Savings, Investment Spending, and the Financial System

1. Given the following information about the closed economy of Brittania, what is the level of investment spending and private savings, and what is the budget balance? What is the relationship among the three? Is national savings equal to investment spending? There are no government transfers.

\[
\begin{align*}
\text{GDP} &= 1,000 \text{ million} \\
T &= 50 \text{ million} \\
C &= 850 \text{ million} \\
G &= 100 \text{ million}
\end{align*}
\]

**Solution**

In a closed economy, investment spending is equal to GDP minus consumer spending minus government purchases of goods and services. In Brittania, investment spending is $50 million:

\[
I = \text{GDP} - C - G \\
I = 1,000 \text{ million} - 850 \text{ million} - 100 \text{ million} = 50 \text{ million}
\]

Private savings is equal to disposable income (income net of taxes—and recall that there are no government transfers) minus consumer spending. In Brittania, private savings is $100 million:

\[
\text{Private savings} = \text{GDP} - T - C = 1,000 \text{ million} - 50 \text{ million} - 850 \text{ million} = 100 \text{ million}
\]

The budget balance is equal to tax revenue minus government purchases of goods and services. In Brittania, the government is running a budget deficit of $50 million:

\[
\text{Budget balance} = T - G = 50 \text{ million} - 100 \text{ million} = -50 \text{ million}
\]

National savings is the sum of private savings and the budget balance; that is, it is $100 million – $50 million = $50 million. So investment spending does equal national savings.

2. Given the following information about the open economy of Regalia, what is the level of investment spending and private savings, and what are the budget balance and net capital inflow? What is the relationship among the four? There are no government transfers. *(Hint: net capital inflow equals the value of imports (IM) minus the value of exports (X).)*

\[
\begin{align*}
\text{GDP} &= 1,000 \text{ million} \\
C &= 850 \text{ million} \\
T &= 50 \text{ million} \\
G &= 100 \text{ million} \\
X &= 100 \text{ million} \\
IM &= 125 \text{ million}
\end{align*}
\]

**Solution**

In an economy with capital inflows or outflows, investment spending is equal to GDP minus consumer spending minus government purchases of goods and services plus net capital inflow, the value of imports minus the value of exports. In Regalia, investment spending is $75 million:

\[
I = (\text{GDP} - C - G) + (IM - X) \\
I = (1,000 \text{ million} - 850 \text{ million} - 100 \text{ million}) + (125 \text{ million} - 100 \text{ million}) \\
I = 50 \text{ million} + 25 \text{ million} = 75 \text{ million}
\]
Private savings and the budget balance are measured in the same way regardless of whether or not there are capital inflows or outflows. (Again, recall that there are no government transfers.) In Regalia, private savings is $100 million and the budget balance is $-50 million (that is, the government is running a deficit of $50 million):

Private savings = GDP − T − C = $1,000 million − $50 million − $850 million = $100 million

Budget balance = T − G = $50 million − $100 million = $-50 million

An economy will experience a positive net capital inflow equal to the difference between imports and exports when imports exceed exports; it will experience a capital outflow (a negative net capital inflow) equal to the difference between imports and exports when exports exceed imports. Regalia has a positive net capital inflow equal to $25 million:

Net capital inflow = IM − X = $125 million − $100 million = $25 million

Investment spending must equal the sum of private savings, the budget balance, and the net capital inflow. In Regalia, we can see that this relationship holds among the four:

I = Private savings + Budget balance + Net capital inflow = $75 million

3. The accompanying table shows the percentage of GDP accounted for by private savings, investment spending, and net capital inflow in the economies of Capsland and Marsalia. Capsland is currently experiencing a positive net capital inflow and Marsalia, a negative net capital outflow. What is the budget balance (as a percentage of GDP) in both countries? Are Capsland and Marsalia running a budget deficit or surplus?

<table>
<thead>
<tr>
<th></th>
<th>Capsland</th>
<th>Marsalia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment spending as a percentage of GDP</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Private savings as a percentage of GDP</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Net capital inflow as a percentage of GDP</td>
<td>5</td>
<td>-2</td>
</tr>
</tbody>
</table>

3. In both countries, investment spending as a percentage of GDP must be equal to the sum of private savings, the budget balance, and net capital inflow as a percentage of GDP. We can calculate the budget balance as investment spending minus the sum of private savings and net capital inflow:

I = Private savings + Budget balance + Net capital inflow

Budget balance = I − Private savings − Net capital inflow

In Capsland, the budget balance is 5% of GDP; the government is running a budget surplus equal to 5% of GDP:

