Introduction to Finance

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Chapter 9 *Business Investment*

"Being good in business is the most fascinating kind of art … Making money is art and working is art and good business is the best art." – *Andy Warhol* [1](1928-87)

[1] In Andy Warhol (U.S. pop artist), *From A to B and Back Again* (1975).

In Chapter Nine You Will Learn:

1. **What are the pitfalls and limitations of business investment analysis?**
2. **What are the components of NPV?**
3. **How do you calculate the cost of capital with the weighted average cost of capital?**
4. **What are the characteristics of a typical business investment?**
5. **For a typical business investment, can you show that NPV, benchmarked payback-period, benchmarked IRR, and the value to expenditure ratios (either for assets or equity), lead to the same investment decision?**
6. **In which business investment cases must we use IRR with care?**
7. **How do you include inflation forecasts in business investment analysis?**
8. **To what extent are depreciation tax-shields an important component of the business investment decision?**

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(9.1) Introduction

Business Investment Analysis, which is also known as *Capital Expenditure Analysis*, *Real Asset Investment Analysis* or *Capital Budgeting*, is an investigation of the merits of long-term business investments. A number of different criteria have been proposed and developed in the financial literature for the selection and evaluation of business investments. Each criterion has advantages and disadvantages, which we examine and study in this chapter.

Assessing business investments is an important exercise for any business. The particular criterion your firm uses is probably less important than the planning effort itself. In planning for business investments, you learn a great deal about the venture you undertake. If this planning is not done, these lessons are not learnt and mistakes can be made.

(9.2) Pitfalls of Business Investment Analysis

The first limitation of business investment analysis is the prediction of future cash flows. Because, as we will see more formally later, these cash flows typically depend upon revenues (or cost reductions), realized cash flows can vary tremendously from forecasts. The fact that predictions are difficult to make does not mean that business investment analysis should be abandoned. In the process of undertaking the analysis, you learn a great deal about your investment and you are likely to uncover ways to increase cash flows and/or reduce their variability. An investment is not static but a dynamic set of decisions that require continuous learning. As you plan and learn, you will better direct the course of your investment.

A second pitfall of business investment analysis is its quantitative nature. Placing a dollar value on future benefits has a way of suggesting exactness/certainty that probably does not exist in your business environment. For this reason, it is important to highlight the possible crudeness of your predictions with a "scenario analysis" for critical forecasts. For example, you might consider the worthiness of an investment based upon "optimistic," "most likely," and "pessimistic" sales forecasts. This "sensitivity" analysis in your investigation highlights the risk of your business

venture. In addition, in many business environments, intangible and qualitative factors are as important in the ultimate decision as are quantitative factors. Make sure that the quantitative nature of your investigation does not mislead the decision-maker. Qualitative as well as quantitative factors should be fully presented and considered.

A third pitfall is that cash flow predictions have a way of being overly optimistic. Any investment in an organization has a "champion." Wittingly or unwittingly, an investment champion, in order to see his/her investment accepted, can exaggerate the prospects for future benefits. Because these benefits may not be realized for many years, it is difficult in retrospect to discipline an investment champion for exaggerated claims. It is also difficult to ascertain whether original assumptions were unrealistic or whether the business environment unpredictably became less attractive than anticipated. The best defensive against the "investment champion problem" is due diligence in the evaluation of investment proposals. Careful questioning of the champion on critical assumptions will ensure a realistic presentation. The capital budgeting techniques in this chapter are critical for developing the theoretical background necessary against which investment proposals can be evaluated. The financial ratios that we investigated in Chapter 2 of this book are also invaluable for assessing the reasonableness of assumptions in business investment analysis. For example, if the new investment is an expansion of an existing business, then financial ratios for the expansion should bear a close resemblance to the financial ratios of the firm as a whole. If there is a divergence between the two, discrepancies should be explained and justified. If the contribution margin for the firm as a whole is 20% but an investment champion suggests a contribution margin of 40% for a new product, then this discrepancy requires explanation. The trade capital to sales ratio gives an indication of incremental required trade capital investment arising from predicted sales increases for a new business. The invested capital turnover ratio gives an indication of incremental invested capital required to support future predicted sales. The EBITDA margin gives an indication of expected profitability for a new venture. Benchmarking new ventures with your firm's exiting operations is a helpful way to assure realistic assumptions in the analysis.

A fourth pitfall of business investment analysis is that it is occasionally used in organizations to justify a decision that has already been made for internal or external political reasons. In your analysis, if you are required to rationalize a decision that has already been made, don't lose heart. The investigation process is equally if not more important than is the ultimate decision. In the process of gathering required information for your analysis, you will learn a great deal about the characteristics of both your firm and the new venture. Searching out this required information from various individuals in your firm will be a learning experience in itself. This search can be a good way to showcase your talents as a financial analyst. The knowledge and understanding you acquire from your analysis will allow you to better direct the course of the investment. An investment requires a sequence of decisions and managerial controls. You may not be able change the decision on the venture, but you should be able to contribute to its successful implementation and development once started. Take advantage of your opportunities.

Fifth, companies grow but a typical business investment does not. A typical business investment has two features: there is no expectation that the investment will end at any fixed future date and there is no expectation that cash flows will grow. Cash flows might unexpectedly increase or decrease, but we do not expect these changes in the first instance. For example, we would not expect the cash flows of an individual location of Tim Hortons to grow. A Tims Hortons outlet is constrained by space. There is a limit to the number of cups of coffee and donuts that we can sell with that space. The reason that the Tim Hortons company grows is because they add locations. So, while we consider exceptions, you can think of Chapter 9 as primarily about a business investment that is the equivalent of one Tim Hortons location. On the other hand, in Chapter 10, our focus is on companies that grow.

(9.3) NPV and Business Investment

Suppose that your boss asks you to prepare a report on a proposed new business investment. You must decide whether this is a "good" investment and recommend it or not. One way to answer this question is to calculate the NPV of the business investment. Remember that you can interpret NPV as wealth creation for financial asset-holders of the firm and shareholders in particular (because they get the major benefit of the new business investment). If NPV is greater than or

equal to zero, then the business investment creates wealth for these groups and should, consequently, be undertaken by business managers who aim to maximize shareholder wealth.

The first thing that we do in this chapter is to illustrate with the aid of an example how to apply our theory of value (Discounted Cash Flow or, equivalently, Net Present Value) to business investments.

NPV

In this section, we discuss the application of our theory of value, NPV, to business investments. First, we discuss this application in general terms. Second, we illustrate the application of our theory of value, NPV, with a numerical example. In upcoming sections, we describe and investigate three alternatives to NPV for business investment analysis: the payback period, the internal rate of return (IRR), and the accounting rate of return (ARR). For a typical business investment, we show that these alternative investment criteria lead to the same investment decision as NPV.

Business Investment Analysis Intro: 10 Minutes

The application of our theory of value to any investment requires two principal elements: the forecast cash flows and the opportunity cost for discounting these future cash flows.

Let us briefly begin with the second element, the opportunity cost or, equivalently, the discount rate for business investment analysis. The opportunity cost for business investment analysis is called the *Cost of Capital*. In section 9.4 we illustrate a methodology to calculate a firm's cost of capital called the *Weighted Average Cost of Capital* (WACC).

Second, the cash flows that we discount for business investments are incremental predicted future *Free Cash Flow* (FCF) with the operating definition of FCF that we developed in Chapter 2 of this book. "Incremental" means the increase in a firm's FCF that arises from undertaking the business investment under consideration. The "numerator" of discounted cash flow analysis for business investment analysis is incremental future predicted FCF.

Let the symbol Δ indicate the change in a financial measure arising because a firm underrates a new business investment. For example, FCF is the Free Cash Flow of a firm before a new business investment. On the other hand, ΔFCF is the increase in a firm's FCF that occurs as the result of a new business investment. The impact of a new business investment on a firm's FCF is:

$$\Delta FCF = \Delta FFO - \Delta IC$$

Recall that IC is an acronym for Invested Capital, which measures business expenditure for a firm. Thus, ΔIC is the increment to business expenditure to undertake a new business investment. Further, firms commonly make two types of business investments: short-term trade capital (TC) to support the firm's trading function (primarily sales) and long-term depreciable asset investment measured by Net Fixed Assets (NFA). So, IC=TC+NFA. Incremental investment for a new business investment is incremental TC capital plus incremental NFA, which is capital expenditure (CAPX). So, $\Delta IC = \Delta TC + \Delta NFA = \Delta TC + CAPX$.

In addition, recall that the acronym FFO represents Funds From Operations, which is the fundamental benefit of business investment to a firm. So, ΔFFO is the increment to a firm's FFO as the result of a new business investment.

More specifically with the "top-down" calculation for FFO:

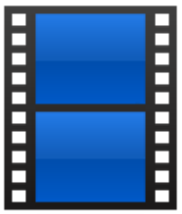
$$\Delta FFO = [\Delta EBITDA - \Delta CCA] \times (1 - tax\ rate) + \Delta CCA$$

Let us consider an example of business investment analysis for a typical business investment. In this example we will presume that the firm makes only one business investment. This is not typical of most companies, but it will simplify our analysis. Further, we will presume that the one business investment that this company makes does not grow.

Typical Business Investments (non-growing): 3 Minutes

Example of Business Investment Analysis

ABC Co. Limited of Coquitlam, British Columbia has just started their business. Nonetheless, their shares trade on the Toronto stock exchange. Their business investment is comprised of **$1,100,000** of depreciable assets and **$200,000** of trade capital assets. Based on their best estimates, ABC predicts per annum revenues of **$1,500,000**. They expect a contribution margin of **20%** and fixed operating costs of **$50,000** per annum. They expect no revenue growth. ABC is a non-growing firm, and therefore, they have no retention for the purpose of reinvestment. Dividends, year after year, into the indefinite future, are expected to be equal to ABC's net income. The corporate tax rate is **40%**. ABC has financed their investment of **$1,300,000** with long term bonds and with common equity. Coupons are paid annually and the next and upcoming coupon is in exactly one year. The par value on the bonds is **$950,000** and both the coupon rate and the yield are **6%** per annum (compounded once per year). The average rate of return for shares of approximately the same risk as those of ABC is about **10%**. ABC has **100,000** shares outstanding. Economic depreciation, depreciation for reporting, depreciation for tax, and maintenance capital expenditures all equal **4%** of net fixed assets (NFA) per annum. Maintenance capital expenditures maintain the quality of depreciable assets and prevent economic depreciation.



What is Economic Depreciation and Maintenance Capital Expenditures?

Required:

(i) What is the payback period on ABC's operating investment?

PDF **Solution**	**13 Minutes**

(ii) Find the rate of return on invested capital (after tax and after depreciation).

PDF **Solution**	**2 Minutes**

(iii) What is your best estimate of the value of a share in ABC?

Solution	**6 Minutes**

(iv) What is ABC's weighted average cost of capital?

Solution	**4 Minutes**

(v) What is the NPV of ABC's business investment?

Solution	**5 Minutes**

(vi) Is this a "good" investment?

Solution	**13 Minutes**

As you might have guessed, this is a final exam question that I asked students in the past and, therefore, there are a number of required questions that they answered and that we will now investigate together. If you want to review the answers before-hand, they are given in the embedded document entitled "Solution."

