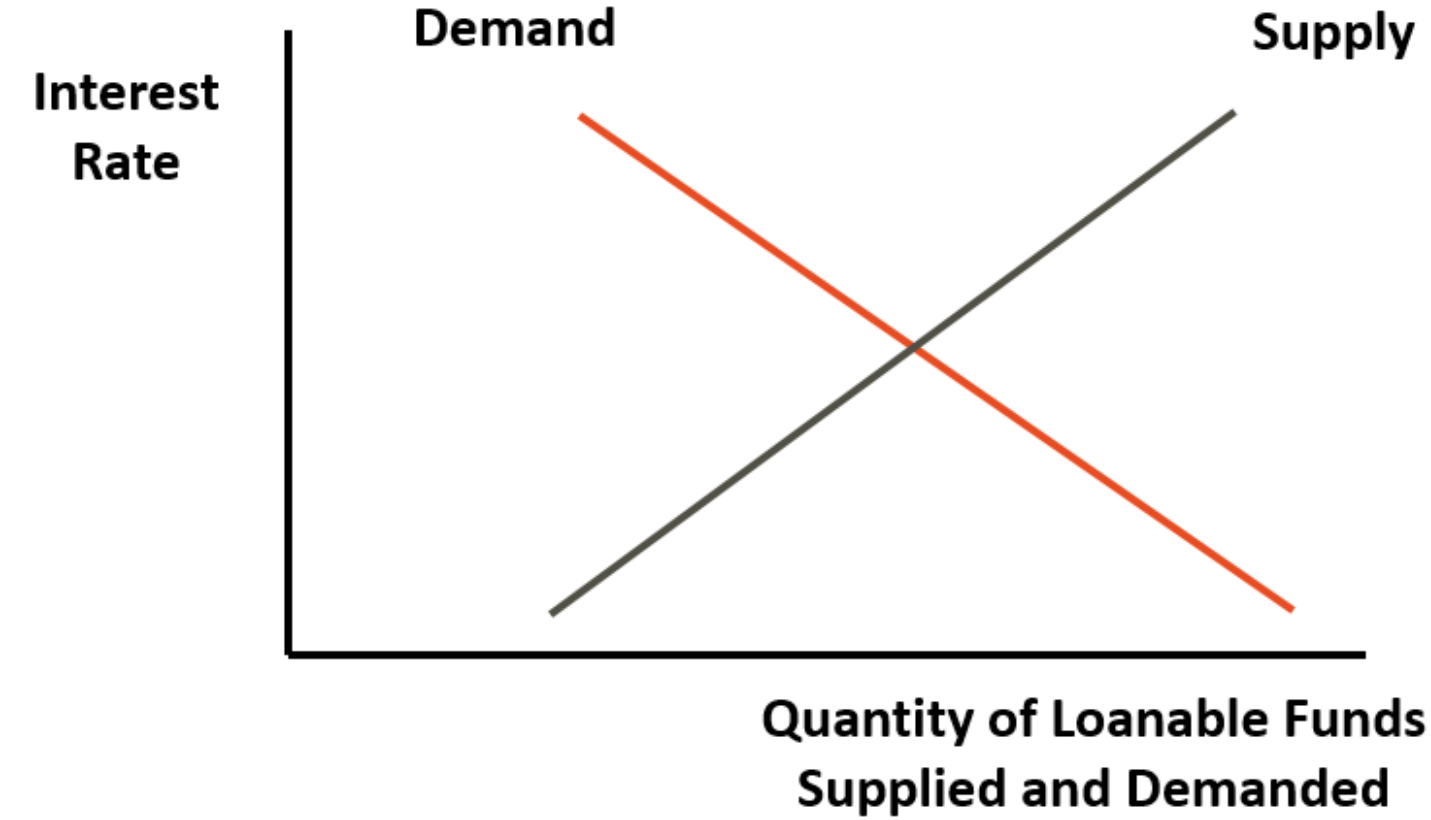
Loanable Funds Theory



- **Loanable funds theory explains interest rates and interest rate movements**
- **Views level of interest rates as resulting from factors that affect the supply of and demand for loanable funds**
- **Categorizes financial market participants – e.g., consumers, businesses, governments, and foreign participants – as net suppliers or demanders of funds**