Budget balance = 20% − 10% − 5%

Budget balance = 5%

In Marsalia, the budget balance is -3% of GDP; the government is running a budget deficit equal to 3% of GDP:

Budget balance = 20% − 25% − (-2%) = 20% − 25% + 2%

Budget balance = -3%
4. Assume the economy is open to capital inflows and outflows and therefore net capital inflow equals imports (IM) minus exports (X). Answer each of the following questions.

a. \( X = \$125 \text{ million} \)
   \( IM = \$80 \text{ million} \)
   Budget balance = \(-$200 \text{ million} \)
   \( I = \$250 \text{ million} \)
   Calculate private savings.

b. \( X = \$85 \text{ million} \)
   \( IM = \$135 \text{ million} \)
   Budget balance = \$100 \text{ million} 
   Private savings = \$250 \text{ million} 
   Calculate \( I \).

c. \( X = \$60 \text{ million} \)
   \( IM = \$95 \text{ million} \)
   Private savings = \$325 \text{ million} 
   \( I = \$300 \text{ million} \)
   Calculate the budget balance

d. Private savings = \$325 \text{ million} 
   \( I = \$400 \text{ million} \)
   Budget balance = \$10 \text{ million} 
   Calculate \( IM - X \).

4. According to the savings–investment spending identity in an economy open to capital flows from and to abroad, the following must hold: \( I = \text{Private savings} + \text{Budget balance} + (IM - X) \). We use this to solve for the missing variable in each problem.

a. \( \$350 \text{ million} = \text{Private savings} - \$200 \text{ million} + (\$80 \text{ million} - \$125 \text{ million}) \)
   So private savings = \$595 \text{ million} 

b. \( I = \$250 \text{ million} + \$100 \text{ million} + (\$135 \text{ million} - \$85 \text{ million}) \)
   So \( I = \$400 \text{ million} \)

c. \( \$300 \text{ million} = \$325 \text{ million} + \text{Budget balance} + (\$95 \text{ million} - \$60 \text{ million}) \)
   So the budget balance = \(-$60 \text{ million} \)

d. \( \$400 \text{ million} = \$325 \text{ million} + \$10 \text{ million} + (IM - X) \)
   So net capital inflow \( (IM - X) = \$65 \text{ million} \)

5. The accompanying table, taken from the National Income and Product Accounts Tables, shows the various components of U.S. GDP in 2009 and 2010 in billions of dollars.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$13,939.0</td>
<td>$9,866.1</td>
<td>$2,052.2</td>
<td>$2,412.2</td>
<td>(-$1,296.0)</td>
<td>?</td>
</tr>
<tr>
<td>2010</td>
<td>$14,526.5</td>
<td>$10,245.5</td>
<td>$2,300.4</td>
<td>$2,497.5</td>
<td>(?)</td>
<td>$1,198.5</td>
</tr>
</tbody>
</table>

a. Complete the table by filling in the missing figures.

b. For each year, calculate taxes (after transfers) as a percentage of GDP.

c. For each year, calculate national savings and private savings.
5. a. Because savings by the government is equal to the difference between the tax revenue that it collects (after transfers) and current government purchases of goods and services, the table can be completed as shown below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross domestic product (billions of dollars)</th>
<th>Private consumption (billions of dollars)</th>
<th>Gross domestic investment (billions of dollars)</th>
<th>Government purchases of goods and services (billions of dollars)</th>
<th>Government savings (budget balance) (billions of dollars)</th>
<th>Net government taxes after transfers (billions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$13,939.0</td>
<td>$2,052.2</td>
<td>$2,412.2</td>
<td>$1,116.2</td>
<td>$1,116.2</td>
<td>$1,116.2</td>
</tr>
<tr>
<td>2010</td>
<td>14,526.5</td>
<td>2,300.4</td>
<td>2,497.5</td>
<td>$1,299.0</td>
<td>1,198.5</td>
<td></td>
</tr>
</tbody>
</table>

b. In 2009, taxes (after transfers) as a percentage of GDP were 8.0%, and in 2010, 8.3%. This can be found by dividing taxes (after transfers) by GDP.

c. National and private savings for 2009 and 2010 are listed in the accompanying table. Private savings is equal to disposable income, that is, income after taxes and transfers (GDP − T + TR) minus consumption (C). For instance, in 2009, private savings is $13,939.0 − $1,116.2 − $9,866.1 = $2,956.7. National savings is the sum of the budget balance and private savings. For instance, in 2009, national savings is $2,956.7 − $1,296.0 = $1,660.7. Alternatively, of course, you could calculate national savings as the sum of the budget balance (T − G − TR) and private savings (GDP − T + TR − C), which is equal to T − G − TR + GDP − T + TR − C = GDP − G − C, which of course gives the same result.