We presume that four financial measures related to depreciation are all equal to one another and have a rate of 4% per annum. In particular:

Economic Depreciation
= Financial Statement Depreciation
= Depreciation for Taxes
= Maintenance Capital Expenditure (MCAPX)

You might ask what we would do in the business world if these four amounts were not equal to one another? The answer is that our analysis would be a little more involved, but not much. You can think of this example as a close approximation to the actual business world. Further, there is so much variability in forecast amounts, cash flows, compared to realized amounts, that this presumption is unlikely to be the cause of the unexpected failure of an accepted investment. Other business investment features, like, for example, sales targets that are not achieved, are much more likely to be the source of this failure. Worry about the "big" stuff and forget the "little" stuff as inconsequential.

Economic depreciation is the reduced ability of a business investment to sustain cash flow. For example, you might own an apartment building and rent the units to tenants. If you do not periodically replace the appliances when they break, if you do not replace the roof when it begins to leak, if you do not replace the carpets when they become soiled, you will become a "slum landlord." Your tenants will leave or they will require reduced rents. In either case, the revenues

on your investment will fall. This fall decreases FCF, which is economic depreciation. However, if the investment was "good" in the first instance and if repairs/replacement of depreciable assets are a "mini" version of the original investment, they are "good" investments as well.[2] So, Maintenance Capital Expenditures (MCAPX) are periodic capital expenditures (replacement of appliances, replacement of the roof, replacement of carpets) to "maintain" the quality of an investment to prevent economic depreciation. In our example, the forecast of per annum maintenance capital expenditures equals our forecast of economic depreciation, which is 4% per year of beginning of period NFA, which is $1,100,000. So, MCAPX=0.04*1,100,000 =$44,000/annum.

Firms generally have two types of capital expenditures: capital expenditures to maintain existing assets, MCAPX, and growth capital expenditures (GCAPX). Since the firm in our problem does not grow, it makes no growth capital expenditures.

Financial statement depreciation is an estimate by accountants of future per annum maintenance capital expenditures to offset economic depreciation. In Canada, Capital cost allowance (CCA) is the corporate tax deduction that the government allows for depreciation for tax purposes. In our example, financial statement depreciation (DEPREC) is DEPREC=0.04*1,100,000=$44,000. CCA is CCA=0.04*1,100,000=$44,000. While both financial statement depreciation and CCA forecast future maintenance capital expenditures per annum, in both cases, they are non-cash charges. On the other hand, MCAPX is a real dollar investment to offset economic depreciation. At the end of the year, ABC takes a depreciation charge of DEPREC=$44,000. Also at the end of the year, ABC makes (or at least is forecast to make) a MCAPX=$44,000. On the ABC's balance sheet, NFA falls by $44,000 due to DEPREC, but increases by $44,000 due to MCAPX. Because we expect no growth CAPX, we expect NFA to be $1,100,000 indefinitely in the future.

[2] We could prove this proposition, but we won't.

In the first instance, ABC makes a TC investment of $200,000 and a depreciable asset investment of $1,100,000 to start the business. They finance this business investment with debt of $950,000 and equity of $350,000. So, at the start of this business, the IC balance sheet for ABC is:

Invested Capital Balance Sheet

Trade Capital	200,000	Bonds	950,000
Net Fixed Assets	1,100,000	Equity	350,000
IC	1,300,000	IC	1,300,000

The initial TC investment is necessary to get this business going. We will be increasing sales from zero to $2,500,000 (forecast) and, thus, we need TC to support these sales (inventory and accounts receivable principally). However, we do not expect sales to grow thereafter and, therefore, our best prediction is we need not increment TC after the first instance: $\Delta TC=0$. Also in the first instance, ABC makes a depreciable asset investment of $1,100,000 to start the business. However, thereafter, because this investment does not grow, CAPX is only MCAPX and not GCAPX in addition. So, after the first instance, CAPX=MCAPX=$44,000.

Our forecast for incremental EBITDA for ABC as the result of this business expenditure is:

$$\Delta EBITDA=[CM/S]*\Delta SALES-\Delta FC=0.2*1{,}500{,}000-50{,}000=\$250{,}000$$

For a non-growing business investment, like ABC,

$$\Delta FCF=\Delta FFO-\Delta TC-MCAPX$$

$$=[\Delta EBITDA-\Delta CCA]\times(1-\text{tax rate})+\Delta CCA-\Delta TC-MCAPX$$

$$=[250{,}000-44{,}000]\times 0.6+44{,}000-0-44{,}000=\$123{,}600/\text{annum}$$

So, we now know that as the result of a $1,300,000 IC investment, the net benefit to ABC is forecast to be ΔFCF =$123,600 per year.

Next, to calculate NPV, so that we can determine whether this is a good investment, we need the cost of capital as a discount rate for business investment analysis. Part (v) of our sample final exam question above is to calculate ABC's WACC. However, before we get to this part of the sample problem, let me give you the answer: WACC=6.7% per annum. When, eventually, we come back to this part of the sample final exam question, we will verify that this value is correct.

For any business investment,

$$\text{NPV}=\text{PV}-\Delta\text{IC}$$

where PV is the present value of prediction future incremental FCF. For a non-growing investment, PV has a particularly simple form: an ordinary perpetuity,

$$\text{NPV}=\frac{\Delta FCF}{WACC}-\Delta\text{IC}=\frac{123,600}{0.067}-1,300,000=\$544,776.12>0$$

Because NPV>0, the investment creates wealth for financial asset-holders and shareholders in particular, which indicates that it is a "good" investment and should be undertake by business managers aiming to increase shareholders' wealth. So, we have an affirmative answer to the question we originally posed: this is a "good" investment. We have answered parts (vi) and (vii) of our sample final example question above. We will answer the first five parts, (i)-(v) as we proceed through the remainder of this chapter.

(9.4) Weighted Average Cost of Capital (WACC)

The opportunity cost rate of return for business investment analysis is called the *Cost of Capital*. In this section we describe a methodology to calculate a firm's Cost of Capital called the *Weighted Average Cost of Capital* (WACC). WACC is a weighted average of the opportunity costs of all of the financial assets of a firm that, miraculously, produces an opportunity cost for

the business investments of a firm. This methodology is miraculous because the business investments of a firm do not trade in organized markets and, therefore, the cost of capital is not directly observable. WACC is an indirect way to calculate a firm's cost of capital from opportunity costs for the financial assets of a firm. Because financial assets trade in organized markets, the opportunity costs for financial assets are either directly observable or relatively easy to calculate/estimate with financial market trading information.

The WACC is,

$$WACC = (1\text{-}t)*r_D * \frac{MVD}{MVD + MVE} + MCR * \frac{MVE}{MVD+MVE}$$

where, r_D is the expected rate on debt (the yield bonds, for example), *t* is the corporate tax rate, MCR is the market capitalization rate on common equity, MVE is the market value of equity (that is, market cap), MVD is the market value of debt, and the sum of MVD and MVE, MVD+MVE is the market value of asset (also known as "enterprise value").

The weights in the WACC are the fractions of the firm, which are capitalized by each of its financial assets, respectively, using *market value weights*. The weight on debt is the debt to asset ratio with market values for both debt and assets. The weight on equity is the equity to asset ratio with market values for both equity and assets. An *after corporate tax* discount rate is used for debt because interest is tax deductible for a firm, and therefore, is "less costly" than is equity (recall that dividends are not tax deductible for a firm). The after corporate tax discount rate for bonds is the yield to maturity times one minus the tax rate. The discount rate for equity is the market capitalization rate.

We can calculate the WACC for either a public firm or a private firm. However, the calculation is easier for a public firm because more financial information is available for public firms. In particular, market values for debt and equity are observable from financial markets so that the weights of the WACC, the debt to asset ratio and the equity to asset ratio with market values, are

easily calculated. For a private firm, the market value weights must be estimated with other methods.

As an illustration of WACC, let us return to the sample final example question of section 9.3. To calculate WACC for ABC Company Limited, a public firm, we need the market value balance sheet that gives use MVD, MVE and MVD+MVE=MVA (market value of assets, or, sometimes called Enterprise Value).

The market value and the book value (par value) of ABC's debt equal one another because the coupon rate on bonds equals the yield to maturity. So MVD=Par Value = $950,000.

Second, let us apply the discounted dividend model to find the market value of ABC's equity. Normally, this calculation is not necessary for a public firm because MVE = $(\#\,shares)*(share\ price)$, but in this question we have not been given share price so we have to find it. Recall that ABC Company Limited is a non-growing company. It has only one business investment that does not grow. So, ABC has a payout ratio of 1 and a retention ratio of 0. ABC pays all earnings as dividends. Now find forecast per annum earnings (NI),

$$\Delta\text{NI} = [\Delta EBITDA - \Delta\text{INTEREST-}\Delta\text{DEPREC}]\times(1 - tax\ rate)$$

$$=0.6*(250{,}000\text{-}57{,}000\text{-}44{,}000)=89{,}400.$$

The $57,000 in per annum $interest comes from a 6% coupon rate on par value of $950,000, ΔINTEREST=0.06*950,000=$57,000. Because ABC Company Limited has a payout ratio of one,

$$MVE = \frac{DIVIDENDS}{MCR} = \frac{89{,}400}{0.1} = \$894{,}000$$

and share price is 894,000/100,000 = 8.94 (the 100,000 is # shares outstanding). So we can now summarize the market value of ABC Co's financial and business assets in a market value balance sheet. Remember that a market value balance sheet summarizes the sellable value of assets, both real and financial.

Market Value Balance Sheet

MVA	$1,844,000	MVD	$950,000
		MVE	$894,000

Because the yield on ABC's debt is 6% (not the coupon rate but the yield, although, in the current problem they are the same) and the corporate tax rate is 40%,

$$WACC = (1\text{-}t)*r_D * \frac{MVD}{MVD + MVE} + MCR * \frac{MVE}{MVD+MVE}$$

$$WACC = 0.6*0.06* \times \frac{950,000}{1,844,000} + 0.1 \times \frac{894,000}{1,844,000} = 6.7\%$$

So, we have now verified the Cost of Capital that I gave you in section 9.3 to calculate the NPV of ABC's business investment to confirm that this was a "good" business investment. ABC's WACC is 6.7%.

9.5 Additional Business Investment Measures

There are a number of alternatives to NPV for making business investment choices. It is common for many finance textbooks to extol the virtues of NPV and disparage other investment criteria. However, for a typical business investment, we illustrate in this section that these alternative investment criteria lead to the same investment decision. An attractive investment based on one criterion is attractive based on any of these other investment criteria. Further, each of these alternative criteria measures a different aspect of a business investment. They help to produce a well-rounded perspective on a new venture.

However, for special cases, these investment criteria might lead to different investment outcomes and, therefore, later in this chapter we investigate special cases of business investment analysis

for business investments that are not typical. There is no sense in letting special cases establish general rules.

If the primary benefit of business investment analysis is that it focuses the planning effort of a firm, it may not be terribly important, in most cases, which investment criteria you use. Any criterion can equally well focus your organization's planning effort. The *system* and procedures for business investment analysis that you have in place are likely more important than is the specific investment criterion.

