Chapter 4
Consumption, Saving, and Investment

■ Multiple Choice Questions

1. Desired national saving equals
   (a) \( Y - C^d - G \).
   (b) \( C^d + I^d + G \).
   (c) \( I^d + G \).
   (d) \( Y - I^d - G \).
   Answer: A
   Level of difficulty: 1
   Section: 4.1

2. With no inflation and a nominal interest rate \( i \) of .03, a person can trade off one unit of current consumption for _____ units of future consumption.
   (a) 0.97
   (b) 1.03
   (c) .03
   (d) –.03
   Answer: B
   Level of difficulty: 1
   Section: 4.1

3. The desire to have a relatively even pattern of consumption over time is known as
   (a) excess sensitivity.
   (b) the substitution effect.
   (c) the consumption-smoothing motive.
   (d) forced saving.
   Answer: C
   Level of difficulty: 1
   Section: 4.1

4. When a person gets an increase in current income, what is likely to happen to consumption and saving?
   (a) Consumption increases and saving increases.
   (b) Consumption increases and saving decreases.
   (c) Consumption decreases and saving increases.
   (d) Consumption decreases and saving decreases.
   Answer: A
   Level of difficulty: 1
   Section: 4.1
5. Last year, Linus earned a salary of $25,000 and he spent $24,000, thus saving $1000. At the end of the year, he received a bonus of $1000 and he spent $500 of it, saving the other $500. What was his marginal propensity to consume?
(a) 0.96
(b) 0.50
(c) 0.04
(d) 0.02
Answer: B
Level of difficulty: 2
Section: 4.1

6. The fraction of additional current income that a person consumes in the current period is known as the
(a) consumption-smoothing motive.
(b) consumption deficit.
(c) saving rate.
(d) marginal propensity to consume.
Answer: D
Level of difficulty: 1
Section: 4.1

7. An increase in expected future output while holding today’s output constant would
(a) increase today’s desired consumption and increase desired national saving.
(b) increase today’s desired consumption and decrease desired national saving.
(c) decrease today’s desired consumption and increase desired national saving.
(d) decrease today’s desired consumption and decrease desired national saving.
Answer: B
Level of difficulty: 2
Section: 4.1

8. When a person receives an increase in wealth, what is likely to happen to consumption and saving?
(a) Consumption increases and saving increases.
(b) Consumption increases and saving decreases.
(c) Consumption decreases and saving increases.
(d) Consumption decreases and saving decreases.
Answer: B
Level of difficulty: 1
Section: 4.1

9. Aunt Agatha has just left her nephew $5000. The most likely response is for her nephew to
(a) increase current consumption, but not future consumption.
(b) decrease current consumption, but increase future consumption.
(c) increase future consumption, but not current consumption.
(d) increase both current consumption and future consumption.
Answer: D
Level of difficulty: 1
Section: 4.1
10. The stock market just crashed; the Dow Jones Industrial Average fell by 750 points. You would expect the effect on aggregate consumption to be the largest if which of the following facts was true?
   (a) The crash had been preceded by a large run-up in the price of stocks.
   (b) Most stocks were owned by insurance companies.
   (c) Most stocks were owned by pension funds that invested in the market.
   (d) Many individuals had invested in the stock market immediately prior to the crash.
   Answer: D
   Level of difficulty: 2
   Section: 4.1

11. If the substitution effect of the real interest rate on saving is larger than the income effect of the real interest rate on saving, then a rise in the real interest rate leads to a _____ in consumption and a _____ in saving, for someone who’s a lender.
   (a) fall; fall
   (b) fall; rise
   (c) rise; rise
   (d) rise; fall
   Answer: B
   Level of difficulty: 1
   Section: 4.1

12. If the substitution effect of the real interest rate on saving is smaller than the income effect of the real interest rate on saving, then a rise in the real interest rate leads to a _____ in consumption and a _____ in saving, for someone who’s a lender.
   (a) fall; fall
   (b) fall; rise
   (c) rise; rise
   (d) rise; fall
   Answer: D
   Level of difficulty: 1
   Section: 4.1