<table>
<thead>
<tr>
<th>Year</th>
<th>National savings (billions of dollars)</th>
<th>Private savings (billions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$1,660.7</td>
<td>$2,956.7</td>
</tr>
<tr>
<td>2010</td>
<td>1,783.5</td>
<td>3,082.5</td>
</tr>
</tbody>
</table>

6. Use the market for loanable funds shown in the accompanying diagram to explain what happens to private savings, private investment spending, and the interest rate if each of the following events occur. Assume that there are no capital inflows or outflows.

a. The government reduces the size of its deficit to zero.

b. At any given interest rate, consumers decide to save more. Assume the budget balance is zero.

c. At any given interest rate, businesses become very optimistic about the future profitability of investment spending. Assume the budget balance is zero.
6. a. If the government reduces its deficit to zero, there will be a decrease in the demand for loanable funds, from $D_1$ to $D_2$, equal to the reduction in the size of the deficit. In the accompanying figure, the amount $Q_1 - Q_3$ represents the amount by which the government decreases its deficit. In response to the decrease in demand, the interest rate falls from $r_1$ to $r_2$. This fall in interest rates will increase private investment spending from $Q_3$ to $Q_2$ and decrease private savings from $Q_1$ to $Q_2$.

b. If consumers decide to save more, there will be an increase in the supply of loanable funds. In the accompanying figure, this is represented by the rightward shift of the supply curve from $S_1$ to $S_2$. The increase in the supply of loanable funds reduces the equilibrium interest rate from $r_1$ to $r_2$. In response to the lower interest rate, private investment spending will rise from $Q_1$ to $Q_2$.

c. Higher investment spending at any given interest rate leads to an increase in the demand for loanable funds. In the accompanying figure, the increase in the demand for loanable funds shifts the demand curve from $D_1$ to $D_2$ and raises the equilibrium interest rate from $r_1$ to $r_2$. In response to the higher interest rate, private savings will rise from $Q_1$ to $Q_2$. 
7. The government is running a budget balance of zero when it decides to increase education spending by $200 billion and finance the spending by selling bonds. The accompanying diagram shows the market for loanable funds before the government sells the bonds. Assume that there are no capital inflows or outflows. How will the equilibrium interest rate and the equilibrium quantity of loanable funds change? Is there any crowding out in the market?

Solution

The $200 billion in government borrowing will increase the demand for loanable funds from $D_1$ to $D_2$ as shown in the accompanying diagram. The equilibrium interest rate rises from 10% to 12%, and the equilibrium quantity of loanable funds increases from $500 billion to $600 billion. The rise in the interest rate will lead to an increase in private savings of $100 billion, and private investment spending will fall by $100 to $400 billion. Through the rise in the interest rate, the increase in government borrowing crowded out $100 billion in private investment spending.

8. In 2010, Congress estimated that the cost of increasing the U.S. presence in Afghanistan by 30,000 troops was approximately $36 billion. Since the U.S. government was running a budget deficit at the time, assume that the surge in troop levels was financed by government borrowing, which increases the demand for loanable funds without affecting supply. This question considers the likely effect of this government expenditure on the interest rate.

a. Draw typical demand ($D_1$) and supply ($S_1$) curves for loanable funds without the cost of the surge in troop levels accounted for. Label the vertical axis “Interest rate” and the horizontal axis “Quantity of loanable funds.” Label the equilibrium point ($E_1$) and the equilibrium interest rate ($r_1$).
b. Now draw a new diagram with the cost of the surge in troop levels included in the analysis. Shift the demand curve in the appropriate direction. Label the new equilibrium point \( E_2 \) and the new equilibrium interest rate \( r_2 \).

c. How does the equilibrium interest rate change in response to government expenditure on the troop surge? Explain.

8. a. The demand for loanable funds without government borrowing to finance the surge in troop levels in Afghanistan is shown in the accompanying diagram.

![Diagram showing demand and supply of loanable funds](image)

8. b. Interest rate

\[
\begin{align*}
\text{Interest rate} & \quad S_1 \\
& \quad E_1 \\
& \quad D_1 \\
\end{align*}
\]

8. c. Government borrowing to finance the troop surge raises the interest rate in equilibrium because the supply of loanable funds remains constant but the demand rises.