If you are preparing an investment proposal that you will be presenting to senior managers or the board of directors of a firm, you should be ready to discuss all of the investment criteria that we study in this chapter. You can be sure that if you have not prepared in your proposal one of these measures, there will be somebody in attendance at this meeting who will ask about it. Best be prepared.

THE PAYBACK PERIOD

The payback period is the length of time that it takes to "recoup," incremental expenditure for a new business investment (that is, ΔIC) with incremental FCF (that is, ΔFCF). Typically, these after tax cash flow benefits are incrementally summed and they are not discounted. For a new business investment, forecast future incremental FCF can have many different patterns. In this section, we illustrate the payback period with a typical business investment, which we represent as a non-growing perpetuity. We continue with the sample final exam question from the previous section. In this case, the incremental cash flows on that business investment are:

Table

Example of the Payback Period

0	1	2	3	4	⋯
-1,300,000	123,600	123,600	123,600	123,600	⋯

The payback period for an ordinary perpetuity has a particularly easy form: incremental expenditure divided by incremental FCF per year:

$$\text{Payback Period} = \frac{\Delta IC}{\Delta FCF} = \frac{1,300,000}{123,600} = 10.52 \text{ years}$$

As an approximation, and the approximation is exact for an investment that has cash flows that do not grow (which is a typical business investment), the payback period is the inverse of the IRR. For a non-growing business investment (which is our example),

$$\text{IRR} = \frac{\Delta FCF}{\Delta IC} = \frac{123,600}{1,300,000} = 9.51\% \text{ per annum}$$

Note that,

$$\text{Payback Period} = \frac{1}{IRR} = \frac{1}{0.0951} = 10.52 \text{ years}$$

Because the payback period is the inverse of the IRR, an approximate payback period *benchmark* (and the approximation is exact for an investment that has non-growing cash flows, which is a typical business investment), is the inverse of the cost of capital. In our example,

$$\text{Benchmark Payback Period} = \frac{1}{WACC} = \frac{1}{0.067} = 14.92 \text{ years}$$

As business persons, we always prefer investments that ”pay back” sooner. So, in our example, because the payback period is less than the benchmark payback period, 10.52 years < 14.92 years, this is a “good” investment and should be undertaken by business managers who aim to maximize shareholders wealth. This is the second way in which we have asked and answered the question: “Is this a good investment.” For a typical business investment with non-growing incremental FCF, if the investment is good according to the NPV rule (accept the investment if NPV>0) then, the investment is also good according to the payback period rule (accept the

investment if the payback period < benchmark payback period). In our sample final exam question from section 9.3 we have now answered part (i) and part (vii) a second time.

THE IRR

The internal rate of return (IRR) is that hypothetical discount rate which makes NPV equal to zero. The IRR is "the" rate of return on an investment. The rule for using the IRR is composed of two steps. The first step is to calculate the IRR on incremental FCF. The IRR can be calculated for any pattern of predicted future FCF. However, we know from our analysis in Chapter 6 of this electronic book that there are a number of instances (3 or 4 depending on how you count) where the IRR is easy to calculate with a formula. One of these cases is for a non-growing ordinary perpetuity, which represents a typical business investment. For the sample final exam question from section 9.3, we know from our discussion of the payback period that,

$$\text{IRR} = \frac{\Delta FCF}{\Delta IC} = \frac{123,600}{1,300,000} = 9.51\% \text{ per annum}$$

The second step in the IRR rule is to compare the IRR to the *cost of capital*. The general rule for using the IRR is:

If IRR ≥ cost of capital, accept the investment.
If IRR < cost of capital, reject the investment.

In the sample final exam from section 9.3, because the IRR is greater than the cost of capital, 9.51% > 6.7%, this is a "good" investment and should be undertaken by business managers who aim to maximize shareholders wealth. This is the third way in which we have asked and answered the question: "Is this a good investment." For a typical business investment with non-growing incremental FCF, if the investment is good according to the NPV rule (accept the investment if NPV>0) then, the investment is also good according to the IRR rule (accept the

investment if the IRR > cost of capital). In our sample final exam question from section 9.3 we have now answered part (iii) and we have answered part (vii) a third time.

The ACCOUNTING RATE OF RETURN (ARR)

The accounting rate of return (ARR) is net operating income (NOI) divided by book value.[3] We can calculate ARR for an entire business or for an incremental business investment. For an entire business, ARR is the rate of return on invested capital after tax and after depreciation (ROIC) that we defined and calculated in Chapter two:

$$\text{ARR for an Company } = \frac{NOI}{IC} = \frac{(1-t)*\left[EBITDA - DEPREC\right]}{IC}$$

For a new investment ARR is incremental NOI divided by incremental business investment, which is incremental IC.

$$\text{ARR for New Business Investment} = \frac{\Delta NOI}{\Delta IC} = \frac{(1-t)*\left[\Delta EBITDA - \Delta DEPREC\right]}{\Delta IC}$$

If cash flows continue indefinitely without growth (which is a typical business investment), then the ARR, either for an entire company or for a new business investment is the IRR. In the sample final exam question from section 9.3, the entire business is a single investment. So, these two ARRs are the same. Let us find the ARR in that question.

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[3] The ARR is purported by most Finance textbooks to have a number of irredeemable deficiencies. First, the accounting rate of return does not use cash flows but, instead, uses net operating income, which employs an arbitrary depreciation schedule. Second, because ARR is simply averaged over time, it ignores the time value of money. Because of these features, the ARR is commonly dismissed by academics in finance. However, Bierman and Smidt show in their book on capital budgeting: *The Capital Budgeting Decision: Economic Analysis of Investment Projects* (Chapter 2), that there is nothing wrong with the ARR methodology. Difficulties arise only if one uses an inappropriate depreciation schedule. If *economic depreciation* is reduced capacity of an asset to generate future cash flows, and if in your analysis you choose a depreciation schedule for internal decision making purposes that reflects this economic depreciation, then the accounting rate of return is the same as the IRR and you can use it in exactly the same way. Bierman and Smidt present a methodology to find an economic depreciation schedule for a business investment with any pattern of forecast future cash flows.

$$\text{ARR} = \frac{\Delta NOI}{\Delta IC} = \frac{0.6*[\$250,000 - 44,000]}{1,300,000} = 9.51\% = IRR$$

Because the ARR is the same as the IRR, we can use the ARR in the same way as the IRR.

If ARR ≥ cost of capital, accept the investment.

If ARR < cost of capital, reject the investment.

In the sample final exam from section 9.3, because the ARR is greater than the cost of capital, 9.51% > 6.7%, this is a "good" investment and should be undertaken by business managers who aim to maximize shareholders wealth. This is the fourth way in which we have asked and answered the question: "Is this a good investment." For a typical business investment with non-growing incremental FCF, if the investment is good according to the NPV rule (accept the investment if NPV>0) then the investment is also good according to the ARR rule (accept the investment if the ARR > cost of capital). In our sample final exam question from section 9.3 we have now answered part (ii) and part (vii) a fourth time.

9.6 CASES WHERE THE IRR MUST BE USED WITH CARE[4]

IRR and Non-Typical Business Investments: 6 Minutes

The internal rate of return is a very close "cousin" of NPV. The IRR rule and the NPV rule (i.e., accept if NPV is positive) generally lead to the same decision. To illustrate why the IRR rule and NPV are the same, consider the following diagram.

[4] Many of the ideas for section 9.6 I have borrowed from *Principles of Corporate Finance* by Brealey, Myers, and Allen, 8'th edition, chapter 5, McGrawHill Irwin Publishers.

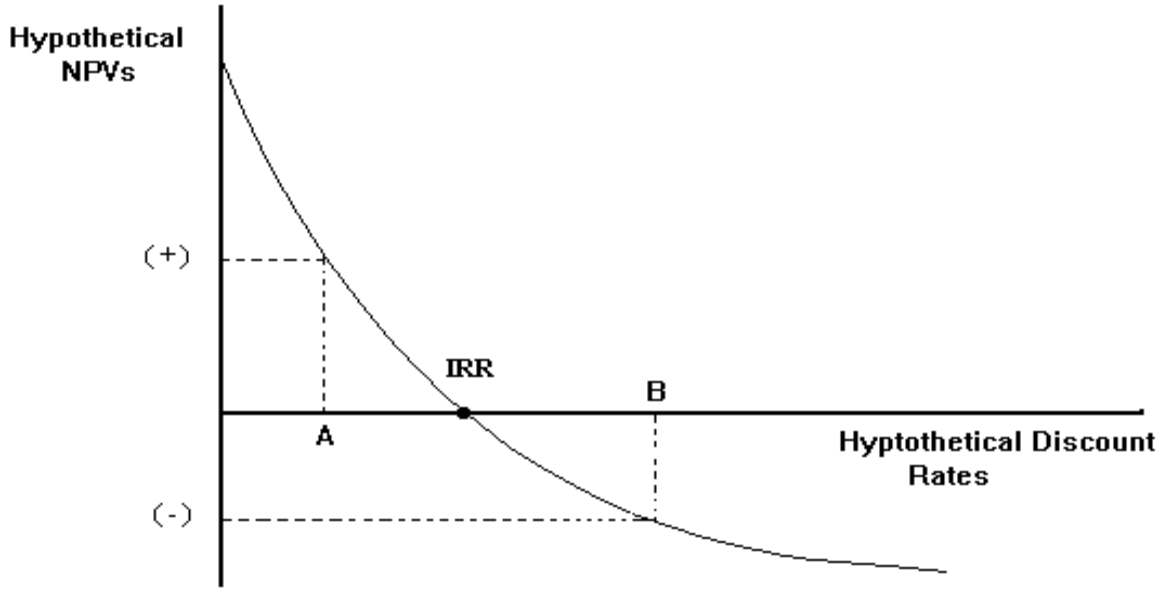


Exhibit 9-2: The NPV Schedule

For the same predicted cash flows, the NPV schedule traces the NPV for various hypothetical discount rates. There is only one market determined cost of capital. However, we can undertake a hypothetical experiment by increasing or decreasing the discount rate to determine the impact on NPV. Exhibit 9-2 depicts the result of this experiment for a hypothetical business investment.

The discount rate where the NPV schedule crosses the zero axis is the IRR. Suppose that the cost of capital (and there is only one) is at point A in the diagram. In this case, the IRR is greater than the cost of capital, and therefore, the IRR rule implies that the investment should be accepted. If one moves up to the NPV schedule and across, you find that the NPV for this business investment is positive. The investment should be accepted according to the NPV rule. The two decision rules produce the same result.

On the other hand, suppose the cost of capital is at point B in the diagram. The IRR is lesser than the cost of capital, and therefore, the IRR rule implies that the investment should be rejected. If one moves down to the NPV schedule and across, you find that the NPV for this business

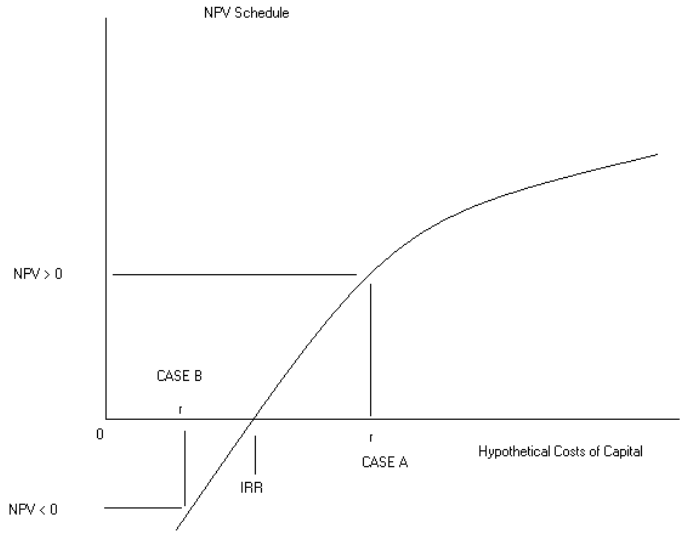
investment is negative. The investment should be rejected according to the NPV rule. Once more, the two decision rules produce the same result.