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Supply and Demand for Loanable Funds



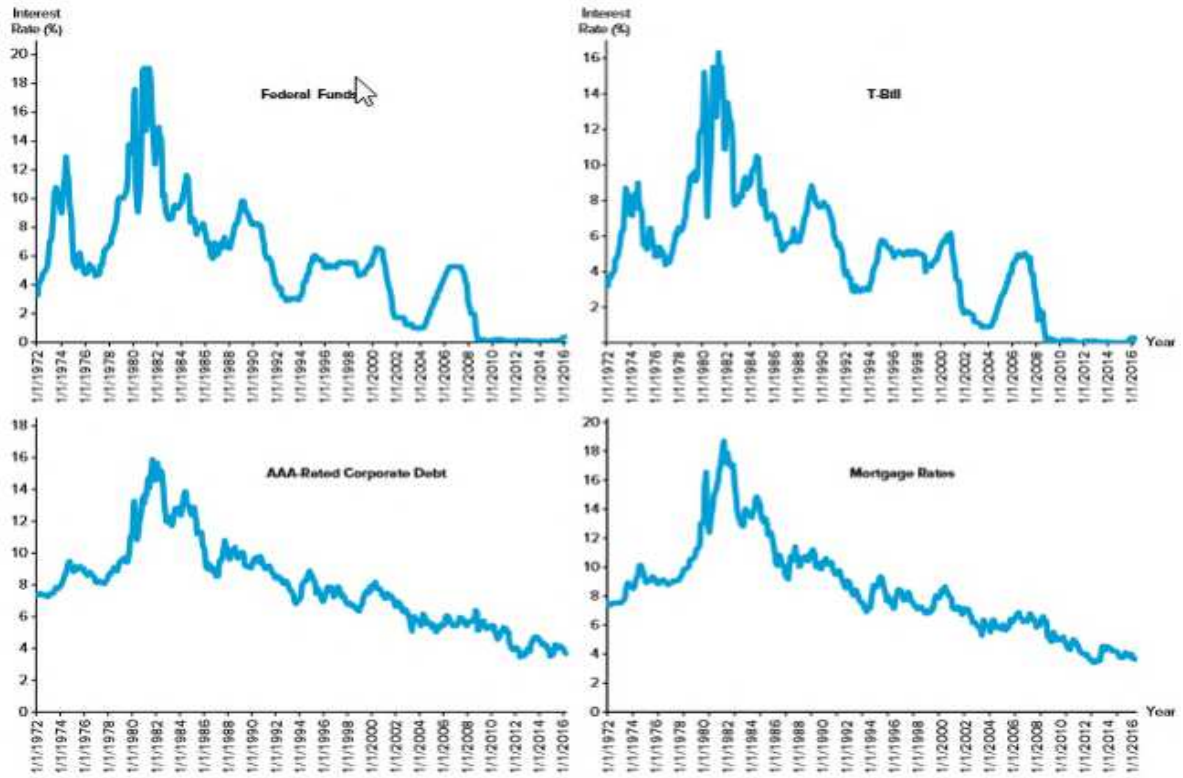
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Key Interest Rates Over Time

Figure 2–1 Key U.S. Interest Rates, 1972–2016



Source: Federal Reserve Board website, May 2016. www.federalreserve.gov

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Net Supply & Demand of Funds in U.S. in 2016



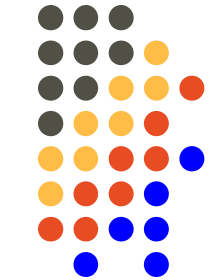
TABLE 2–1 Funds Supplied and Demanded by Various Groups
(in trillions of dollars)

	Funds Supplied	Funds Demanded	Net Funds Supplied (Funds Supplied—Funds Demanded)
Households	$70.33	$14.51	$55.82
Business—nonfinancial	23.20	55.85	−32.65
Business—financial	85.91	96.90	−10.99
Government units	5.22	23.19	−17.97
Foreign participants	23.03	17.24	5.79

Source: Federal Reserve Board website, "Financial Accounts of the United States," May 2016. www.federalreserve.gov

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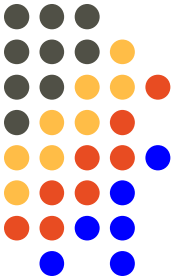
Determinants of Household Savings



1. Interest rates and tax policy.
2. Income and wealth: the greater the wealth or income, the greater the amount saved.
3. Attitudes about saving versus borrowing.
4. Credit availability: the greater the amount of easily obtainable consumer credit the lower the need to save.
5. Job security and belief in soundness of entitlements.

