Lesson 5: Investment, Time, and Capital Markets

Overview

Introduction to Lesson 5

In this lesson, we’ll discuss how individuals and firms make investments in durable items, commonly called capital. The following are key aspects regarding these types of investment. First, durable items get used repeatedly; their use value is important, more so than their purchase value. Second, acquiring most capital investment involves large sums of money, for which companies and individuals must borrow. Even if they buy with their own money, that money has opportunity cost. Third is the risk associated with this kind of investment. Once any large investment is made, it cannot be recovered if the project is stopped partway through. These kinds of problems do not arise when spending on variable costs such as hiring labour. As you work through Lesson 5, you will learn to distinguish between stock and flow variables.

Lesson 5 covers Chapter 15 of the textbook (pp. 559–584 and pp. 588–591). You will be directed to read certain portions at applicable points throughout the lesson.

*Note that you will not be responsible for material from pages 584 to 587.*

Lesson Objectives

After completing Lesson 5, you should be able to

1. describe the concept of stock and flow variables and explain its importance in making investment decisions.

2. explain the concept of present discounted value and how it is computed, and describe its application to capital investment decisions.

3. explain the different types of bonds and how to value them.

4. explain the concept of net present value criterion and how it is computed; describe the impact of discount rate on net present value and the use of net present value in decision making for different capital investment projects.

5. recognize different kinds of risks encountered in capital investment decisions and describe how different tools are used to deal with those risks.

6. describe how individuals make investment decisions.

7. recognize the process and problems of investment in human capital.
recognize that there are different possibilities for determining appropriate discount rates.

Objective 1: Stock and Flow

Required Reading

Read pages 560–561 of your textbook

Any production process involves factor inputs. Some factor inputs can be categorized as stock whereas others can be categorized as flows. For example, a farmer has land, buildings, a combine, and other equipment worth $3 million altogether. As these items are not expected to change during a relatively short period of time, they can be considered stock. On the other hand, the farmer is going to buy fuel, seed, and fertilizer, hire labour, as well as pay for irrigation and other utilities. He also produces wheat, barley, canola, and other agricultural products. As these inputs and output variables may change in a relatively short period of time, they can be considered flow variables.

When the farmer calculates his profit, he can easily find out the cost from these flow inputs and benefits or revenue from his flow outputs. Does this give him enough information to calculate his profit? The answer is no. He also has an opportunity cost for his land and capital worth $3 million. Imagine if he were to sell all his land and capital assets and deposit this $3 million in bank account or fixed deposit that can earn interest. Even with a low interest rate of 3%, he can earn $90,000. This is the opportunity cost of his capital assets.

In other words, by continuing his farming business, he is foregoing this amount, so this sum needs to be included in his profit calculation. A clear understanding of stock and flow variables is an opportunity to calculate actual return or profit and to make appropriate decisions.

Problem 5-1: Understanding Stock and Flow

Rick’s Feedlot Operation sits on 40 acres, where three barns and two feed preparation factories are located. The farm also has several pieces of heavy machinery. It raises 2,500 head of cattle, hires 25 labourers, and incurs approximately $23,000 worth of monthly feed costs. The farm’s annual gross return is approximately $1.8 million. What are the stock and flow variables for this farm? How might Rick’s Feedlot Operation take those into consideration for its production decisions?

Answer to Problem 5-1

The value of the land, three barns, factories, and heavy machinery are the stock
variables as those are not likely to change on a day-to-day basis. The cost of labour and other inputs, as well as gross revenue, are flow variables as those are likely to change from year to year. When making decisions, the farm should take into consideration the rental value of all stock variables and actual value of all flow variables.

**Objective 2: Present Discounted Value**

**Required Reading**

Read pages 561–564 of your textbook, including Example 15.1

Every capital item depreciates. A car you bought this year will be worth less next year. A textbook you bought this semester will lose its value next semester. How much value is lost? After a certain amount of time, how much is your capital going to be worth? The process of discounting will answer that question. Perhaps you will receive an amount in the future and would like to know how much that amount is currently worth. Or perhaps you may receive a stream of payments—how much is that currently worth? We need discounting to answer these questions too. Suppose you will need $400 to buy a textbook next year. How much do you need to set aside today to have $400 next year, assuming that the fund you set aside will earn interest of 7%? Discounting is the process of determining the present value, PV, of a future sum of money S if compounded annually.

\[
S = PV(1+i)^t \quad \text{Or} \quad PV = S \left( \frac{1}{1+i} \right)^t
\]

With multiple compounding in a year, \[
PV = S \left( \frac{1}{1+i/m} \right)^{mt}
\]

**Problem 5-2: Computing Present Discounted Value**

You will receive a sum of $500, 5 years from now from an investment. How much is that worth now with a 10% discount rate compounded four times a year?