As long as the NPV schedule depicted in exhibit 9-2 is strictly downward sloping, the IRR rule and the NPV rule result in the same decision. Standard investments that require an initial expenditure, followed by positive expected future cash flows, give strictly downward sloping NPV schedules. For these investments, the IRR rule and the NPV rule are the same.

There are special cases of business investment analysis where IRR and NPV do not result in the same decision. Or, better said, there are some cases where you must use the IRR with caution. These cases are all associated with non-typical business investments.

Dis-Investments

The IRR decision rule must be reversed for "dis-investments." A dis-investment is (more or less) the opposite of an investment. For a dis-investment, you receive cash up-front, and then, you repay in the future. Dis-investments are not uncommon in business. For example, a firm can sell a division to another business. This sale generates immediate cash, but the profit that the division once generated is now forgone. Another example of a dis-investment is "outsourcing," where a firm sells an operating activity previously undertaken "in-house" to an independent operator and then contracts for those services to be provided.



Because everything must be reversed in a dis-investment, the IRR rule for dis-investments is,

If IRR < cost of capital, accept the dis-investment
If IRR ≥ cost of capital, reject the dis-investment.

The discount rate where the NPV schedule crosses the zero axis is the IRR. Suppose that the cost of capital (and there is only one) is at point A in the above diagram. In this case, the IRR is less than the cost of capital, and therefore, the IRR rule for business investment implies that the dis-investment should be undertaken. If one moves up to the NPV schedule and across, you find that the NPV for the dis-investment is positive. The dis-investment should be accepted according to the NPV rule. The two decision rules produce the same result.

On the other hand, suppose the cost of capital is at point B in the diagram. The IRR is greater than the cost of capital, and therefore, the IRR rule implies that the dis-investment should be rejected. If one moves down to the NPV schedule and across, you find that the NPV for the dis-investment is negative. The investment should be rejected according to the NPV rule. Once more, the two decision rules produce the same result.

Problem: ABC Hotels Ltd. is considering "out-sourcing" its laundry, which it now cleans "in-house." Currently, ABC trucks soiled bedding, towels, wash-cloths, etc., for all ABC hotels to a central laundry and once cleaned, these items are then returned. As an alternative, ABC is considering selling its laundry operations in its entirety, including equipment and real estate, to an independent business. The independent business has offered ABC $1,000,000 for the laundry operation. Thereafter, ABC expects to pay $150,000 per annum indefinitely (net of expenses and taxes) to the independent business for ABC Hotel laundry services.

Required:

(a) What is the IRR on this dis-investment?

(b) For what values of the cost of capital should ABC Hotels proceed with the laundry outsourcing and for what values should they not? Explain, briefly.

Solution: Since, $1{,}000{,}000 - \frac{150{,}000}{IRR} = 0$, the IRR is 15%. Because this is a dis-investment (the opposite of an investment), we must reverse the standard IRR rule for real-asset investment. So, ABC Hotels should outsource their laundry if the IRR is less then their cost of capital. If their cost of capital equals or exceeds 15%, then ABC should out-source.

IRR and Dis-Investment: 9 Minutes

Multiple IRRs

A second case where IRR must be used with care arises in investments where multiple IRRs are possible. Multiple IRRS are rare in the business world, but they are common in a particular industry: natural resources and energy. There are two features of investments in this industry that

are not typical. First, many natural resource investments have a finite life. After the ore is extracted from a mine, the life of the mine is over. Second, natural resource and energy investments often require large cash outlays at the end of the investment's life. For example, a mine site must be reclaimed to its original environmental standard, a nuclear plant must be disassembled and the nuclear waste disposed. These investment types often have multiple IRRs.

Consider the following example:

Table 9-3: Multiple IRRs

0	1	2
-100	230	-132

In this investment, there is a large negative cash outflow at the end of the life of the investment.

The NPV schedule for the above cash flows is:

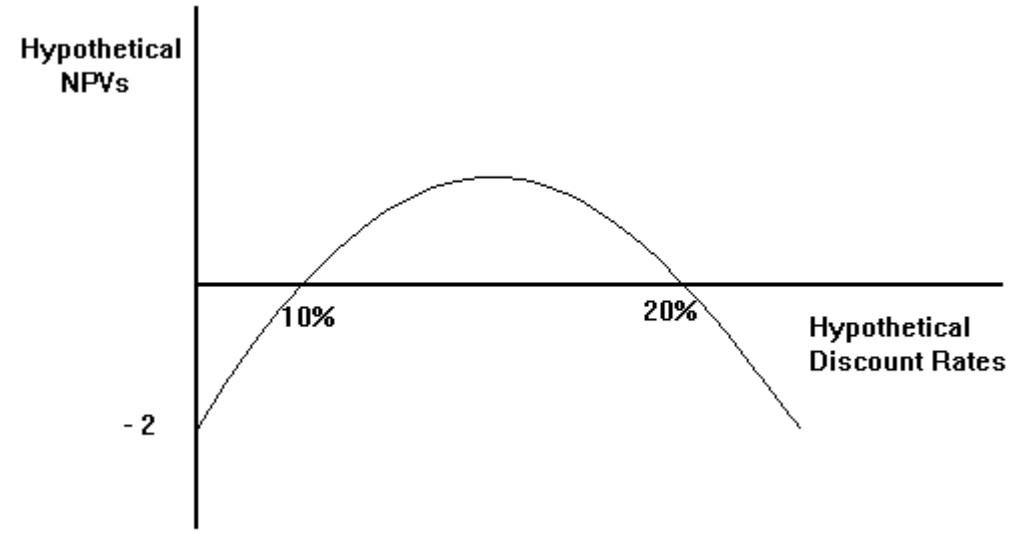


Exhibit 9-3: Multiple IRRs

Notice that the NPV schedule increases, crosses the horizontal axis, then decreases and crosses the horizontal axis once more. There are two IRRs, one at 10% and the other at 20%.

What is the rate of return on this investment? Is it 10% or is it 20%. Is this investment acceptable or not?

As you can see from the diagram, the IRR rule must be modified if there are multiple IRRs. In this particular case, the IRR rule says to accept the investment if the cost of capital is greater than or equal to10%, but less than or equal to 20%. For this range of the cost of capital, the NPV for this business investment is positive. However, those amounts, 10% and 20%, are not easy to determine, and therefore, describing the IRR rule generally for an investment is also not easy.

In general, the maximum number of IRRs for an investment is equal to the number of cash flow sign changes. In the example, there is a sign change from -100 to +230, and a second from +230 to -132. Therefore, two IRRs are possible.

We can resolve the multiple IRR problem if we use the *Modified* IRR (MIRR) rather than the IRR itself.

The Modified Internal Rate of Return (MIRR)

In the modified IRR (MIRR), you specify a reinvestment rate for intermediate cash flows. In the example above, suppose we reinvest the one intermediate cash flow of $230 for one year at 5%. For a $100 investment, the payoff on the investment is then $109.50 ($230 × 1.05 - $132) after two years. The MIRR is the annualized holding period rate of return after reinvestment of intermediate cash flows. In our example, this is $(1.095)^{1/2} - 1 = 4.64\%$. If your assumed reinvestment rate is for *financial assets*, it is natural to presume that the cost of capital is equal to the reinvestment rate (because the cost of capital is also a financial market rate). We then compare the MIRR of 4.64% to the cost of capital of 5%. Because the MIRR is lesser than the cost of capital, the investment is rejected. Alternatively, if the reinvestment rate is 10%, the MIRR is equal to the cost of capital (you can verify this assertion for yourself) and the investment is just marginally accepted. For reinvestment rates lesser than 10%, the investment is rejected. For reinvestment rates greater than 10 percent but lesser than 20 percent, the

investment is accepted. For reinvestment rates greater than 20%, the investment is rejected. This pattern of accepting and rejecting the investment follows the NPV schedule depicted in exhibit 9-2. This equivalence implies that under the assumption that the reinvestment rate is the same as the cost of capital, the MIRR rule leads to the same decision as NPV.

If you presume a reinvestment rate for the MIRR that is not the same as the cost of capital, you should ask yourself whether you have correctly predicted the cash flows for your investment. For example, if you presume the reinvestment rate is greater than the cost of capital (which is a financial market rate), the implication is that the reinvestment is an additional business investment for your firm. In this case, you have a business investment within a business investment. But this observation implies that the investment and the "investment with a investment" are a single investment with a composite of cash flows. Possibly you should be investigating the composite of cash flows rather than the original subset of cash flows.

MIRR and Multiple IRRs: 17 Minutes

IRR and Mutually Exclusive Investments

Like all rates of return, IRR has a scale problem if the choice is between *mutually exclusive* investments. A pair of investments is mutually exclusive if the choice of either precludes the other. There are a number of ways that this investment characteristic might arise. First, investments might be mutually exclusive because of the nature of the business decision to be made. For example, when choosing a fleet of vehicles, you can choose to drive GM trucks or Ford trucks, but not both. If you choose Ford, you cannot choose GM, and vice versa. Second, mutually exclusive investments might arise from *capital rationing*. If a firm has a preset capital budget (i.e., a self-imposed budget for capital investments), this budget might be "blown" by a single investment or a sub-set of investments. Remaining investments, then, cannot be financed.

Inability to *finance* investments is not likely the reason for capital rationing in large firms that have, more or less, unfettered access to financial markets. If large firms ration their capital, they do so to ensure that the investments they accept are of the highest caliber, and not tainted by optimistic investment champions. In the absence of self-imposed capital rationing, firms should take all positive-NPV investments. Smaller firms have more difficulty accessing financial markets, and therefore, capital rationing might be due to an inability to raise funds or it might be self-imposed.

As an example of the scale problem for IRR with mutually exclusive investments, consider the following table:

Table: IRR and the Scale Problem

	time 0	time 1	NPV at 5%	IRR
Investment A	-100	150	42.85	50%
Investment B	-1,000	1,100	47.62	10%

Investment A requires an investment of $100 and generates $150 in one year. Investment B requires an investment of $1,000 and generates $1,100 in one year. At a 5% cost of capital the NPV is greatest on investment B. However, investment A has a greater IRR. This example illustrates that it might be better to take a lesser rate of return on a larger investment if the associated wealth increase for shareholders (i.e., the NPV) is greater.