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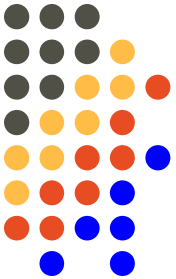
Determinants of Foreign Funds Invested in the U.S.



1. **Relative interest rates and returns on global investments.**
2. **Expected exchange rate changes.**
3. **Safe haven status of U.S. investments.**
4. **Foreign central bank investments in the U.S.**

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Federal Government Demand for Funds Concluded



Governments borrow heavily in the markets for loanable funds.

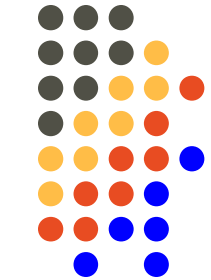
- **$23.19 trillion in 2016.**

United States.

- **National debt was $19.21 trillion in 2016.**
  - National debt (and interest payments on the national debt) have to be financed in large part by additional borrowing.

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Business Demand for Funds



Level of interest rates:

- When the cost of loanable funds is high (i.e., interest rates are high), businesses finance internally.

Expected future profitability vs. risk:

- The greater the number of profitable projects available to businesses, the greater the demand for loanable funds.

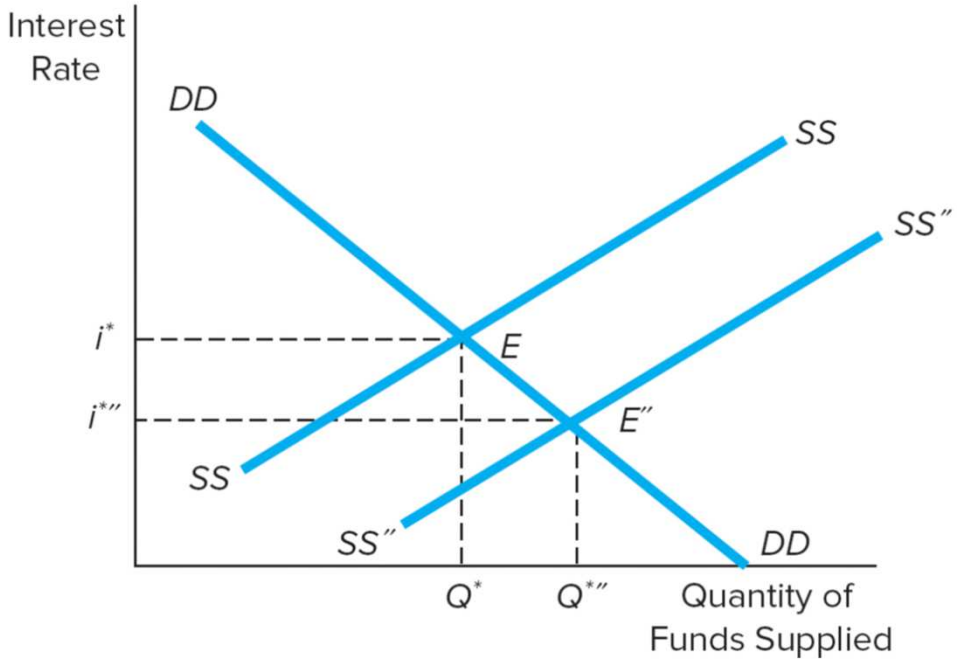
Expected economic growth.