13. With a nominal interest rate of 4%, an expected inflation rate of 1%, and interest income taxed at a rate of 25%, what is the expected after-tax real interest rate?
   (a) 3%
   (b) 2%
   (c) 1%
   (d) 0%
   Answer: B
   Level of difficulty: 2
   Section: 4.1
14. The nominal interest rate is 10%, the expected inflation rate is 5%, and the combined state-federal tax rate is 35%. The expected after-tax real interest rate is
(a) 1.50%.
(b) 3.25%.
(c) 5.00%.
(d) 6.50%.
Answer: A
Level of difficulty: 2
Section: 4.1

15. Three factors that cause interest rates among different financial instruments to vary are
(a) default risk, expected inflation, and taxability.
(b) default risk, current inflation, and taxability.
(c) default risk, maturity, and taxability.
(d) default risk, expected inflation, and maturity.
Answer: C
Level of difficulty: 1
Section: 4.1

16. If an investor has a tax rate on interest income of 25% and the inflation rate is 4%, which bond has the lowest expected after-tax real interest rate?
(a) A Treasury bond paying 9%
(b) A corporate bond paying 8%
(c) A Treasury bond paying 7%
(d) A municipal bond paying 6%
Answer: C
Level of difficulty: 2
Section: 4.1

17. The yield curve shows
(a) the yields on stocks of different maturities.
(b) the interest rates on bonds of different maturities.
(c) the yields on stocks with differing default risk.
(d) the yields on bonds with differing default risk.
Answer: B
Level of difficulty: 1
Section: 4.1

18. Desired national saving would increase unambiguously if there were
(a) an increase in current output and expected future output.
(b) an increase in expected future output and government purchases.
(c) an increase in expected future output and the expected real interest rate.
(d) a fall in both government purchases and expected future output.
Answer: D
Level of difficulty: 2
Section: 4.1
19. The Ricardian equivalence proposition suggests that a government deficit caused by a tax cut
   (a) causes inflation.
   (b) causes a current account deficit.
   (c) raises interest rates.
   (d) doesn’t affect consumption.
   Answer: D
   Level of difficulty: 2
   Section: 4.1

20. If the government cuts taxes today, issuing debt today and repaying the debt plus interest next year,
   a rational taxpayer will
   (a) spend the full amount of the tax cut today and reduce consumption next year.
   (b) increase consumption today, before taxes go up next year.
   (c) increase saving today, leaving consumption unchanged.
   (d) leave a smaller gross bequest to her or his heirs.
   Answer: C
   Level of difficulty: 2
   Section: 4.1

21. Which of the factors listed below might cause the Ricardian equivalence proposition to be violated?
   (a) There may be international capital inflows and outflows.
   (b) Consumers may not understand that an increase in government borrowing today is likely to lead
       to higher future taxes.
   (c) There may be constraints on the level of government spending.
   (d) There may be constraints on the level of government taxation.
   Answer: B
   Level of difficulty: 1
   Section: 4.1

22. The user cost of capital is given by the following formula, where $p_k$ is the real price of capital goods,
   $d$ is the depreciation rate, and $r$ is the expected real interest rate.
   (a) $uc = (r + d)/p_k$
   (b) $uc = p_k/(r + d)$
   (c) $uc = d p_k/r$
   (d) $uc = (r + d)p_k$
   Answer: D
   Level of difficulty: 1
   Section: 4.2
23. Which of the following machines has the lowest user cost? Machine A costs $15,000 and depreciates at a rate of 25%; machine B costs $10,000 and depreciates at a rate of 20%; machine C costs $20,000 and depreciates at a rate of 10%; and machine D costs $17,000 and depreciates at a rate of 11%. The expected real interest rate is 5%.
   (a) Machine A
   (b) Machine B
   (c) Machine C
   (d) Machine D
   Answer: B
   Level of difficulty: 2
   Section: 4.2