If the mutually exclusive nature of investments arises from capital rationing, the scale problem can be resolved by measuring the IRR for the *entire* capital budget. In the above example, it appears that the firm has a capital budget of $1000. If you take investment B, the entire budget is used. On the other hand, if you choose investment A, only $100 is used but the remaining $900 is insufficient to finance investment B. What does the firm do with the remaining $900? Because it cannot be used for investment, it should be invested in financial assets at 5% for the period. The payoff on the capital budget is, therefore, $1.05*900 + 150 = $1095. The NPV (at a 5% discount factor) for this investment is $42.85. This amount is exactly the same as that reported in the above exhibit because the firm's financial asset investment is "zero-NPV:" NPV

for the capital budget = NPV of investment A + NPV of financial asset investment = \$42.85 + 0 = \$42.85. The IRR on the entire capital budget is $\frac{1,095}{1,000} - 1 = 9.5\%$. Both the IRR and the NPV are inferior to those for investment B, and therefore, investment B should be chosen.

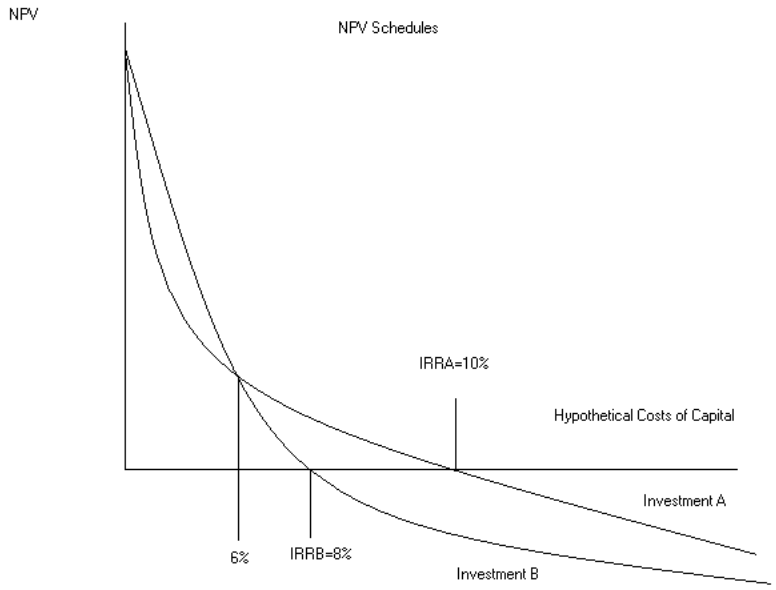
For any cost of capital, we can also resolve the IRR scale problem if we determine the IRRs for the two investments and the hypothetical cost of capital where the investment NPVs equal one another. These calculations will tell us the ranges of the cost of capital for which we prefer one investment over the other. As an example of this method, let us consider a problem.

Problem: ABC Company Ltd., is considering two possible business investments that are of approximately the same risk. In both cases, the cash-flow benefit of either investment begins one year from today. Investment A requires an expenditure today of \$1,000,000. The non-growing incremental benefit is \$A per annum in after tax operating cash-flows indefinitely. Investment B requires an expenditure today of \$2,000,000. The non-growing incremental benefit is \$B per annum in after tax operating cash-flows indefinitely. Ignore capital cost allowance and depreciation in this problem. The internal rate of return on investment B is 8%. The internal rate of return on investment A is 10%. ABC has asked for your advice on which investment they should choose. How do you respond? For what range of discount rates is investment A preferred to investment B?

Solution: Note that we cannot choose investment A over investment B simply because the IRR is greater on investment A. We might, alternatively, prefer to take a lower return on investment B because it is a larger and might create more wealth.

The IRR for investment A is 10%. So, -1,000,000+A/0.1 = 0, and, A=\$100,000. The IRR for investment B is 8%. So, -2,000,000+B/0.08 = 0, and, B=\$160,000.

Let *r* be the cost of capital. We choose investment A over investment B for that cost of capital range for which $NPV_A \geq NPV_B$. So, choose investment A if, -1,000,000 +100,000/r > -2,000,000 + 160,000/r. You can verify that $NPV_A \geq NPV_B$ if $r \geq 6\%$. However, if the cost of capital is greater than 10% we should choose neither investment because, then, they both have negative NPVs. We can see the reason for these conclusions by examining the NPV schedules for investments A and B together below in the following diagram.



Notice that for any cost of capital between 6% (where the two NPVs equal one another) and 10%, the IRR of investment A, investment A is preferable to investment B because it has greater NPV. On the other hand, for costs of capital below 6%, the NPV on investment B exceeds that of investment A, and therefore, it is preferable for costs of capital in this range.

IRR and Mutually Exclusive Business Investments: 24 Minutes

9.7 INFLATION AND BUSINESS INVESTMENT

For a typical business investment where incremental non-growing FCF continues indefinitely, the payback period rule, the IRR rule, and the ARR rule yield the same business investment decision as does the NPV rule. However, you might argue that a typical business investment has growing rather than non-growing cash flows because of inflation (inflation makes *nominal* cash flows grow). The answer to this question is that, while we did not highlight the fact in our earlier discussion and analysis, we were really presuming *real* incremental FCF and a *real* cost of capital. So, our conclusions from prior analysis remain valid. This section is about how to correctly incorporate inflation into business investment analysis.

The general rule for integrating predictions of inflation in business investment analysis is that they should either be included in both the numerator and denominator of discounted cash flow or they should be excluded from both. The first approach we might call "nominal versus nominal" and the second approach we might call "real versus real." One simply has to be consistent in the numerator and denominator of DCF analysis. If one uses nominal cash flows (which incorporate forecast future inflation), then one must use a nominal opportunity that financial markets have adjusted for forecast inflation. On the other hand, if one uses real cash flows (unadjusted for forecast future inflation) then one must use a real opportunity cost (which requires undoing the inflation adjustment that financial markets incorporate in observed financial market returns).

Let us consider an example. Suppose you are contemplating a business investment. You expect real FCF on the business investment to be $100,000 in real terms (that is, in today's purchasing

power). Measure this incremental FCF at year-end, so real FCF is an ordinary non-growing perpetuity. The investment required to start your business today is $1,000,000. The nominal cost of capital for this business investment is 10.16% per annum. Since this is a rate determined from estimation or observation of financial market returns, it has embedded in it an investor compensation for expected future inflation. Suppose that expected future inflation is 2% per annum.

How can inflation be embedded in the cost of capital? Recall that the cost of capital is a financial market rate of return. It is the expected rate of return on a set of financial assets that have the same risk as the investment under investigation. Also, recall from our discussions in both chapter 6 and 7 of this electronic book that inflationary expectations are naturally impounded in financial market rates by the buy and selling of investors. For example, if inflation is expected to be greater in the future, investors will pay less for fixed-rate financial assets (like bonds), and therefore, rates of return increase. In chapter 6, we described the relation between nominal rates of return (compounded once per annum and observed in financial markets), expected inflation, and real rates of return using Fisher's relation:

$$1 + r = (1 + r^*) \times (1 + \pi)$$

where

r	is the nominal rate of return in (compounded once per year),
r*	is the real rate of return,
π	is the expected rate of inflation

Because the cost of capital is determined in financial markets, it includes a compensation for investors for expected future inflation. Let us remove the compensation for inflation from the nominal rate of 10.16% with Fisher's relation to make it a real rate.

$$1 + 0.1016 = (1 + r^*) \times (1 + 0.02)$$

Solve for the real cost of capital, r^*, to find, $r^* = 8\%$ per annum.

We can discount incremental FCF in one of two ways. First, we can discount real FCF flows at a real discount rate. Or, we can discount nominal FCF, which includes a factor for the effect of anticipated inflation, at a nominal discount rate.

A graphical depiction of real FCFs is,

0	1	2	3	4	···
-1,000,000	100,000	100,000	100,000	100,000	···

With the real versus real approach to valuation, and with the formula for a non-growing ordinary perpetuity, NPV is,

$$NPV = \frac{100,000}{0.08} - 1,000,000 = \$250,000$$

A graphical depiction of nominal FCFs is,

0	1	2	3	4	···
-1,000,000	100,000*1.02	$100,000*1.02^2$	$100,000*1.02^3$	$100,000*1.02^4$	···

We expect nominal FCF to grow at the rate of inflation: 2% per annum. With the nominal versus nominal approach to valuation (that is, nominal FCF and the nominal cost of capital), and with the formula for a growing ordinary perpetuity, NPV is,

$$NPV = \frac{100,000*1.02}{0.1016 - 0.02} - 1,000,000 = \$250,000$$

Note that NPV is identical with the real versus real approach and the nominal versus nominal approach.

This analysis suggests that inflation should have no impact on the business economy. Regardless of predicted future inflation, if NPV is positive with the real versus real approach, it is also positive with the nominal versus nominal approach. Thus, the investment decision of business managers is unaffected by inflation. We say that inflation has no "real" effects on the business

economy. Of course, while our example is a good approximation to the business world, it is, nonetheless, stylized and does not capture all aspects of business investment analysis. For example, our analysis does not recognize that CCA is unadjusted for inflation and, therefore, higher than expected inflation dilutes the tax saving benefit of this allowance. In addition, our example does not recognize that coupon payments on debt are not adjusted for inflation and, therefore, unexpectedly high inflation dilutes the value of the liability that we might use to finance a business investment.

Inflation and Business Investments: 15 Minutes

(9.8) CAVEATS FOR BUSINESS INVESTMENT ANALYSIS

Net present value (NPV) is a measure of shareholders' incremental wealth from a business investment[5]. If this wealth increment is not positive, the investment should be rejected. There are a number of unique features of the application of discounted cash flow analysis to business investment. Many of these unique features are related to business investments that are not typical. That is, incremental forecast future FCF cannot be represented as a non-growing ordinary perpetuity. This section of this book discusses these features.

Use an Asset Approach for Capital Budgeting

When you are given the responsibility for preparing an investment proposal for review of senior managers or the board of directors, there are two principal questions that often must be answered.

[5] For firms in financial distress, NPV is the wealth increment for the composite of all financial asset holders. In this case, the debt-holders of a firm have a financial asset with equity characteristics.

First, should the investment be made, and second how should it be financed? In your analysis, you are much less likely to make mistakes if you take a "divide and conquer" approach to these two questions. First, determine whether or not the investment should be accepted. If the NPV of the investment is positive, the investment creates wealth for your shareholders and should be undertaken. This methodology takes an "asset" perspective because asset cash flows (before payments to suppliers of capital, like interest) are discounted at the cost of capital, which is an asset discount rate. If you decide that the investment creates wealth for shareholders, you can then investigate the question of how it should be financed.

When considering a set of relatively small investments compared to the size of a firm, the financing question is naturally separated from the individual investments. Financing is not likely to be done investment by investment, but for the firm as a whole. All worthy investments are financed from the firm's overall capital budget. On the other hand, for investments that are large compared to the size of the firm, financing arrangements must be planned and negotiated concurrently with the process of investment investigation in order to have funds on hand when the investment is ready to proceed. Thus, even though we may separate the investment question from the financing question for the purpose of analysis, in practice they are often intertwined.

It is possible to use an "equity" approach to investment evaluation. Cash flows after payments to suppliers of capital (like interest) can be discounted at an equity discount rate. However, this approach is conceptually more difficult and requires greater care to determine the appropriate cash flows to be discounted and the appropriate equity discount rate.

SALES PREDICTIONS AND OPERATING CASH FLOWS

In short term financial planning – cash budgeting and pro-forma financial statements – which we investigated in an earlier chapter, a primary requirement for analysis is a prediction of future

sales. Sales predictions are also, often, a fundamental part of long term financial planning – business investment analysis – which we investigate in this chapter.