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Effect on Interest Rates from a Shift in the Supply Curve for Loanable Funds

Figure 2–4 The Effect on Interest Rates from a Shift in the Supply Curve of or Demand Curve for Loanable Funds

(a) Increase in the supply of loanable funds

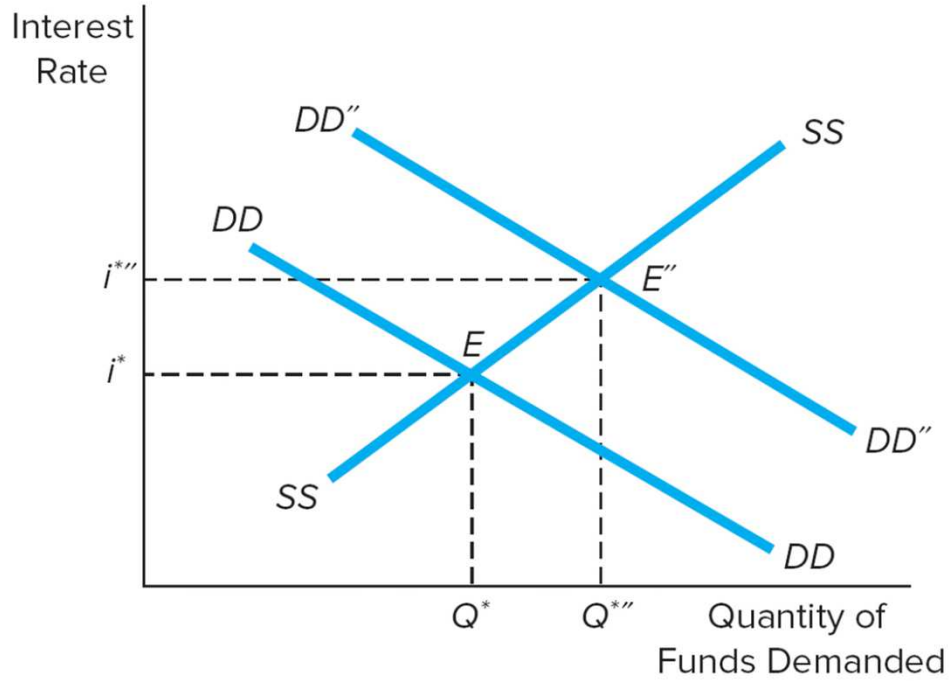


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Effect on Interest Rates from a Shift in the Demand Curve for Loanable Funds

(b) Increase in the demand for loanable funds



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Factors that Affect the Supply of and Demand for Loanable Funds for a Financial Security [1]

TABLE 2–2 Factors That Affect the Supply of and Demand for Loanable Funds for a Financial Security

Panel A: The supply of funds		
Factor	**Impact on Supply of Funds**	**Impact on Equilibrium Interest Rate***
Interest rate	Movement along the supply curve	Direct
Total wealth	Shift supply curve	Inverse
Risk of financial security	Shift supply curve	Direct
Near-term spending needs	Shift supply curve	Direct
Monetary expansion	Shift supply curve	Inverse
Economic conditions	Shift supply curve	Inverse

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Factors that Affect the Supply of and Demand for Loanable Funds for a Financial Security 2

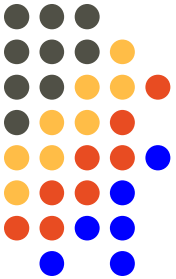
Panel B: The demand for funds		
Factor	**Impact on Demand for Funds**	**Impact on Equilibrium Interest Rate**
Interest rate	Movement along the demand curve	Direct
Utility derived from asset purchased with borrowed funds	Shift demand curve	Direct
Restrictiveness of nonprice conditions	Shift demand curve	Inverse
Economic conditions	Shift demand curve	Direct

*A “direct” impact on equilibrium interest rates means that as the “factor” increases (decreases) the equilibrium interest rate increases (decreases). An “inverse” impact means that as the factor increases (decreases) the equilibrium interest rate decreases (increases).

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Determinants of Interest Rates for Individual Securities [1]



$$i_j^* = f(IP, RFR, DRP_j, LRP_j, SCP_j, MP_j)$$

Inflation (*IP*).

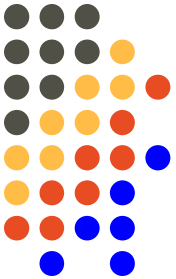
$$IP = \left[\frac{(CPI_{t+1} - CPI_t)}{CPI_t}\right] \times 100$$

Real risk-free interest rate (*RFR*) and the Fisher effect.

