2 The concept of net present value

Companies invest in a variety of real assets. These include tangible assets such as plant and machinery and intangible assets such as management contracts and patents. The object of the investment, or capital budgeting, decision is to find real assets which are worth more than they cost. In this chapter we will show what this objective means in a country with extensive and well-functioning capital markets. At the same time we will take the first, most basic steps toward understanding how assets are valued. It turns out that if there is a good market for an asset, its value is exactly the same as the market price.

There are a few cases in which it is not that difficult to estimate asset values. In real estate, for example, you can hire a professional appraiser to do it for you. Suppose you own an apartment building. The odds are that your appraiser’s estimate of its value will be within a few percent of what the building would actually sell for. After all, there is continuous activity in the real estate market, and the appraiser’s stock-in-trade is knowledge of the prices at which similar properties have recently changed hands.

Thus the problem of valuing real estate is simplified by the existence of an active market in which all kinds of properties are bought and sold. For many purposes no formal theory of value is needed. We can take the market’s word for it.

But we have to go deeper than that. First, it is important to know how asset values are reached in an active market. Even if you can take the appraiser’s word for it, it is important to understand why that apartment building is worth, say, $250,000 and not a higher or lower figure. Second, the market for most corporate assets is pretty thin. Look in the classified advertisements in the Wall Street Journal: it is not often that you see a blast furnace for sale.

It is easy to think of cases in which you need to make your own estimate of value. For instance, some real assets are inseparable from the firms that hold them. One reason for IBM’s success has been its effective marketing organization. That organization is an extremely valuable asset, but it is hard to imagine IBM auctioning it off, for it is worth more to IBM than to any prospective buyer. The organization can be evaluated only as part of IBM.

Companies are always searching for assets that are worth more to them than to others. That apartment house is worth more to you if you can manage it better than others. But in that case, looking at the price of similar buildings will not tell you what your apartment house is worth under your management. For that you need a theory of value.

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1 Needless to say, there are some kinds of properties that appraisers find really difficult to value—for example, nobody knows for how much you could sell the Taj Mahal or the Parthenon or the Eiffel Tower. But we assume that our apartment building is a very standard property.
2-1 Introduction to present value

Later in this chapter we will prove why the concept of present value is useful. However, that concept will go down more easily if we first acquire an intuitive understanding of it.

Suppose your apartment house burns down, leaving you with a vacant lot worth $50,000 and a check for $200,000 from the fire insurance company. You consider rebuilding, but your real estate adviser suggests putting up an office building instead. The construction cost would be $300,000, and there would also be the cost of the land, which might otherwise be sold for $50,000. On the other hand, your adviser foresees a shortage of office space and predicts that a year from now the new building would fetch $400,000 if you sold it. Thus you would be investing $350,000 now in the expectation of realizing $400,000 a year hence. You should go ahead if the present value of the expected $400,000 payoff is greater than the investment of $350,000. Therefore, you need to ask yourself, “What is the value today of $400,000 1 year from now, and is that present value greater than $350,000?”

Calculating present value

The present value of $400,000 1 year from now must be less than $400,000. The reason for this is summed up by the following principle: A dollar today is worth more than a dollar tomorrow, because the dollar today can be invested to start earning interest immediately.

Thus, the present value of a delayed payoff may be found by multiplying the payoff by a discount factor which is less than 1. (If the discount factor were more than 1, a dollar today would be worth less than a dollar tomorrow.) If $C_1$ denotes the expected payoff at time period 1 (1 year hence), then

\[
\text{Present value (PV)} = \text{discount factor} \times C_1
\]

This discount factor is expressed as the reciprocal of 1 plus a rate of return:

\[
\text{Discount factor} = \frac{1}{1 + r}
\]

The rate of return $r$ is the reward that investors demand for accepting delayed payment.

Let us consider the real estate investment, assuming for the moment that the $400,000 payoff is a sure thing. The office building is not the only way to obtain $400,000 a year from now. You could invest in United States government securities maturing in a year. Suppose these securities yield 7 percent interest. How much would you have to invest in them in order to receive $400,000 at the end of the year? That is an easy question. You would have to invest $400,000/1.07, which is $373,832. Therefore at an interest rate of 7 percent, the present value of $400,000 1 year from now is $373,832.