As an example, suppose that as the result of a real-asset investment, you predict that the incremental effect on dollar sales for your firm will be $100,000. This increment might be the result of a planned new product. You estimate that the contribution margin will be 20%. The incremental impact of the investment on fixed cost is expected to be $10,000 per annum. The corporate tax rate is 40% and the firm must earn its cost of capital, 10% per annum.

The benefit due to an increment change in EBITDA equals $10,000 [(0.20) × $100,000 – $10,000]. The after-tax increment to the firm's profitability from this investment is $6,000 [(0.60) × $10,000]. The present value of these perpetual annual benefits is $60,000 [$6,000 ÷ 0.10].

USE ONLY INCREMENTAL CASH FLOWS

In order to separate the existing firm from benefits arising from a new business investment, you should use the notion of *incremental cash flows*. Incremental cash flows are those cash flows that arise only because the investment is accepted. Cash flows that are received or paid regardless of whether or not the investment is accepted are not incremental and should not be attributed to the investment.

An example of this notion of "incremental" is that of *sunk costs*. Sunk costs are those past expenses and expenditures which are irreversible and irretrievable. Because bygones are bygones, the magnitude of these costs should have no bearing on your decision today. This decision should be based on predictions of immediate and *future* cash flows.

Suppose that an investment made five years ago at a cost of $10 million can be sold today for only $6 million. Our decision today should be based on the immediate opportunity for a cash

inflow of $6 million dollars. An attempt to recoup our loss of $4 million on this investment might mistakenly lead us to keep this particular investment longer than we should.

IS YOUR INVESTMENT OF FINITE LIFE OR NOT?

For planning and strategy purposes, firms often use a planning horizon. For example, a firm might be trying to position itself where it would like to be in five years. Because of this perspective, senior managers often require explicit cash flow predictions for new business investments over this planning period. The specific length of time in your firm's planning horizon might be chosen because reasonable predictions are possible for your business over this interval. When analyzing major capital investments, therefore, it makes sense, when forecasting cash flows, to focus on this time interval. In valuation parlance, the period over which cash flows are explicitly forecast is called the *explicit forecast period*. However, you should recognize that the world is not likely to cease at the end of your explicit forecast period. Even though they may be more difficult to forecast, cash flows will undoubtedly continue thereafter. Many capital investments can generate cash flows indefinitely.

Cash flows after the explicit forecast period can be an important source of value for your investment. If you discount predicted cash flows only over your explicit forecast period, you will under-represent the value of the investment to your shareholders.

Rather than a typical business investment that might be best represented as an ordinary non-growing perpetuity, to be more exact in your analysis, you might want to forecast incremental FCF, year by year, for the years of your explicit forecast period and then as a non-growing perpetuity thereafter (recall business investments do not typically grow). A perpetuity representation of cash flows after the explicit forecast period is often helpful for the purpose of analysis. A perpetuity representation is convenient because each and every individual cash flow need not be predicted indefinitely. The value of cash flows after the explicit forecast period is called the *terminal value* of the investment.

As an example of this design feature for business investment analysis, let us consider an example. You have predicted that sales on a new product will be $100,000, $110,000, $150,000, $175,000, and $200,000 respectively in the five years of your explicit forecast period. Thereafter, you are less certain about the level of sales, but $200,000 per year is a realistic target. Contribution margin for the product is 20% per annum and fixed costs should be around $10,000 per year. The required investment is $100,000. Your firm's tax rate is 40%. An appropriate opportunity costs for investments of this risk level is about 12% per annum. After tax cash flows on the investment are:

Table: Capital Budgeting with an Explicit Forecast Period

Year	1	2	3	4	5	Thereafter
Predicted Sales	$100,000	$110,000	$150,000	$175,000	$200,000	$200,000
After-tax Cash Flows	$6,000	$7,200	$12,000	$15,000	$18,000	$18,000

Should this investment be undertaken, and what are the relative components of value?

The terminal value of the investment is $18,000/0.12 = $150,000. NPV of the investment is:

NPV = – Investment

+ PV of After Tax Cash Flows in the Explicit Forecast Period

+ PV of Terminal Value,

$$= -100{,}000 + \frac{6{,}000}{(1.12)} + \frac{7{,}200}{(1.12)^2} + \frac{12{,}000}{(1.12)^3} + \frac{15{,}000}{(1.12)^4} + \frac{18{,}000}{(1.12)^5} + \frac{150{,}000}{(1.12)^5}$$

$$= -100{,}000 + \$39{,}385 + \$85{,}114$$

$$= \$24{,}499$$

In this example, the NPV is positive, and therefore, the investment should be undertaken. Notice that most of the value of the investment arises from cash flows which are predicted after the

explicit forecast period. If you were to discount only the cash flows in the explicit forecast period, you would mistakenly reject the investment.

SALVAGE FOR INVESTMENTS WITH FINITE LIFE

If your business investment has a finite predicted life, you should include salvage values at the end of the investment as an incremental benefit. Because required investment in business activity is of two types (trade capital and depreciable asset investment), there should be two types of salvage, one for trade capital and the other for plant, property, and equipment (PPE). PPE is likely subject to considerable economic depreciation. For example, you might sell machinery at the end of a investment for a small fraction of its original cost. On the other hand, because trade capital is a close monetary substitute, it is unlikely to be subject to considerable depreciation. For example, to begin a real asset investment, you might have to increment the trade capital of a firm by $100,000. These funds don't disappear. They circulate through the fundamental working capital accounts of the firm, inventory, accounts receivable, and cash. At the end of the useful life of the investment, this trade capital can be liquidated. In an orderly liquidation (i.e., not forced), you might be able to receive the full dollar amount of trade capital. In other words, for the $100,000 originally invested, you might be able to liquidate trade capital and receive this full amount back from the investment. This liquidated trade capital can be used for other corporate purposes and, therefore, should be considered a benefit of the investment.

ACCOUNTING NUMBERS ARE NOT CASH FLOWS

Discounted cash flow analysis calls for the discounting of cash flows. Accounting numbers and allocations are not necessarily cash flows and, therefore, they should be transformed to cash flow equivalents before discounting. In particular, net operating income includes a non-cash depreciation charge, and therefore, it is not a cash flow.

If you don't discount net operating income, how then is depreciation represented in discounted cash flow analysis of a business investment?

The answer to this question is that economic depreciation on an asset is represented by its salvage value. For example, in your business investment analysis, you include the cost of a depreciable asset as $100,000, and you predict that salvage in 10 years is $10,000. Economic depreciation is reflected in your prediction that you will sell the asset in the future at a price lower than what you paid for it. In your business investment analysis, if you were to also discount net operating income, which includes a per period depreciation charge, you would be double counting depreciation.

INCLUDE ALL OPPORTUNITY COSTS

Often internal corporate resources that you employ for your business investment have alternative uses. These "in-house" resources, therefore, are not used in your investment at zero cost. The cost to the investment of using in-house resources is not being able to use these resources in their next best alternative use. The notion of opportunity costs is that you should consider all possible alternative uses of the resources you have available within your firm. You should employ corporate resources to maximize the NPV of the set of investments that you take.

As an example of opportunity costs in action, suppose that your business investment uses some office space in your corporate head office. Even if this space is empty, it does not come to your business investment. The opportunity cost is not leasing or sub-leasing this space to generate revenues for your company. So the cost to your business investment is foregoing leasing revenues (after tax).

BUSINESS INVESTMENT EXAMPLE

To illustrate some of these ideas, consider an example of business investment analysis.

Example: A firm owns a plant that cost $20 million dollars to build ten years ago. Right now it can be sold for $10 million dollars. The plant can operate for only 10 more years at which time it could be sold for an estimated salvage of $1 million. The plant produces a product that generates $2 million in cash operating-profit every year for the life of the plant. Continued use of the plant requires an increase in trade capital assets of $100,000 (to be maintained at this

higher level for the life of the plant). Ignore taxes and inflation in this problem. You have done a risk assessment of this business and from your understanding of financial markets you believe that an appropriate opportunity cost for invested funds is 5% per annum.

The first thing we need to do is to identify exactly what the investment alternatives are. We could continue the plant in operation or we could sell the plant. We could find the NPV of the two alternatives separately or we could view the option to sell as the opportunity cost for the option to continue. The "next best alternative" use for the plant (compared to continuing operations) is to sell for $10 million dollars. The wealth created by the continue to operate option compared to the sell option is calculated by the following NPV:

$$NPV = -0.1 - 10 + \frac{2}{0.05}\left[1 - \frac{1}{(1.05)^{10}}\right] + \frac{0.1}{(1.05)^{10}} + \frac{1}{(1.05)^{10}} = \$6.02 \text{ million}$$

The opportunity cost of the continuation option is the option to sell, and therefore, the sale price of the plant is subtracted in this relative NPV calculation. The $100,000 increment to trade capital is the only direct required investment. The present value of the annuity of yearly profits is the primary benefit of continued operation. There are two salvage amounts at the end of the life of the investment. First, the plant can be sold for $1 million at that time. Second, the higher level of trade capital, which is maintained for the ten-year life of continued operations, is liquidated dollar for dollar (without depreciation, deterioration, leakage or loss).

In this problem we have used the incremental notion. The investment is valued separately from the other business activities of the firm. In addition, we have ignored sunk costs. The original purchase price of the plant, 20 million dollars, is irrelevant for our decision today.

The Capital Cost Allowance System

Expenditures which firms make on fixed assets (plant and equipment, for example) are not expensible for financial statement purposes or deductible for tax purposes. Instead, these expenditures are amortized over time. In the case of financial statements, the amortized amount

in a period is called depreciation. In taxation, the government allows a "capital cost allowance" (CCA) instead of depreciation. Presumably, the government requires CCA rather than financial statement depreciation because of the otherwise adverse incentive for firms to exaggerate financial statement depreciation (which is at their discretion) to reduce their taxes payable.

In this subsection, we describe the generalities of the CCA system in Canada. Because CCA reduces taxable income (even though it is a non-cash charge) it can be an extremely important component of the benefits associated with depreciable business investments. Recall that a depreciable asset is not defined in the Income Tax Act but for administrative purposes it typically corresponds to those assets that you would normally think of as being subject to depreciation. Financial assets and land are non-depreciable, and therefore, there is no CCA on these assets.

In most cases, CCA is not taken on individual assets but on prescribed classes of similar assets. An exception is some rental properties: CCA is taken on individual buildings. The determination of asset classes is established by government Income Tax Regulations. These classes are referred to as CCA classes. When a taxpayer has several assets in a class, they are treated as a unit with respect to the calculation of CCA. Also, for most CCA classes, the maximum CCA that may be claimed for a class of assets in a year is calculated on the declining balance of the asset class. The declining balance of the asset class is called the *undepreciated capital cost* of the asset class (i.e., UCC balance).

Common CCA classes and their declining balance rates (other than in the year of acquisition) are given in the following table. A more complete listing is available from the website of *Canada Revenue Agency* (CRA) www.cra-arc.gc.ca/tx/bsnss/tpcs/slprtnr/rprtng/cptl/dprcbl-eng.html.