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

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Determinants of Interest Rates for Individual Securities 2



Default risk premium (*DRP*).

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

i_{jt} = interest rate on security issued by a non-Treasury issuer (issuer *j)* of maturity **m** at time ***t***

i_{Tt} = interest rate on security issued by the U.S. Treasury of maturity **m** at time ***t***

Liquidity risk (*LRP*).

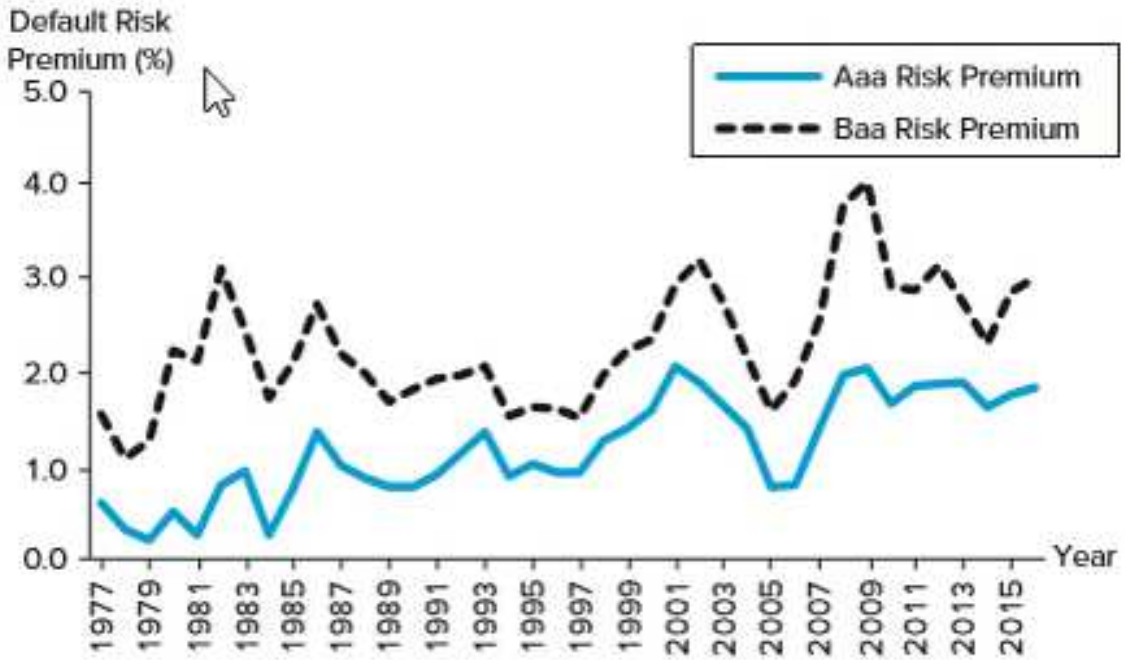
Special provisions (*SCP*).

Term to maturity (*MP*).