9. Explain why equilibrium in the loanable funds market maximizes efficiency.

**Solution**

9. Equilibrium in the loanable funds market maximizes efficiency because it ensures that investment spending projects with higher rates of return get funded before those with lower rates of return. At the same time, private savers with the lowest opportunity cost for their funds will have their offers of loans accepted before savers with higher opportunity costs of funds. So in equilibrium the projects with the highest rates of return will be funded by savers with the lowest costs of lending. This makes it more likely that lenders and borrowers will make mutually beneficial trades—trades that make society as a whole better off.

10. How would you respond to a friend who claims that the government should eliminate all purchases that are financed by borrowing because such borrowing crowds out private investment spending?
10. You might first acknowledge that, other things equal, when the government runs a budget deficit, there is an increase in the demand for loanable funds. The increase in demand raises interest rates and decreases private investment spending. This means that businesses will add less physical capital each year and productivity growth may be slower than it would be if the government had not borrowed to cover its deficit. However, you might then explain that some government purchases are necessary for economic growth. Government funds much of the infrastructure within which the economy operates (for example, the legal framework, the court system, and the communications network), and the government also invests in education, roads, and airports necessary for economic growth.

11. Boris Borrower and Lynn Lender agree that Lynn will lend Boris $10,000 and that Boris will repay the $10,000 with interest in one year. They agree to a nominal interest rate of 8%, reflecting a real interest rate of 3% on the loan and a commonly shared expected inflation rate of 5% over the next year.

a. If the inflation rate is actually 4% over the next year, how does that lower-than-expected inflation rate affect Boris and Lynn? Who is better off?

b. If the actual inflation rate is 7% over the next year, how does that affect Boris and Lynn? Who is better off?

12. Using the accompanying diagram, explain what will happen to the market for loanable funds when there is a fall of 2 percentage points in the expected future inflation rate. How will the change in the expected future inflation rate affect the equilibrium quantity of loanable funds?

![Diagram of the market for loanable funds with a downward shift in the supply curve from S_1 to S_1']
12. In the accompanying diagram, the market for loanable funds is initially in equilibrium at $E_1$, with a nominal interest rate of 8%. A fall of 2 percentage points in the expected future inflation rate leads, by the Fisher effect, to a fall of 2 percentage points in the nominal interest rate to 6%. The real interest rate and the equilibrium quantity of loanable funds remain unchanged. The change in expected inflation causes both a downward shift of the supply curve for loanable funds, from $S_1$ to $S_2$, and a downward shift of the demand curve for loanable funds, from $D_1$ to $D_2$.

13. The accompanying diagram shows data for the interest rate on 10-year euro area government bonds and inflation for the euro area for 1991 through mid-2011, as reported by the European Central Bank. How would you describe the relationship between the two? How does the pattern compare to that of the United States in Figure 10-8?

13. As in the case of the United States in panel (a) of Figure 10-8, the euro area experience is largely one of low and relatively constant inflation. As expectations of future inflation declined, so did interest rates during the first part of the period illustrated in the accompanying diagram. Based on the expectation of continuing low inflation, fluctuations in the interest rate after about 2000 reflect changes in the demand for, and the supply of, loanable funds, rather than changes in inflation expectations. In the euro area, unlike in the United States, the interest rate did not markedly increase during the period of the U.S. housing boom, and it did not markedly decrease after the bust in the U.S. housing market. Instead, the interest rate remained relatively constant, suggesting that there was either no change in the demand for, and the supply of, loanable funds, or that the demand for, and the supply of, loanable funds decreased during the recession at about the same rate, keeping the interest rate relatively constant.
14. For each of the following, is it an example of investment spending, investing in financial assets, or investing in physical assets?

a. Rupert Moneybucks buys 100 shares of existing Coca-Cola stock.

b. Rhonda Moviestar spends $10 million to buy a mansion built in the 1970s.

c. Ronald Basketballstar spends $10 million to build a new mansion with a view of the Pacific Ocean.

d. Rawlings builds a new plant to make catcher's mitts.

e. Russia buys $100 million in U.S. government bonds.