Asset Class	Rate	Description of Class
1	4%	most buildings or other structures, including the component parts (like plumbing, heating, and air conditioning),
3	5%	Most buildings acquired before 1990,
6	10%	Certain buildings for farming or fishing.
7	15%	boats, fittings, ships,
8	20%	tangible capital property and machinery not included in other classes,
9	25%	aircraft,
10	30%	automotive and electronic equipment.
10.1	30%	passenger vehicles,
12	100%	tools or utensils costing less than $200,
16	40%	automobiles for lease or rent,
17	8%	data communications switching equipment,
31	5%	multiple unit residential buildings,
35	7%	railway car,
43	30%	manufacturing and processing equipment.
45	45%	General purposes data processing equipment
46	30%	Data network infrastructure equipment
50	55%	General purpose electronic data-processing equipment acquired after Mar 2007

Capital cost allowance for most asset classes (but not all asset classes) is calculated on the declining balance of the asset class. The balance to which the rate is applied is the opening balance of the asset class (the UCC) plus one half of net additions to the asset class (as long as this value is positive). For the tax year at hand, net additions is the sum of the purchase prices of assets for the class (plus transactions costs) less the sum of the disposal values of assets for the class (net of transactions costs). The disposal value for an asset is the lesser of the sale price (less transaction costs) and the original cost. If the sale price is greater than the original cost, the firm has incurred a taxable capital gain (and there are associated tax consequences). CCA (should you choose to take it) is the maximum CCA rate for the class, times the UCC balance at the beginning of the tax year plus one-half of net additions (if this value is positive). You might choose not to take CCA if you have no taxes to be reduced in the current year or in any of the

prior three years (i.e., no benefit associated with carrying losses back to prior tax years). In this case, you should probably not use the CCA but apply it in a future year when in fact you may reduce taxes payable. UCC balance at the end of the year is UCC balance at the beginning of the year plus net additions (note, this is net additions not one half of net additions) less CCA taken for the tax year.

As an illustration of these calculations, consider a firm that has a Class 10 UCC balance of $1.0 million at the beginning of the tax year. Over the year, they purchase additional Class 10 assets for $200,000 and they sell class 10 assets for $75,000 (which is less than the original cost). What is the maximum CCA that the firm can take for Class 10 this tax year?

Illustration of CCA for Positive Net Additions to UCC

Opening Balance UCC	$1,000,000
One half net additions	$62,500=0.5*(200,000-75,000)
CCA	0.30*(1,062,500)=$318,750
Ending Balance UCC	1,000,000+125,000-318,750 = $806,250

If purchases less sales for assets in a class is negative (i.e., there are more sales than purchases), then the UCC balance is reduced by the full amount of disposals less acquistions. In our above example, suppose that purchases are $75,000 and disposals are $200,000 (which is less than the original cost of these assets). What is the maximum CCA in this case?

Illustration of CCA for Negative Net Additions to UCC

Opening Balance UCC	$1,000,000
Net Disposals	$(125,000)
CCA	0.30 × $875,000= $262,500
Ending Balance UCC	$1,000,000–$125,000–$262,500 = $612,500

PRESENT VALUE OF CCA TAX SHIELDS

When a firm buys a depreciable asset it creates an intangible asset. This asset is the ability to reduce future taxes through the capital cost allowance system. The accountants in your firm will not put this asset on the balance sheet, but it nonetheless has value, and therefore, should be included as a benefit of the business investment in your business investment analysis.

The reduction in tax in a particular year (the tax shield) arising from the capital cost allowance system is the corporate tax rate times the CCA deduction. In the example that we investigated in section 9.3 as the result of maintenance capital expenditures (MCAPX) the ABC company always had net fixed assets, NFA, which in that example we presumed was the same as UCC of $1,100,000. The CCA rate is 4% and the tax rate is 40%. So the per annum CCA tax shield is 0.4*0.04*1,100,000=$17,600. The discount rate is WACC=6.7%. Because this firm makes MCAPX every year, CCA tax shields neither decline nor increase. So the PV of CCA tax shields is $17,600/0.067=$262,686.57. Contrary to this example, if depreciable asset investment is "lumpy," that is a new depreciable asset does not require MCAPX for many years after initial purchase, then CCA tax shields will decline over time as the UCC balance of an asset class declines.

To illustrate the tax benefits of a depreciable asset purchase without subsequent MCAPX, let us consider an example. Suppose you purchase, in your firm, a depreciable asset for $100,000. This asset belongs to CCA class 7, which has a 15% declining balance rate. The following table calculates the incremental future CCA deductions available to your firm arising from your depreciable asset purchase. The pattern of these deductions recognizes the half-year rule for net acquisitions to a CCA asset class. The tax reduction (which is also called the CCA tax shield) which results, year by year, from these deductions is calculated as a presumed tax rate of 22.12% times the amount of the CCA deduction. These tax shields are given in the last column of the table. Because there is no explicit termination date for CCA, these tax shields, while they become smaller and smaller, can continue into the indefinite future.

Table: Tax Shields Arising From a Depreciable Asset Purchase

Year	Incremental UCC balance (opening)	Incremental CCA	Tax Shield (tax rate * CCA)
		–	–
1	50,000.00	7,500.00	1659.00
2	92,500.00	13,875.00	3,069.15
3	78,625.00	11,793.75	2,608.78
4	66,831.25	10,024.69	2,217.46
5	56,806.56	8,520.90	1,884.82
.	.	.	.
.	.	.	.
.	.	.	.

The yearly tax shields, from a depreciable asset purchase today, can be discounted to determine a present value. This amount is the value of the firm's ability to reduce taxes in the future through the capital cost allowance system.

The present value of CCA tax shields is given by the following formula:

$$\textbf{PV of Tax Shields} = \frac{I}{2}\,\frac{d*t}{(r+d)}\left(\frac{2+r}{1+r}\right), \qquad \textbf{(9.1)}$$

where

I = investment in the depreciable asset,
d = CCA rate,
t = corporate tax rate,
r = cost of capital.

In our example, suppose that the cost of capital for the firm is 10%. The present value of tax shields is, therefore,

$$\text{PV of Tax Shields} = \frac{100{,}000}{2}\,\frac{0.15*0.2212}{(.1+0.15)}\left(\frac{2+0.1}{1+0.1}\right) = \$12{,}668.83.$$

Take a moment to think about this calculation: it represents the value of tax reductions that the government offers for the purchase of a depreciable asset. This tax subsidy amounts to over twelve thousand dollars! The original purchase price of the asset was $100,000, and therefore, over time, the government contributes $12,668.83 ÷ $100,000 ≈ 12.67% to the purchase price.

Because of the relative magnitude of this subsidy, tax considerations are often critical in the acceptability and feasibility of business investments made by firms.

CCA TAX SHIELDS

ABC Company Ltd. is investigating a business investment. The investment requires the purchase of a depreciable asset that has a CCA rate of 20%. The purchase price of the depreciable asset is $10,000. Because the investment increments the level of sales in the firm, trade capital investment must be increased by $2,000 for the life of the investment. The corporate tax rate is 40%. The increment to before tax operating profits is $2,500 per annum for 10 years. ABC has many assets in this asset but no salvage on this particular asset is expected at the end of the life of the investment. The cost of capital for ABC is 10% per annum. Should the investment be undertaken?

In this example, you should recognize that incremental CCA, arising from the purchase of this depreciable asset, continues after the life of the investment. Because there are many assets in this asset class, it is reasonable to presume that this situation will continue in the future and that the UCC balance for the entire asset class will be positive at that time. Therefore, even though our depreciable asset is scrapped in 10 years, the CCA tax shields that it generates will continue into the indefinite future.

The NPV of this business investment is:

$$NPV = -10{,}000 - 2{,}000 + \frac{0.6*2{,}500}{0.1}\left[1 - \frac{1}{(1+0.1)^{10}}\right] + \frac{10{,}000}{2}\,\frac{0.20*0.4}{(.1+0.20)}\left(\frac{2+0.1}{1+0.1}\right) + \frac{2{,}000}{(1.1)^{10}}$$

$$= -10{,}000 - 2{,}000 + 9{,}216.85 + 2{,}545.45 + 771.08 = \$533.39$$

The terms in this summation, leading to the NPV are: (1) the investment in the depreciable asset, (2) the incremental investment in trade capital, (3) the value of incremental after tax operating profits, (4) the present value of tax shields, (5) the present value of liquidated trade capital at the end of the life of the investment. Because the NPV is positive, the investment should be

accepted. Notice, however, that the value of incremental after tax profits is small compared to the required investments in trade capital and depreciable assets. The tax shield benefits from capital cost allowances are essential for the feasibility of this investment.

CCA DISPOSAL RULES WITH MANY ASSETS IN A CLASS

When a firm sells a depreciable asset, it loses some of the ability it once had to reduce future taxes through capital cost allowances. If you think of the benefits of CCA as being an intangible asset, the disposal of an asset, which requires that the UCC balance for the asset class be reduced, destroys some of this intangible asset. Any increase in the UCC balance creates this intangible asset, and any reduction in the UCC balance destroys some of this intangible asset. In business investment analysis this loss is a "cost" of the disposal.

In this subsection, we consider depreciable asset disposals that do not cause the CCA class to be collapsed. This "zeroing" of a CCA class and the associated capital budgeting implications are investigated in later subsections. A CCA class must be collapsed, with associated tax consequences, when either there are no remaining assets in the class or a required reduction in the UCC balance would otherwise cause the UCC balance to become negative.

There are no capital losses on depreciable assets, but there are capital gains on depreciable assets. If the sale price of an asset is greater than the purchase cost, then 50% of this difference is included into taxable income and is taxed. In addition, the UCC balance of the asset class is reduced by the lesser of: (1) the sale price or (2) the original cost. The value of tax shields destroyed by this reduction is called the present value of tax shields lost:

$$\text{PV of tax shields lost} = \left(\textit{Lesser of Sale Price and Original Cost}\right)\frac{\frac{dt}{(r+d)}}{(1+r)^n} \qquad \textbf{(9.2)}$$

where d = CCA rate,
t = corporate tax rate,
r = cost of capital,

n = number of years to termination of the investment.

Because tax shields are lost, not today, but in the future when the depreciable asset is salvaged, the present value of tax shields lost must be discounted to the present. Notice that, unlike equation (9.1) for the present value of tax shields, the formula for present value of tax shields lost in equation (9.2) doesn't have the "2's." The reason for this difference is an asymmetry in the income tax act and its associated regulations. One half of net acquisitions are added to the UCC balance of an asset class in the year of acquisition and the other half in the following year. On the other hand, if there are net disposals of assets for a year, the UCC balance is reduced by the full amount of net disposals. In other words, there is no half-year rule for disposals from a CCA class. Because the UCC balance is reduced by the full amount of disposal in the year of disposal, the half-year rule induced "2's" do not appear in equation 9.2.