24. Which of the following machines has the lowest user cost? Machine A costs $15,000 and depreciates at a rate of 25%; machine B costs $10,000 and depreciates at a rate of 20%; machine C costs $20,000 and depreciates at a rate of 10%; and machine D costs $17,000 and depreciates at a rate of 11%. The expected real interest rate is 0%.
   (a) Machine A
   (b) Machine B
   (c) Machine C
   (d) Machine D
   Answer: D
   Level of difficulty: 2
   Section: 4.2

25. Calculate the user cost of capital of a machine that costs $5,000 and depreciates at a rate of 25%, when the expected real interest rate is 5%.
   (a) $150
   (b) $500
   (c) $1500
   (d) $5000
   Answer: C
   Level of difficulty: 2
   Section: 4.2

26. Calculate the user cost of capital of a machine that costs $5,000 and depreciates at a rate of 25%, when the nominal interest rate is 10% and the expected inflation rate is 5%.
   (a) $150
   (b) $500
   (c) $1500
   (d) $5000
   Answer: C
   Level of difficulty: 2
   Section: 4.2
27. Calculate the user cost of capital of a machine that costs $100,000 and depreciates at a rate of 25%, when the nominal interest rate is 4% and the expected inflation rate is 1%.
   (a) $3000
   (b) $25,000
   (c) $28,000
   (d) $29,000
   Answer: C
   Level of difficulty: 2
   Section: 4.2

28. You are trying to figure out how much capacity to add to your factory. You will increase capacity as long as
   (a) the expected marginal product of capital is positive.
   (b) the expected marginal product of capital is greater than or equal to the marginal product of capital.
   (c) the expected marginal product of capital is greater than or equal to the expected marginal product of labor.
   (d) the expected marginal product of capital is greater than or equal to the user cost of capital.
   Answer: D
   Level of difficulty: 1
   Section: 4.2

29. The relationship between stock prices and firms’ investments in physical capital is captured by what theory?
   (a) User-cost-of-capital theory
   (b) $q$ theory
   (c) Yield-curve theory
   (d) Keynesian theory
   Answer: B
   Level of difficulty: 1
   Section: 4.2

30. Tobin’s $q$ is equal to
   (a) the ratio of capital’s market value to its replacement cost.
   (b) the ratio of capital’s replacement cost to its market value.
   (c) the expected after-tax real interest rate.
   (d) the stock market value of a firm.
   Answer: A
   Level of difficulty: 1
   Section: 4.2
31. If the stock market value of a firm is $10 million and the firm owns $15 million of capital, then Tobin’s $q$ equals
   (a) $\frac{2}{3}$.
   (b) 1.
   (c) $\frac{3}{2}$.
   (d) 4.
   Answer: A
   Level of difficulty: 2
   Section: 4.2

32. A firm should invest more if Tobin’s $q$
   (a) equals zero.
   (b) is less than one.
   (c) equals one.
   (d) is more than one.
   Answer: D
   Level of difficulty: 1
   Section: 4.2

33. A technological improvement will
   (a) increase the desired capital stock.
   (b) decrease the desired capital stock.
   (c) have no effect on the desired capital stock.
   (d) have the same effect on the desired capital stock as an increase in corporate taxes.
   Answer: A
   Level of difficulty: 1
   Section: 4.2

34. Suppose your company is in equilibrium, with its capital stock at its desired level. A permanent decline in the expected real interest rate now has what effect on your desired capital stock?
   (a) Raises it, because the future marginal productivity of capital is higher
   (b) Lowers it, because the future marginal productivity of capital is lower
   (c) Raises it, because the user cost of capital is now lower
   (d) Lowers it, because the user cost of capital is now higher
   Answer: C
   Level of difficulty: 2
   Section: 4.2

35. Suppose your company is in equilibrium, with its capital stock at its desired level. A permanent increase in the depreciation rate now has what effect on your desired capital stock?
   (a) Raises it, because the future marginal productivity of capital is higher
   (b) Lowers it, because the future marginal productivity of capital is lower
   (c) Raises it, because the user cost of capital is now lower
   (d) Lowers it, because the user cost of capital is now higher
   Answer: D
   Level of difficulty: 2
   Section: 4.2
36. Calculate the tax-adjusted user cost of capital of a machine that costs $10,000 and depreciates at a rate of 10%, when the real interest rate is 3% and the tax rate on revenue is 5%.
   (a) $1238
   (b) $1300
   (c) $1368
   (d) $1800
   Answer: C
   Level of difficulty: 2
   Section: 4.2