14. a. When Rupert Moneybucks buys 100 shares of existing Coca-Cola stock, he is investing in a financial asset. He has a paper claim that entitles him to future income from Coca-Cola. It is not an example of investment spending because it does not add to the stock of physical capital in the economy.

b. When Rhonda Moviestar spends $10 million to buy a mansion built in the 1970s, she is investing in a physical asset; she has bought something that she has the right to use or to dispose of as she wishes. It is not an example of investment spending because it does not add to the stock of physical capital in the economy—the mansion was preexisting.

c. When Ronald Basketballstar spends $10 million to build a new mansion with a view of the Pacific Ocean, he has engaged in investment spending because he has added to the amount of housing in the economy.

d. When Rawlings builds a new plant to make catcher's mitts, it has engaged in investment spending because it has added to the economy's stock of physical capital.

e. When the government of Russia buys $100 million in U.S. government bonds, it has invested in a financial asset. The Russian government has a paper claim on the United States that entitles it to future income. It is not an example of investment spending because it does not add to the stock of physical capital in either economy.

15. Explain how a well-functioning financial system increases savings and investment spending, holding the budget balance and any capital flows fixed.

15. A well-functioning financial system increases both the supply of loanable funds and the demand for loanable funds in three ways. (1) It reduces the transaction costs of making financial deals incurred by either lenders or borrowers. (2) It reduces the risk associated with making investments or engaging in investment spending. (3) By increasing the liquidity of financial assets, it makes saving and the purchasing of financial assets more attractive to potential lenders, which increases investment spending.

16. What are the important types of financial intermediaries in the U.S. economy? What are the primary assets of these intermediaries, and how do they facilitate investment spending and saving?
16. Mutual funds, pension funds, life insurance companies, and banks are the most important types of financial intermediaries in the U.S. economy. Mutual funds are companies that buy stocks of other companies (the mutual funds companies’ primary assets) and resell shares of the portfolio composed of those stocks to individual investors. Pension funds are a type of mutual fund that hold financial assets of other companies (the pension funds’ primary assets) and sell shares to individual savers for retirement income. A life insurance company also holds financial assets (the life insurance company’s primary assets) and sells policies that guarantee a payment to a policyholder’s beneficiary when the policyholder dies. A bank makes loans to individuals and corporations (the bank’s primary assets) and accepts deposits from the public that are payable on demand. By either reducing risk through diversification (mutual funds, pension funds), reducing risk through insurance (life insurance companies), lowering transaction costs (mutual funds, pension funds), or providing liquidity (banks), these financial intermediaries facilitate savings and investment spending.

17. Explain the effect on a company’s stock price today of each of the following events, other things held constant.
   a. The interest rate on bonds falls.
   b. Several companies in the same sector announce surprisingly higher sales.
   c. A change in the tax law passed last year reduces this year’s profit.
   d. The company unexpectedly announces that due to an accounting error, it must amend last year’s accounting statement and reduce last year’s reported profit by $5 million. It also announces that this change has no implications for future profits.

   **Solution**

   **a.** Because bonds are a substitute asset for stocks, this will lead to a rise in all stock prices, including this company’s stock price.

   **b.** This will lead to an immediate rise in the company’s stock price because it is unexpected information that communicates to investors that the company’s sector is doing well, and so it is likely that the company will also experience higher sales and a higher-than-expected future profit.

   **c.** This will have no effect on the company’s stock price today because the effect of the change in the tax law on this year’s profit would have been incorporated into the company’s stock price when the tax law change was announced.

   **d.** This will have no effect on the company’s stock price today because the stock price is based on expectations about the future stock price, and this is unaffected by changes in previous years’ profits.

18. Sallie Mae is a quasi-governmental agency that packages individual student loans into pools of loans and sells shares of these pools to investors as Sallie Mae bonds.

   a. What is this process called? What effect will it have on investors compared to situations in which they could only buy and sell individual student loans?

   b. What effect do you think Sallie Mae’s actions will have on the ability of students to get loans?

   c. Suppose that a very severe recession hits and, as a consequence, many graduating students cannot get jobs and default on their student loans. What effect will this have on Sallie Mae bonds? Why is it likely that investors now believe Sallie Mae bonds to be riskier than expected? What will be the effect on the availability of student loans?
18. a. By pooling individual loans and selling shares of those pools as bonds, Sallie Mae has engaged in **securitization**. Because the likelihood that a default by one student is usually unrelated to, or independent from, the likelihood of default by some other student, buying a Sallie Mae bond provides greater diversification for an investor than an individual student loan. It also provides liquidity because it can be bought and sold like a typical bond.

b. With Sallie Mae bonds, investors will be more willing to supply funds for students compared to a situation in which only individual loans were available. As a result, students should be able to receive more loans at a lower interest rate.