**Answer to Problem 5-2**

We can use the multiple compounding formula above to find out.

\[
PV = 500 \times \left( \frac{1}{1 + \frac{0.1}{4}} \right)^{4*5} = 305.14
\]

The amount of a present discounted value depends on the principal, the discount rate,
and the total duration of discounting. As the formula states, the present value is directly proportional to the principal, and inversely proportional to discount rate and period of discounting. Table 5-1 shows present discounted values of $100 for different years and with different discount rates.

### Table 5-1: Present Value of $100 paid after 1, 2, 5, 10, 20, and 30 Years at Various Discount Rates

<table>
<thead>
<tr>
<th>Discount Rate</th>
<th>1 Year</th>
<th>2 Years</th>
<th>5 Years</th>
<th>10 Years</th>
<th>20 Years</th>
<th>30 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00%</td>
<td>99.01</td>
<td>98.03</td>
<td>95.15</td>
<td>90.53</td>
<td>81.95</td>
<td>74.19</td>
</tr>
<tr>
<td>2.00%</td>
<td>98.04</td>
<td>96.12</td>
<td>90.57</td>
<td>82.03</td>
<td>67.30</td>
<td>55.21</td>
</tr>
<tr>
<td>3.00%</td>
<td>97.09</td>
<td>94.26</td>
<td>86.26</td>
<td>74.41</td>
<td>55.37</td>
<td>41.20</td>
</tr>
<tr>
<td>4.00%</td>
<td>96.15</td>
<td>92.46</td>
<td>82.19</td>
<td>67.56</td>
<td>45.64</td>
<td>30.83</td>
</tr>
<tr>
<td>5.00%</td>
<td>95.24</td>
<td>90.70</td>
<td>78.35</td>
<td>61.39</td>
<td>37.69</td>
<td>23.14</td>
</tr>
<tr>
<td>6.00%</td>
<td>94.34</td>
<td>89.00</td>
<td>74.73</td>
<td>55.84</td>
<td>31.18</td>
<td>17.41</td>
</tr>
<tr>
<td>7.00%</td>
<td>93.46</td>
<td>87.34</td>
<td>71.30</td>
<td>50.83</td>
<td>25.84</td>
<td>13.14</td>
</tr>
<tr>
<td>8.00%</td>
<td>92.59</td>
<td>85.73</td>
<td>68.06</td>
<td>46.32</td>
<td>21.45</td>
<td>9.94</td>
</tr>
<tr>
<td>9.00%</td>
<td>91.74</td>
<td>84.17</td>
<td>64.99</td>
<td>42.24</td>
<td>17.84</td>
<td>7.54</td>
</tr>
<tr>
<td>10.00%</td>
<td>90.91</td>
<td>82.64</td>
<td>62.09</td>
<td>38.55</td>
<td>14.86</td>
<td>5.73</td>
</tr>
</tbody>
</table>

### 5.2.1 Present Value of a Stream of Cash Flow

We have calculated the present value of one-time payment. In many cases, we make an initial investment and then receive periodic payments. Let’s determine the present value of such situations and how this information is used for investment decisions. Suppose you invest $1,000, which will give you interest of $80 each of the following 5 years and then return you the principal $1,000 at the end of the 5th year. The interest rate remains constant at 10% for the next 5 years. What is the present value of your investment? Was it rational to go forward with this investment?

The present value of this stream of payment:

$$ PV = \frac{80}{1.1} + \frac{80}{(1.1)^2} + \frac{80}{(1.1)^3} + \frac{1080}{(1.1)^4} = 72.73 + 66.12 + 60.11 + 54.64 + 670.60 = 924.18 $$

So, the general formula for computing the present discounted value of a series of payments can be expressed as:

$$ PV = \frac{S_1}{(1+i)^1} + \frac{S_2}{(1+i)^2} + \ldots + \frac{S_n}{(1+i)^n} $$

The formula is also applicable if the interest rate differs from one year to the next.
Problem 5-3: Calculating Present Discounted Value of a Stream of Payments

You invested $1,000, which will give you interest of $100 each of the following 5 years and then return the principal $1,000 at the end of the 5th year. You expect the discount rate for the first 2 years to be 10%, the next 2 years to be 8%, and the last year to be 9%. Calculate the present discounted value of this stream of payments.

Answer to Problem 5-3

In this case, the interest rates are different at different years, so we have to use different interest rates. The basic formula remains the same.

$$PV = \frac{100}{1.1} + \frac{100}{(1.1)^2} + \frac{100}{(1.08)^2} + \frac{100}{(1.08)^3} + \frac{1100}{(1.09)^5} = 90.91 + 92.64 + 79.38 + 73.50 + 714.92 = 1041.36$$

Example 15.1: The Value of Lost Earnings (textbook, pp 563–564) provides another illustration of present discounted value.