37. Cummins, Hubbard, and Hassett studied the effects of taxes on investment by
   (a) seeing if investment spending is correlated with taxes on investment.
   (b) examining what happened to investment when major tax reforms took place.
   (c) raising tax rates on certain businesses and testing their reaction.
   (d) raising tax rates on equipment and reducing tax rates on structures.
   Answer: B
   Level of difficulty: 1
   Section: 4.2

38. Cummins, Hubbard, and Hassett found that investment responded to a tax change that affected the user cost of capital, with an elasticity of
   (a) 0.
   (b) –0.25.
   (c) –0.66.
   (d) –1.
   Answer: C
   Level of difficulty: 1
   Section: 4.2

39. What is the difference between gross investment and net investment?
   (a) Net investment = gross investment minus taxes
   (b) Net investment = gross investment minus net factor payments
   (c) Net investment = gross investment minus inventory accumulation
   (d) Net investment = gross investment minus depreciation
   Answer: D
   Level of difficulty: 1
   Section: 4.2

40. In 2003, your firm’s capital stock equaled $100 million, and in 2004 it equaled $105 million. The average depreciation rate on your capital stock is 20%. Gross investment in 2004 equaled
   (a) $1 million.
   (b) $5 million.
   (c) $7 million.
   (d) $25 million.
   Answer: D
   Level of difficulty: 1
   Section: 4.2
41. In 2003, your firm’s capital stock equaled $10 million, and in 2004 it equaled $15 million. The average depreciation rate on your capital stock was 20%. Net investment in 2004 equaled
   (a) $3 million.
   (b) $4 million.
   (c) $5 million.
   (d) $7 million.
   Answer: C
   Level of difficulty: 1
   Section: 4.2

42. Your firm has capital stock of $10 million and a depreciation rate of 15%. Gross investment is $3 million. How much is net investment?
   (a) $1.5 million
   (b) $2.0 million
   (c) $2.5 million
   (d) $3.5 million
   Answer: A
   Level of difficulty: 2
   Section: 4.2

43. You have just purchased a home that cost $250,000. The nominal mortgage interest rate is 8% per annum, mortgage interest payments are tax deductible, and you are in a 30% tax bracket. The expected inflation rate is 4%. Maintenance and other expenses are 8% of the initial value of the house. What is the real user cost of your house?
   (a) $20,000
   (b) $24,000
   (c) $27,000
   (d) $30,000
   Answer: B
   Level of difficulty: 1
   Section: 4.2

44. When desired national saving equals desired national investment, what market is in equilibrium?
   (a) The goods market
   (b) The money market
   (c) The foreign exchange market
   (d) The stock market
   Answer: A
   Level of difficulty: 1
   Section: 4.3
45. An economy has full-employment output of 5000. Government purchases are 1000. Desired consumption and desired investment are given by

\[ C^d = 3000 - 2000r + 0.10Y \]
\[ I^d = 1000 - 4000r \]

where \( Y \) is output and \( r \) is the real interest rate. The real interest rate that clears the goods market is equal to

(a) 1.25%.
(b) 2.50%.
(c) 8.33%.
(d) 25.00%.

Answer: C
Level of difficulty: 3
Section: 4.3

46. An economy has government purchases of 1000. Desired national saving and desired investment are given by

\[ S^d = 200 + 5000r + 0.10Y - 0.20G \]
\[ I^d = 1000 - 4000r \]

When the full-employment level of output equals 5000, then the real interest rate that clears the goods market will be

(a) 1.11%.
(b) 5.56%.
(c) 16.67%.
(d) 21.11%.

Answer: B
Level of difficulty: 3
Section: 4.3

47. Any change in the economy that raises desired national saving for a given value of the real interest rate will shift the desired national saving curve to

(a) the right and increase the real interest rate.
(b) the right and decrease the real interest rate.
(c) the left and increase the real interest rate.
(d) the left and decrease the real interest rate.