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DRPs Over Time

Figure 2–6 Default Risk Premium on Corporate Bonds

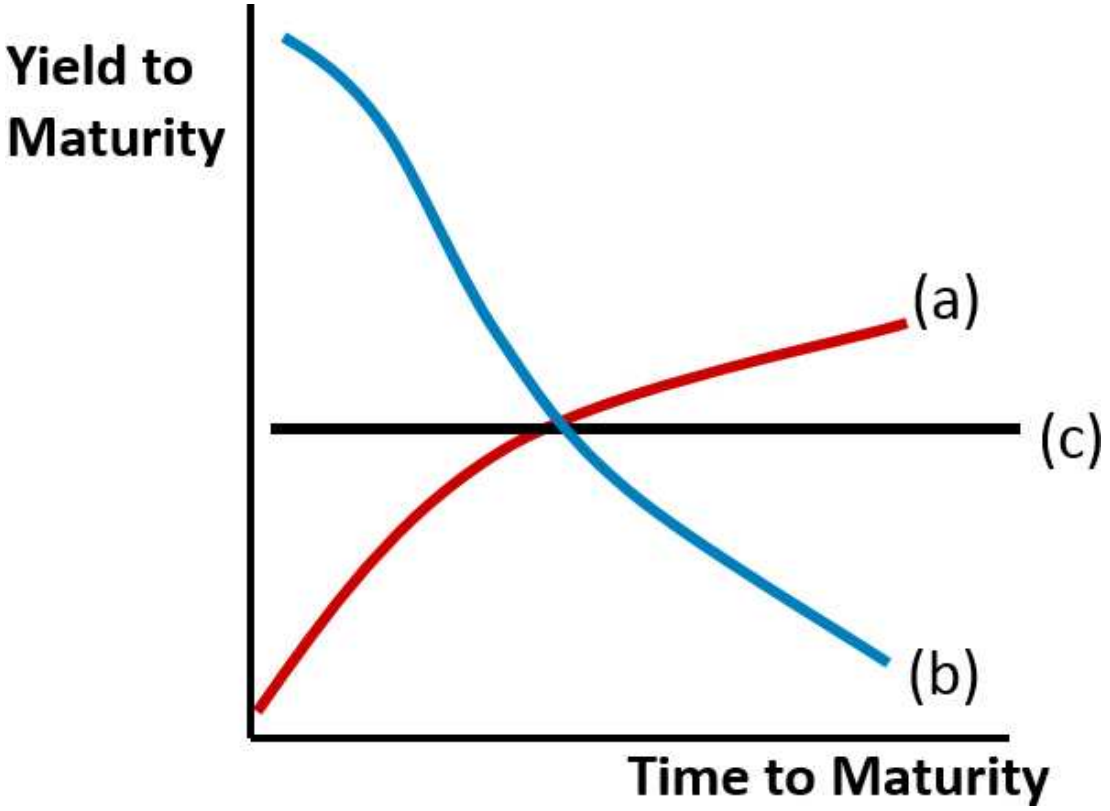


Source: Federal Reserve Board website, May 2016. www.federalreserve.gov

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Term Structure of Interest Rates: the Yield Curve



(a) Upward sloping

(b) Inverted or downward sloping

(c) Flat

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Unbiased Expectations Theory

Current long-term interest rates ($_1R_N$) are geometric averages of current and expected future, $E(_Nr_1)$, short-term interest rates.

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

$_1R_N$ = actual N-period rate today

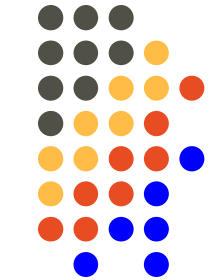
N = term to maturity, N = 1, 2, …, 4, …

$_1R_1$ = actual current one-year rate today

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

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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*.