Let’s assume, as soon as you’ve committed the land and begun construction on the building, you decide to sell your project. How much could you sell it for? That’s another easy question. Since the property produces $400,000, investors would be willing to pay $373,832 for it. That’s what it would cost them to make $400,000 from investing in government securities. Of course you could always sell your property for less, but why sell for less than the market will bear? The $373,832 present value is the only feasible price that satisfies both buyer and seller. Therefore, the present value of the property is also its market price.
To calculate present value, we discount expected future payoffs by the rate of return offered by comparable investment alternatives. This rate of return is often referred to as the discount rate, hurdle rate, or opportunity cost of capital. It is called the opportunity cost because it is the return forgone by investing in the project rather than investing in securities. In our example the opportunity cost was 7 percent. Present value was obtained by dividing $400,000 by 1.07:

\[ PV = \text{discount factor} \times C_1 = \frac{1}{1 + r} C_1 = \frac{400,000}{1.07} = 373,832 \]

**Net present value**

The building is worth $373,832, but this does not mean that you are $373,832 better off. You committed $350,000, and therefore your net present value is $23,832. Net present value (NPV) is found by subtracting the required investment:

\[ \text{NPV} = \text{PV} - \text{required investment} = 373,832 - 350,000 = 23,832 \]

In other words, your office development is worth more than it costs—it makes a net contribution to value. The formula for calculating NPV can simply be written as

\[ \text{NPV} = C_0 + \frac{C_1}{1 + r} \]

remembering that \( C_0 \), the cash flow at time period 0 (that is, today) will usually be a negative number. In other words, \( C_0 \) is an investment and therefore a cash outflow. In our example, \( C_0 = -350,000 \).

**A comment on risk and present value**

We made one unrealistic assumption in our discussion of the office development: Your real estate adviser cannot be certain about future values of office buildings. The $400,000 figure represents the best forecast, but it is not a sure thing.

Therefore, our conclusion about how much investors would pay for the building is wrong. Since they could achieve $400,000 with certainty by buying $373,832 worth of United States government securities, they would not buy your building for that amount. You would have to cut your asking price in order to attract investors' interest.

Here we can invoke a second basic financial principle: A safe dollar is worth more than a risky one. Most investors avoid risk when they can do so without sacrificing return. However, the concepts of present value and the opportunity cost of capital still make sense for risky investments. It is still proper to discount the payoff by the rate of return offered by a comparable investment. But we have to think of expected payoffs and the expected rates of return on other investments.

Not all investments are equally risky. The office development is riskier than a government security but is probably less risky than drilling a wildcat oil well. Suppose you believe the project is about as risky as investment in the stock market and that you forecast a 12 percent rate of return for stock...
market investments. Then 12 percent becomes the appropriate opportunity cost of capital. That is what you are giving up by not investing in comparable securities. You can now recalculate net present value:

\[
PV = \frac{400,000}{1.12} = 357,143
\]

\[
NPV = PV - 350,000 = 7,143
\]

If other investors agree with your forecast of a $400,000 payoff and with your assessment of a 12 percent opportunity cost of capital, then your property ought to be worth $357,143 once construction is under way. If you tried to sell it for more than that, there would be no takers, because the property would then offer an expected rate of return lower than the 12 percent available in the stock market. The office building still makes a net contribution to value, but it is much smaller than our earlier calculations indicated.

In Chapter 1 we said that the financial manager must be concerned with time and uncertainty and their effects on value. This is clearly so in our example. The $400,000 payoff would be worth exactly that if it could be realized instantaneously. If the office building is as risk-free as government securities, the 1-year delay reduces value to $373,832. If the office building is as risky as investment in the stock market, then uncertainty reduces value by a further $16,689 to $357,143.

Unfortunately, adjusting asset values for time and uncertainty is often more complicated than our example suggests. Therefore, we will take the two effects separately. For the most part, we will dodge the problem of risk in Chapters 2 through 6, either treating all payoffs as if they were known with certainty or talking about expected cash flows and expected rates of return without worrying how risk is defined or measured. Then in Chapter 7 we will turn to the problem of understanding how capital markets cope with risk.