Answer: B
Level of difficulty: 1
Section: 4.3
48. An increase in the expected real interest rate tends to
   (a) raise desired savings only.
   (b) raise desired investment only.
   (c) raise both desired savings and desired investment.
   (d) raise desired savings, but lower desired investment.
   Answer: D
   Level of difficulty: 1
   Section: 4.3

49. The saving-investment diagram shows that a higher real interest rate due to a leftward shift of the
   saving curve
   (a) raises the profitability of investment for firms.
   (b) causes the amount of firms’ investment to increase.
   (c) increases the total amount of saving because of the increase in the real interest rate.
   (d) causes the total amounts of saving and investment to fall.
   Answer: D
   Level of difficulty: 2
   Section: 4.3

50. A temporary decrease in government purchases would cause
   (a) a rightward shift in the saving curve and a leftward shift in the investment curve.
   (b) a rightward shift in the saving curve and a rightward shift in the investment curve.
   (c) a rightward shift in the saving curve, but no shift in the investment curve.
   (d) no shift in the saving curve, but a leftward shift in the investment curve.
   Answer: C
   Level of difficulty: 2
   Section: 4.3

51. If consumers foresee future taxes completely, a reduction in taxes this year that is accompanied by
   an offsetting increase in future taxes would cause
   (a) a rightward shift in the saving curve and a rightward shift in the investment curve.
   (b) a shift in neither the saving nor the investment curve.
   (c) a leftward shift in the saving curve, but no shift in the investment curve.
   (d) no shift in the saving curve, but a rightward shift in the investment curve.
   Answer: B
   Level of difficulty: 2
   Section: 4.3

52. An invention that raises the future marginal product of capital would cause an increase in desired
   investment, which would cause the investment curve to shift to the ________ and would cause the
   real interest rate to ________.
   (a) right; increase
   (b) right; decrease
   (c) left; increase
   (d) left; decrease
   Answer: A
   Level of difficulty: 1
   Section: 4.3
53. A temporary supply shock, such as a drought, would
   (a) increase the marginal product of capital and increase desired investment.
   (b) decrease the marginal product of capital and decrease desired investment.
   (c) have little or no effect on desired investment.
   (d) decrease both the marginal product of capital and the marginal product of labor in the long-term future.
   Answer: C
   Level of difficulty: 2
   Section: 4.3

54. David consumes 200 in the current period and 330 in the future period. The real interest rate is 10% per period. David’s present value of lifetime consumption is
   (a) 500.
   (b) 530.
   (c) 550.
   (d) 563.
   Answer: A
   Level of difficulty: 2
   Section: App. 4.A

55. Rachel earns nothing during her learning period, 1100 during her working period, and nothing during her retirement period. She has initial assets of 300. The real interest rate is zero. Rachel is not allowed to borrow by the banks. Whenever possible, Rachel wants to smooth consumption between periods. How much will she save during her working period?
   (a) 400
   (b) 550
   (c) 700
   (d) 950
   Answer: B
   Level of difficulty: 2
   Section: App. 4.A

56. A curve that connects all the consumption combinations that yield the same level of utility is known as
   (a) an isoquant.
   (b) a yield curve.
   (c) a budget line.
   (d) an indifference curve.
   Answer: D
   Level of difficulty: 1
   Section: App. 4.A
57. If Claudette gets a permanent increase in her income of $1000 per year, she saves an extra $200 this year and consumes an extra $800 this year. If the increase in income had been temporary instead of permanent, she would have saved _____ of the extra income.
   (a) More than $200
   (b) Less than $200
   (c) Exactly $200
   (d) None
   Answer: A
   Level of difficulty: 2
   Section: App. 4.A

58. Suppose the government provides a tax cut today that is matched by a tax increase in the future that’s equal in present value to the tax cut. This causes a consumer’s saving to
   (a) decrease.
   (b) increase.
   (c) remain unchanged.
   (d) increase if the person was a lender and decrease if the person was a borrower.
   Answer: B
   Level of difficulty: 2
   Section: App. 4.A