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

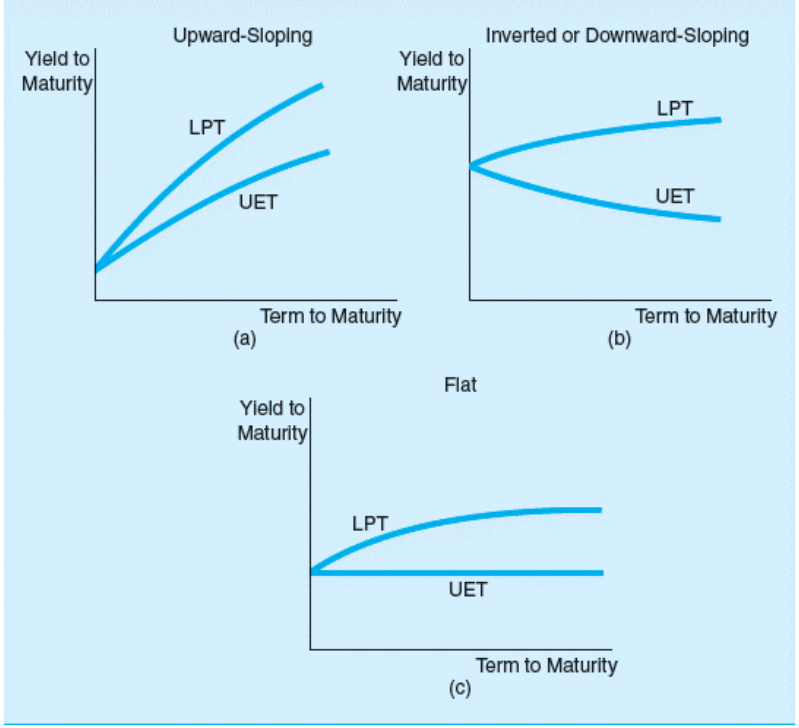
L_t = liquidity premium for period t

$L_2 < L_3 < \ldots L_N$

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UET vs. LPT

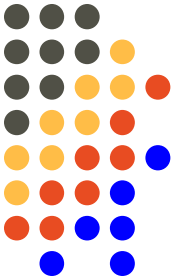
Figure 2–9 Yield Curve under the Unbiased Expectations Theory (UET) versus the Liquidity Premium Theory (LPT)



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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.

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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* years into the future is:

$$ {}_{N}f_{1} = \left[\frac{(1+{}_{1}R_{N})^{N}}{(1+{}_{1}R_{N-1})^{N-1}} \right] - 1 $$

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Time Value of Money and Interest Rates



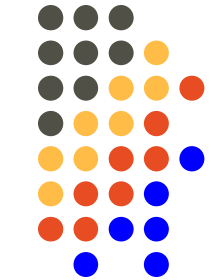
The time value of money is based on the notion that a dollar received today is worth more than a dollar received at some future date.

- **Simple interest:** interest earned on an investment is not reinvested.
- **Compound interest:** interest earned on an investment is reinvested, most common.