c. Widespread defaults by students will result in losses for investors who hold Sallie Mae bonds. Investors will come to believe that due to the recession potential defaults among students are no longer unrelated events and so these bonds are riskier than they expected. As a result, there will be fewer investors willing to buy Sallie Mae bonds at any given interest rate. Students will find it harder to get loans and will have to pay a higher interest rate on those they do get.
Appendix: Toward a Fuller Understanding of Present Value

1. Suppose that a major city’s main thoroughfare, which is also an interstate highway, will be completely closed to traffic for two years, from January 2012 to December 2013, for reconstruction at a cost of $535 million. If the construction company were to keep the highway open for traffic during construction, the highway reconstruction project would take much longer and be more expensive. Suppose that construction would take four years if the highway were kept open, at a total cost of $800 million. The state department of transportation had to make its decision in 2011, one year before the start of construction (so that the first payment was one year away). So the department of transportation had the following choices:

(i) Close the highway during construction, at an annual cost of $267.5 million per year for two years.

(ii) Keep the highway open during construction, at an annual cost of $200 million per year for four years.

a. Suppose the interest rate is 10%. Calculate the present value of the costs incurred under each plan. Which reconstruction plan is less expensive?

b. Now suppose the interest rate is 80%. Calculate the present value of the costs incurred under each plan. Which reconstruction plan is now less expensive?

1. a. The present value of plan (i) is:

\[
\frac{267.5 \text{ million}}{1.1} + \frac{267.5 \text{ million}}{1.1^2} = 243.18 \text{ million} + 221.07 \text{ million} = 464.25 \text{ million}
\]

The present value of plan (ii) is:

\[
\frac{200 \text{ million}}{1.1} + \frac{200 \text{ million}}{1.1^2} + \frac{200 \text{ million}}{1.1^3} + \frac{200 \text{ million}}{1.1^4} = 181.82 \text{ million} + 165.29 \text{ million} + 150.26 \text{ million} + 136.60 \text{ million} = 633.97 \text{ million}
\]

So plan (i) is less expensive.

b. The present value of plan (i) is:

\[
\frac{267.5 \text{ million}}{1.8} + \frac{267.5 \text{ million}}{1.8^2} + \frac{148.61 \text{ million}}{1.8^3} + \frac{82.56 \text{ million}}{1.8^4} = 231.17 \text{ million}
\]

The present value of plan (ii) is:

\[
\frac{200 \text{ million}}{1.8} + \frac{200 \text{ million}}{1.8^2} + \frac{200 \text{ million}}{1.8^3} + \frac{200 \text{ million}}{1.8^4} = 111.11 \text{ million} + 61.73 \text{ million} + 34.29 \text{ million} + 19.05 \text{ million} = 226.18 \text{ million}
\]

Plan (ii) is now less expensive.
2. You have won the state lottery. There are two ways in which you can receive your prize. You can either have $1 million in cash now, or you can have $1.2 million that is paid out as follows: $300,000 now, $300,000 in one year’s time, $300,000 in two years’ time, and $300,000 in three years’ time. The interest rate is 20%. How would you prefer to receive your prize?

Solution

2. If you choose to get $1.2 million paid out over the next three years, the present value of those payments is:

\[
\frac{300,000}{1.2} + \frac{300,000}{1.2^2} + \frac{300,000}{1.2^3} = 250,000 + 208,333 + 173,611 = 931,944
\]

Since this is less than $1 million, you would prefer to get $1 million now instead of $1.2 million over four years.

3. The drug company Pfizer is considering whether to invest in the development of a new cancer drug. Development will require an initial investment of $10 million now; beginning one year from now, the drug will generate annual profits of $4 million for three years.

a. If the interest rate is 12%, should Pfizer invest in the development of the new drug? Why or why not?

b. If the interest rate is 8%, should Pfizer invest in the development of the new drug? Why or why not?

Solution

3. a. The net present value is:

\[
-10,000,000 + \frac{4,000,000}{1.12} + \frac{4,000,000}{1.12^2} + \frac{4,000,000}{1.12^3} = -392,675
\]

Since the net present value is negative, Pfizer should not invest in the development of this drug: it would be better off putting the $10 million into a bank account that pays 12% interest.

b. The net present value is:

\[
-10,000,000 + \frac{4,000,000}{1.08} + \frac{4,000,000}{1.08^2} + \frac{4,000,000}{1.08^3} = 308,387
\]

Since the net present value is positive, Pfizer should invest in the development of this drug: the return on its initial investment of $10 million would be better than what it could get if it put the $10 million into a bank account paying 8% interest.