59. The substitution effect of a decrease in real interest rates is to cause a consumer to
   (a) increase future consumption and decrease current consumption.
   (b) decrease future consumption and increase current consumption.
   (c) increase current consumption and increase saving.
   (d) decrease current consumption and increase saving.
   Answer: B
   Level of difficulty: 2
   Section: App. 4.A

60. For a borrower, an increase in the real interest rate will lead to
   (a) higher current consumption and less borrowing.
   (b) higher current consumption and less saving.
   (c) lower current consumption and less borrowing.
   (d) lower current consumption and less saving.
   Answer: C
   Level of difficulty: 2
   Section: App. 4.A
Essay Questions

1. Jane wants to save $1000 of current income. With an IRA, no taxes are paid on income or interest until the money is withdrawn in five years. Without an IRA, taxes must be paid whenever income or interest is received. Jane’s federal/state tax bracket is 35%, and the nominal interest rate is 8%.
   (a) How much money will Jane have if she puts her money in an IRA and withdraws the money in five years?
   (b) How much money will Jane have if she does NOT put her money in an IRA, but rather in a regular (taxable) savings account, for five years?
   (c) How much does Jane gain in five years by using an IRA rather than a regular savings account?

   Answers:
   (a) $955.06 = [$1000 \times (1.08)^5] \times 0.65$
   (b) $837.51 = $650 \times [1 + (0.08 \times 0.65)]^5$
   (c) $117.55 = $955.06 – $837.51$
Level of difficulty: 3
Section: 4.1

2. Suppose the one-year T-bill rate was 5% on 1/1/2001, 4% on 1/1/2002, and 6% on 1/1/2003. The GDP deflator (1996 = 100) was 110 on 1/1/2001, 112 on 1/1/2002, 114 on 1/1/2003, and 120 on 1/1/2004. The tax rate on interest income is 30%.
   (b) If you began with $1000 on 1/1/2001 and invested in T-bills each year (paying taxes at the end of each year), how much would you have in nominal terms on 1/1/2004? How much would you have in real terms (1996 dollars)?
   (c) How much was your nominal after-tax interest earned in part (b) over the three years? How much did you earn in real (1996) after-tax dollars?

   Answers:
   (a) 2001: 3.5% = 0.05 \times 0.7; 2002: 2.8% = 0.04 \times 0.7; 2003: 4.2% = 0.06 \times 0.7
   (b) Nominal: $1108.67 = $1000 \times 1.035 \times 1.028 \times 1.042; Real: $923.89 = $1108.67/(120/100)
   (c) Nominal: $108.67 = $1108.67 – $1000; Real: $14.80 = $923.89 – $1000/(110/100) = $923.89 – $909.09
Level of difficulty: 3
Section: 4.1

3. The nominal interest rate on taxable bonds is 8%, while on municipal bonds (which aren’t taxable) it is 5%. The expected inflation rate is 3% and the tax rate on interest income is 40%. Calculate the expected after-tax real interest rate on both bonds. Which would be the better investment? Now suppose the actual inflation rate turned out to be 6%. Which bond was the better investment? Would your answer change if inflation had turned out to be 0%?

   Answers: $r_{e,t}$ (taxable bond) = (1 – 0.40)8% – 3% = 1.8%; $r_{e,m}$ (municipal bond) = 5% – 3% = 2%;
   municipal bond is the best buy; note that the same expected inflation rate is subtracted from both, so it doesn’t matter what the actual inflation rate turns out to be—the municipal bond is always the best.

Level of difficulty: 2
Section: 4.1
4. Suppose you divide your life into two periods—working age and retirement age. When you work, you earn labor income $Y$; when retired, you earn no labor income, but must live off your savings and the interest it earns. You save the amount $S$ while working, earning interest at rate $r$, so you have $(1 + r)S$ to live on when retired. Because you don’t need to consume as much when retired, you want to set consumption when working twice as high as consumption when retired.