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Present Value of a Lump Sum



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

$$PV = FV_t I(1 + r)^t$$

PV = present value of cash flow

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

r = interest rate earned per period on investment

t = number of compounding periods in investment horizon

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Future Value of a Lump Sum

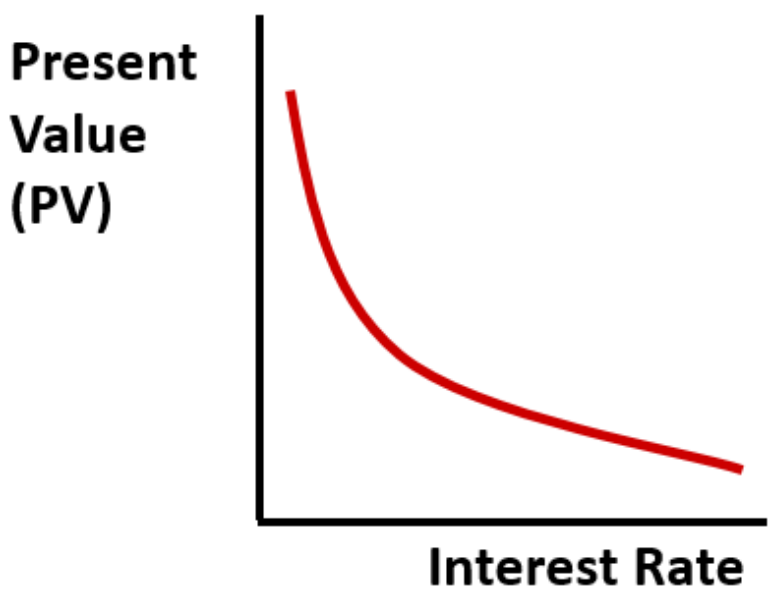


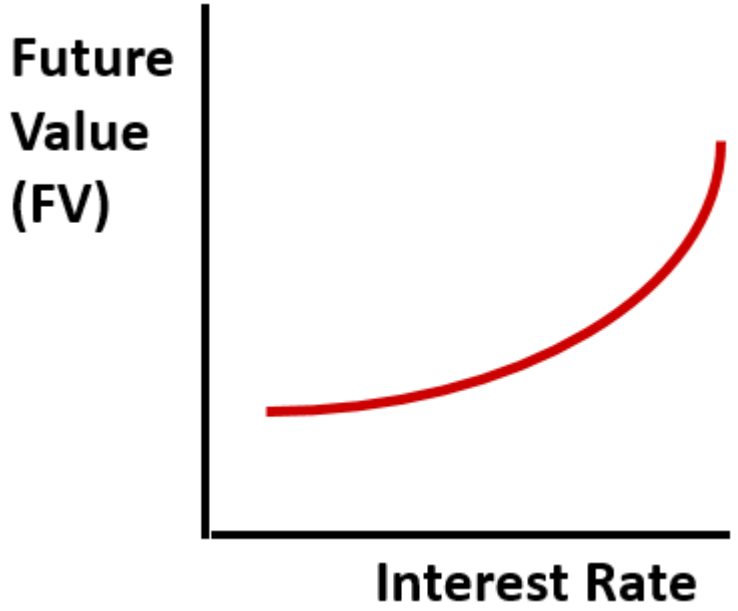
The future value (FV) of a lump sum received at the beginning of the investment horizon

$$FV_t = PV(1 + r)^t$$

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Relation between Interest Rates and Present and Future Values





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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.

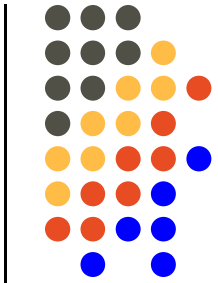
$$PV = PMT \sum_{j=1}^{t} \left[\frac{1}{(1+r)} \right]^{j}$$

$$PV = PMT \times \left[\frac{1 - \frac{1}{(1+r)^{t}}}{r} \right]$$

PMT = periodic annuity payment

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Future Value of an Annuity



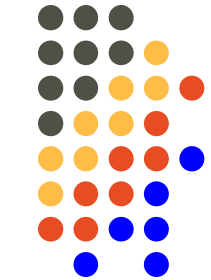
The future value of a series of equal cash flows received at equal intervals throughout the investment horizon.

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

$$FV_t = PMT \times \left[\frac{(1+r)^t - 1}{r}\right]$$

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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

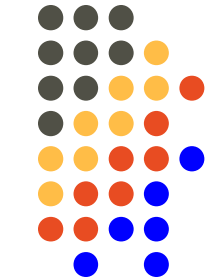
PV = present value (i.e., current price)

PMT = a constant payment every period

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

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Supply and Demand for Loanable Funds Long Description



As supply increases, demand decreases. As supply decreases, demand increases. The horizontal axis is labeled "quantity of loanable funds supplied and demanded" and the vertical axis is the interest rate. Scales are not provided.

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Effect on Interest Rates from a Shift in the Supply Curve for Loanable Funds Long description

The horizontal axis is unitless and displays the quantity of funds supplied. The vertical axis is unitless and displays the interest rate. The demand curve is a decreasing line. The supply curve is an increasing line that intersects the demand curve at point E, which comes from coordinates Q prime, I prime. The supply curve is then shifted to the right. The point E prime is now farther to the right and lower than before and has coordinates Q double prime and i double prime.

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Effect on Interest Rates from a Shift in the Demand Curve for Loanable Funds Long Description

The horizontal axis is unitless and displays the quantity of funds supplied. The vertical axis is unitless and displays the interest rate. The demand curve is a decreasing line. The supply curve is an increasing line that intersects the demand curve at point E, which comes from coordinates Q prime, I prime. The demand curve is then shifted up vertically. The point E prime is now farther to the right and greater than before and has coordinates Q double prime and i double prime.

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Key Interest Rates Over Time Long Description



All four graphs followed the same general trend. The interest rate for all 4 graphs peaked in the early 1980s and then have been on a relatively steady decline ever since.

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DRPs Over Time Long Description

Both premiums have fluctuated together, with the Baa risk premium always about 1% greater than the Aaa risk premium. The Aaa risk premium (%) fluctuated from just over 0% in the late 1970s until about 1.5% in 2015.

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UET vs. LPT Long Description

When upward sloping, the LPT curve and UET curves are both rising in a concave down manner, but the LPT curve is increasing more rapidly (is vertically higher). When downward sloping, the LPT curve is slowly increasing in a concave up manner and the UET curve is slowly decreasing in a concave up manner. When flat, the LPT curve is slowly increasing in a concave down manner and the UET curve is a horizontal line (is flat).

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