Objective 3: The Value of a Bond

Required Reading

Read pages 564–569 of your textbook, including Example 15.2

A bond is a contract between a borrower and a lender. A borrower (often a large corporation or a government) sells bonds to lenders at particular prices, and in return, receives a periodic interest payment (often called coupon payment if the interest rate is fixed for the period) and at the end, the principal. Since bonds are commonly issued by governments or large corporate businesses, the risks associated with buying bonds are relatively low and as such returns are also low.

The present value of stream of payments from a bond can be expressed as:

$$PV = \frac{P_1}{(1+i)} + \frac{P_2}{(1+i)^2} + ... + \frac{P_n}{(1+i)^n}, \text{ where } P \text{ denotes payment and } i \text{ denotes interest (discount rate)}$$

Problem 5-4: Value of a Bond

Suppose you bought a bond with $100 that will pay $10 for each of the next 10 years and at the end you get your principal $100 back as well. How much is the bond worth if the discount rate is 2%? How much if the discount rate is 5%? How much if the discount rate is 10%?
Answer to Problem 5-4
The present value for each year, with respective discount rates, is presented in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>110</td>
</tr>
<tr>
<td>PV (2%)</td>
<td>9.80</td>
<td>9.61</td>
<td>9.42</td>
<td>9.24</td>
<td>9.06</td>
<td>8.88</td>
<td>8.71</td>
<td>8.53</td>
<td>8.37</td>
<td>90.24</td>
<td>171.86</td>
</tr>
<tr>
<td>PV (5%)</td>
<td>9.52</td>
<td>9.07</td>
<td>8.64</td>
<td>8.23</td>
<td>7.84</td>
<td>7.46</td>
<td>7.11</td>
<td>6.77</td>
<td>6.45</td>
<td>67.53</td>
<td>138.61</td>
</tr>
<tr>
<td>PV (10%)</td>
<td>9.09</td>
<td>8.26</td>
<td>7.51</td>
<td>6.83</td>
<td>6.21</td>
<td>5.64</td>
<td>5.13</td>
<td>4.67</td>
<td>4.24</td>
<td>42.41</td>
<td>100.00</td>
</tr>
</tbody>
</table>

We notice from the problem above, the value of a bond decreases as discount rate increases and vice versa. This can be depicted in the Figure 5-1.

**Figure 5-1: Inverse Relationships Between Value of a Bond and Interest Rate**

5.3.1 Perpetuity

Bonds can be of a short term or long term. Short-term bonds typically have a life of few years. Long-term bonds, on the other hand, may have long life such as 20, 30, or even 50 years. Some bonds yield a fixed amount of payment forever, called perpetuity. In the case of a perpetuity,

\[ PV = \frac{P_1}{(1+i)} + \frac{P_2}{(1+i)^2} + \frac{P_3}{(1+i)^3} + \ldots \]  

This can go forever. The simplified form of this equation is

\[ PV = \frac{P}{i} \]

At 2% discount rate, the present value of a perpetuity a perpetuity of $10 is \( \frac{10}{0.02} = 500.00 \). Similarly, the present value of a perpetuity of $10 if the discount rate is 5% is \( \frac{10}{0.05} = 200.00 \).
5.3.2 Effective Yield on a Bond

Bonds are typically bought and sold in the open market and as such their prices vary depending on supply and demand. Although the primary supply of bonds depends on bond issuers, the actual market for bonds is competitive due to large number of suppliers (issuers and many bondholders’ willing to sell) and demanders. So, the interest rate on bonds (sometimes called a coupon) is the price of giving out bonds, and is determined by the market. Thus, to compare with other investment opportunities, we need to understand the actual value of the bond, effective yield (sometimes called rate of return) which is the percentage return from investing in bonds.

Calculating effective yield is simple for perpetuities. Suppose you invest $2,000 that will give you $200 each year for an indefinite period. Your return (or effective yield) would be $200/2000 = 0.1 or 10%. Calculating effective yield of bond for a stream of return is mathematically complicated, but conceptually simple. We know the present value of a bond is \[ PV = \frac{P_1}{(1+i)^1} + \frac{P_2}{(1+i)^2} + \cdots + \frac{P_n}{(1+i)^n}. \] If the \( PV \) and the price of the bond \( P \) are known, then we should be able to calculate \( i \) as \( i \) is the only unknown in the equation. The computation, however, is not going to be simple. One can use spreadsheet to find an approximation.