(a) Suppose you earn $1 million over your working life, and the real interest rate for retirement saving is 50%. How much will you save and how much will you consume in each part of your life?

(b) Suppose your current income went up to $2 million when working. Now what will you save and how much will you consume each period?

(c) Suppose a social security system will pay you 25% of your working income when you are retired. Now (with $Y = 1$ million, as in part (a) how much will you save and how much will you consume each period?

(d) Suppose the interest rate rises (starting from the situation in part (a). Will you save more or less?

Answers:

(a) $c_w = Y - S$, $c_g = (1 + r)S$; $c_w = 2c_g$. So $Y - S = 2(1 + r)S$, or $(3 + 2r)S = Y$. With $r = 0.5$, $3 + 2r = 4$.

Setting $4S = \$1$ million, we get $S = \$250,000$, so $c_g = \$375,000$, and $c_w = \$750,000$.

(b) Now $4S = \$2$ million, so $S = \$500,000$, $c_g = \$750,000$, and $c_w = \$1,500,000$. Higher current income yields higher saving and consumption in both the present and the future.

(c) Now $c_g = (1 + r)S + pY$, where $p = .25$. So $Y - S = 2(1 + r)S + 2pY$, or $(3 + 2r)S = (1 - 2p)Y$.

With $r = 0.5$ and $p = .25$, we get $4S = 0.5 Y$, and with $Y = \$1$ million, this gives $S = \$125,000$, $c_g = \$875,000$, and $c_w = \$437,500$. The social security system reduces saving and increases consumption in both periods.

(d) The basic equation is $(3 + 2r)S = Y$, so as $r$ rises, $S$ declines, with $Y$ held fixed.

Level of difficulty: 3
Section: 4.1

5. In 1991 the federal government changed the withholding amounts for personal taxes. The change meant that people wouldn’t have as much withheld from their paychecks. But there was no change in the tax code itself, so the amount of tax due in April 1992 was not changed. How would consumption and saving respond to this withholding change? (Note: you may assume a real interest rate of 0%.)

Answer: This is just a Ricardian equivalence example. People would not change their consumption, but would increase saving by the amount of the withholding change, so that they would have the same consumption pattern over time.

Level of difficulty: 2
Section: 4.1
6. A firm has current and future marginal productivity of capital given by $MPK = 10,000 - 2K + N$, and marginal productivity of labor given by $MPN = 50 - 2N + K$. The price of capital is $5,000, the real interest rate is 10%, and capital depreciates at a 15% rate. The real wage rate is $15.

(a) Calculate the user cost of capital.

(b) Find the firm’s optimal amount of employment and the size of the capital stock.

**Answers:**

(a) $uc = (r + d)p_K = 0.25 \times 5000 = 1250$.

(b) Setting $w = MPN$ gives $15 = 50 - 2N + K$, or $2N = 35 + K$. Setting $uc = MPK$ gives $1250 = 10,000 - 2K + N$, or $N = -8,750 + 2K$, or $2N = -17,500 + 4K$. Setting $-17,500 + 4K = 35 + K$ gives $3K = 17,535$, which yields $K = 5,845$. Then $N = 2,940$.

Level of difficulty: 3

Section: 4.2

7. What is the $q$ theory of investment? Who developed it? What is $q$, and what do different values of $q$ imply? How is $q$ related to the stock market value of a firm and its capital stock?

**Answers:** The $q$ theory of investment captures the relationship between stock prices and firms’ investment in physical capital. The theory was developed by James Tobin. Tobin’s $q$ equals capital’s market value divided by its cost. When Tobin’s $q$ exceeds one, more investment should take place. When $q$ is less than one, there should be no investment. Tobin’s $q$ is related to the stock market value of the firm via the formula $q = \frac{V}{p_KK}$, where $V$ is the stock market value of the firm, $p_K$ is the price of capital, and $K$ is the quantity of capital.

Level of difficulty: 2

Section: 4.2

8. Use a saving-investment diagram to explain what happens to saving, investment, and the real interest rate in each of the following scenarios.

(a) Current output rises due to a temporary productivity increase.

(b) The tax code changes so that business firms face higher tax rates on their revenue (offset by other lump-sum tax changes so there’s no overall change in tax revenue).

(c) The government increases spending temporarily for a one-year project to turn mercury into gold.

(d) The average educational level rises, inducing an increase in the future marginal productivity of capital.

**Answers:**

(a) The rise in output raises desired saving, shifting the $S'$ curve to the right; in equilibrium, this reduces the real interest rate, increasing investment as well.

(b) The rise in taxes reduces desired investment, shifting the $I'$ curve to the left; in equilibrium, this reduces the real interest rate, reducing saving as well as investment.

(c) The rise in government purchases reduces desired saving, shifting the $S'$ curve to the left; in equilibrium, this raises the real interest rate, reducing investment as well as saving.

(d) The rise in future marginal productivity of capital raises desired investment, shifting the $I'$ curve to the right; in equilibrium, this raises the real interest rate, increasing saving as well as investment.

Level of difficulty: 2

Section: 4.3
9. How would each of the following affect Cheryl Shirker’s current consumption and saving? Cheryl is a forward-looking consumer with no borrowing constraints.
   (a) Cheryl’s firm announces a reorganization plan, increasing Cheryl’s future income dramatically.
   (b) Cheryl’s father, who had planned to leave her a large bequest, must spend all his wealth on medical bills after a prolonged illness.
   (c) The real interest rate rises from its original level. Cheryl originally planned to have no assets for the future; that is, she planned to spend all her original assets and all her income when she was young, and planned to consume an amount equal to her future income when she was old.

   Answers:
   (a) The rise in future income raises her current consumption and reduces her saving.
   (b) The reduction in her wealth reduces her current consumption and raises her saving.
   (c) The rise in the real interest rate causes Cheryl to reduce current consumption and increase saving to allow her to consume more in the future. There’s just a substitution effect and no income effect, since Cheryl was at the no-borrowing, no-lending point initially.

   Level of difficulty: 2
   Section: App. 4.A

10. Suppose you divide your life into two periods—working age and retirement age. When you work, you earn labor income $Y$; when retired, you earn no labor income, but must live off your savings and the interest it earns. You have no initial assets. You save the amount $S$ while working, earning interest at rate $r$, so you have $(1 + r)S$ to live on when retired. Because you don’t need to consume as much when retired, you want to set consumption when working twice as high as consumption when retired.

   (a) Suppose you earn $1 million over your working life, and the real interest rate for retirement saving is 50%. How much will you save, and how much will you consume in each part of your life?
   (b) Suppose your current income went up to $2 million when working. Now what will you save and how much will you consume each period?
   (c) Suppose a social security system will pay you 25% of your working income when you are retired. Now (with $Y = 1$ million as in part (a)) how much will you save and how much will you consume each period?
   (d) Suppose the interest rate rises. Will you save more or less?

   Answers:
   (a) $c_w = Y - S$, $c_g = (1 + r)S$; $c_w = 2c_g$. So $Y - S = 2(1 + r)S$, or $(3 + 2r)S = Y$. With $r = 0.5$, $3 + 2r = 4$. Setting $4S = 1$ million, we get $S = 250,000$, so $c_g = 375,000$, and $c_w = 750,000$.
   (b) Now $4S = 2$ million, so $S = 500,000$, $c_g = 750,000$, and $c_w = 1,500,000$. Higher current income yields higher saving and consumption in both the present and the future.
   (c) Now $c_g = (1 + r)S + pY$, where $p = 0.25$. So $Y - S = 2(1 + r)S + 2pY$, or $(3 + 2r)S = (1 - 2p)Y$. With $r = 0.5$ and $p = 0.25$, we get $4S = 0.5 Y$, and with $Y = 1$ million, this gives $S = 125,000$, $c_w = 875,000$, and $c_g = 437,500$. The social security system reduces saving and increases consumption in both periods.
   (d) The basic equation is $(3 + 2r)S = Y$, so as $r$ rises, $S$ declines, with $Y$ held fixed.

   Level of difficulty: 3
   Section: App. 4.A