As an example of the notion of "tax shields lost," let us consider an example. Suppose that the cost of a depreciable asset is $10,000. Before tax operating profits arising from the investment are $1,000 per annum for the 10-year life of the investment. Disposal of the asset in ten years is expected to generate $12,000. Because there are many assets in this asset class and the UCC balance is large compared to any asset, the reduction in UCC upon disposal of the asset will not create a negative balance. The CCA rate for the asset class is 20%. The corporate tax rate is 40% and the cost of capital is 10%. What is the NPV of the investment, and should it be undertaken? The NPV is:

$$\text{NPV} = -\$10{,}000 + \frac{(1-0.40)\times\$1{,}000}{0.10}\left[1 - \frac{1}{(1+0.10)^{10}}\right]$$

$$+ \frac{\$10{,}000}{2}\times\frac{0.20\times0.40}{0.10+0.20}\times\frac{2+0.10}{1+0.10} + \frac{\$12{,}000}{1.10^{10}}$$

$$- \$10{,}000\times\frac{0.20\times0.40}{0.10+0.20}\times\frac{1}{(1+0.10)^{10}} - \frac{0.40\times0.5\times\$\left(12{,}000-10{,}000\right)}{1.10^{11}}$$

$$= - \$10{,}000 + 3{,}686.74 + 2{,}545.45 + 4{,}626.52 - 1{,}028.12 - 140.20 = - \$309.61$$

The terms in this summation leading to the NPV are: (1) the investment in the depreciable asset, (2) the value of incremental after tax operating profits, (3) the present value of tax shields, (4) the present value of salvage on the depreciable asset, (5) the present value of tax shields lost, (6) the present value of the capital gains tax. Because the NPV is negative, the investment should be rejected. Notice that salvage on the depreciable asset is equal to the sale price but in the formula for the present value of tax shield lost, the original price is used (because it is lesser).

CCA DISPOSAL RULES WITH FEW ASSETS IN A CLASS

Because of the declining balance methodology, it is possible that incremental CCA arising from the purchase of a depreciable asset can continue into the indefinite future. In fact, incremental CCA will continue even if the asset is salvaged at the end of its useful life because CCA is taken on classes of assets rather than individual assets. However, there are circumstances where the disposal of a depreciable asset causes a CCA class to be zeroed (i.e., the class is said to be "collapsed") with associated tax consequences.

First, if the last asset of a CCA class is disposed of, and yet there remains a positive UCC balance for the asset class, the firm is said to have had a "terminal loss." In this case, it is presumably the case that actual economic depreciation has exceeded CCA mandated depreciation, and therefore, to compensate the firm for this "neglected" depreciation, the difference between the beginning UCC balance for the tax year and the disposal price can be used by the firm as a final deduction (from taxable income). If the firm is in a tax-paying position, the reduction of taxes payable that arises from the terminal loss deduction is the corporate tax rate times the terminal loss. When a terminal loss is taken, the UCC balance for the asset class is zeroed.

As an example of a terminal loss calculation consider the following assumed facts. A firm has a beginning of year UCC for asset class 7 in the amount of $100,000. There is only one asset in

the class and it is disposed in the current year for $25,000. The corporate tax rate is 22.12%. The firm is in a tax-paying position. By how much are taxes payable reduced because of the terminal loss deduction? The terminal loss deduction is $100,000 less $25,000, which equals $75,000. The reduction in the firm's tax bill equals $0.2212 \times \$75{,}000 = \$16{,}590$.

Second, if the excess of disposals above acquisitions is lesser than the UCC balance, this excess reduces the balance. However, if the excess of disposals over acquisitions exceeds the UCC balance, the government will "recapture" past CCA deductions. In this case, it appears that economic depreciation has not been as extensive as presumed by the mandated CCA rate for the asset class. In a sense, the government has allowed too much in the way of deductions for depreciation. The government recaptures these depreciation deductions by requiring the inclusion of net disposals (over acquisitions) less the opening UCC balance into taxable income. The UCC balance for the asset class is set to zero when CCA is recaptured.

EXAMPLE

To illustrate some the tax effects associated with asset disposal, consider the following assumed facts. The opening balance for the CCA class is $10,000. There are two assets in this asset class. During the tax year, the firm sells one of the assets for a net price of $55,000. The original cost of the asset was $20,000. The tax rate is the small business tax rate of 22.12%. What is the incremental effect on the firm's tax bill as the result of this sale?

First, you should note that as the result of the pending collapse of the CCA class, the firm loses the ability to reduce taxes into the future on the UCC balance of $10,000. In addition, in the current tax year, there are two effects of the asset disposal. First, the firm realizes a capital gain. The incremental effect on taxes payable is $0.2212 \times 0.5 \times 35{,}000 = \$3{,}871$. Second, there is a recapture of depreciation in the amount of $\$20{,}000 - \$10{,}000 = \$10{,}000$. Notice that the UCC balance is reduced by the lesser of the sale price and the original cost. In this case, the original cost is less than the sale price. Nonetheless, there is a recapture of depreciation in the amount of

$10,000. The incremental increase in taxes payable is 0.2212*10,000 = $2,212. The total incremental effect on the firm's tax bill is $6,083.

TERMINAL LOSSES AND DEPRECIATION RECAPTURE

To illustrate the integration of terminal losses and recapture of depreciation in a capital budgeting exercise, let us consider an example.

ABC Co. Ltd. purchased a high-speed printing press three years ago for $100,000. In operating the press, ABC has earned $10,000 per annum in before tax operating profits in each of the last three years (measure profits at ends of years). Similar per-annum profits are expected for another ten years. Predicted salvage on the press at that time is $9,000. The printing press is the only depreciable asset owned by ABC. The CCA rate on this asset class is 12%. The current UCC balance for the asset class is $50,000. The corporate tax rate is 40%. The appropriate discount rate for capital budgeting purposes is 10% per annum. ABC has been offered $60,000 for the press. If ABC sells the press, it discontinues its printing operations. Should ABC accept the offer?

ABC has two options: they can operate the press for another ten years, or they can sell the press. Let us consider the present values of these two alternatives separately.

If ABC continues to operate the press, they receive after tax operating profits for 10 more years. In addition, they can continue to take CCA on the UCC balance for the asset class of $50,000. They can salvage the press in 10 years. In addition, either a terminal loss or a recapture of depreciation is likely to arise in 10 years because ABC will be selling their only asset. If the sale price is greater than UCC at that time, a recapture of depreciation occurs. If the sale price is lesser than the UCC balance, because they are selling the only asset in the class, a terminal loss arises.

What is the UCC balance for the asset class in 10 years presuming that there are no additions to the class? Because the CCA rate is 12% calculated on the declining balance, UCC in ten years is $0.88^{10}*50{,}000 = 13{,}925.05$. Because this amount is greater than predicted salvage, and the last asset is sold, a terminal loss occurs. The tax benefit of the terminal loss is the tax rate of 40% times the deduction (from taxable income) of 13,925.05 - 9,000 = $4,925.05.

The present value of the continue to operate option is, therefore,

$$PV = \frac{0.6*10{,}000}{0.1}*\left[1-\frac{1}{1.1^{10}}\right] + \frac{50{,}000*0.12*0.4}{(0.1+0.12)}$$

$$+ \frac{9000}{(1.1)^{10}} - \frac{13{,}925.05*0.4*0.12}{(0.1+0.12)*(1.1)^{10}} + \frac{0.4*(4{,}925.05)}{(1.1)^{11}}$$

= PV of after tax profits + PV tax shield on current UCC balance
+ PV of Salvage — PV of tax shields lost upon collapsing the UCC class + PV of terminal loss

$$= 36{,}867.40 + 10{,}909.09 + 3{,}469.89 - 1{,}171.35 + 690.48 = \$50{,}765.51.$$

Notice in these calculations, that both the present value of tax shields lost and the present value of the terminal loss deduction are small relative to the other values in the PV calculation. This is a common feature of tax effects that arise only in the distant future. In practice then, in many cases, and at least as a first approximation, these tax effects can be ignored.

The second option available to ABC is to sell their press for $60,000. However, there are a number of immediate tax consequences of this sale that must be recognized. First, because the sale price is lesser than the original cost, there are no capital gains taxes. There is, however, a recapture of depreciation. We are selling one asset for a price that is greater than the UCC balance for the entire asset class (regardless of the number of assets in the class, which happens to be one). Recapture of depreciation is the difference between the sale price of the asset and the

UCC balance for the asset class, which is 60,000 - 50,000 = 10,000. The present value of the sell option is, therefore, PV = \$60,000 – 0.4× \$10,000 = \$56,000.

Because the present value for the option to sell is greater than the present value of the option to continue, our analysis suggests that ABC should discontinue their printing operation.

(9.9) SUMMARY

Net present value (NPV) is a measure of shareholders' incremental wealth from a business investment. If this wealth increment is not positive, the investment should be rejected. A number of different criteria have been proposed and developed in the financial literature for the selection and evaluation of business investments. Each criteria has advantages and disadvantages that we examine and study in this chapter. There are a number of unique features of the application of discounted cash flow analysis to business investment. We investigate these features in this chapter. Finally, we investigate special cases for the application of our theory of value, discounted cash flow analysis (DCF), to business investments.

(9.10) SUGGESTED READINGS

Bierman, Harold, and Seymour Smidt. *The Capital Budgeting Decision: Economic Analysis and Financing of Investment Projects*, New York: Macmillan Publishing Company, 1994.

Brealey, Myers, Allen, *Principles of Corporate* Finance, 8'th edition, Boston: McGraw-Hill Irwin Publishers, 2006.

(9.11) PROBLEMS

1. Business investment Analysis with CCA.

ABC company has 10 million shares outstanding. Their current earnings per share is $2.00. They are considering an investment of $100,000 in a class-8 depreciable asset (CCA rate is 30%). The benefit of this investment is an increment to before-tax revenues of $50,000 per annum receivable beginning six years from today (measure these benefits at year-end). ABC's tax rate is 30%. ABC requires a rate of return of 12% on their investments. An accountant in the firm recommends that the investment not be accepted because earnings per share will be decreased for 5 years until the benefits of the investment are received. How do you respond?

Solution

2. Business investment Analysis with CCA

On a new business venture, Electronic Systems expects to be able to realize sales of $140,000 per annum. Incremental before tax operating costs are $100,000 per annum. The required outlay is $125,000. This amount is composed of an increment to trade capital of $25,000 and the purchase of a class 8 depreciable asset (CCA rate is 20%) for $100,000. The investment life is 10 years. At that time, the firm expects to be able to salvage the class 8 asset for its incremental undepreciated capital cost. Electronic Systems has many assets in this asset class. Electronic Systems has a tax rate of 25%. They require a rate of return of 12% on investments of this type.

(a) What is the NPV on this investment?

(b) Assume that Electronic Systems uses straight-line depreciation for financial reporting purposes. What is the NPV?

Solution

3. Business investment Analysis with CCA.

ABC has the following investment opportunity.

Required investment	$850,000
Annual Revenues	$500,000
Annual Operating Costs	$200,000

(before depreciation)	
Expected life	20 years
Predicted Salvage on depreciable asset	$700,000
Tax rate	34%

The investment is composed of the purchase of a $600,000 depreciable asset (class 7, CCA rate 15%) and an increment of $250,000 to trade capital. ABC has many assets, and will continue to have many assets in this asset class. Assuming that ABC wants to earn at least 12%, is this an attractive investment?

Solution

4. Inflation.

An investment that costs $100 million today promises *real* (current dollar) after-tax cash flows of $12 million per annum into the indefinite future. Expected inflation, also into the indefinite future, is 3% per annum.

(a) What is the real rate of return on this investment?

(b) What is the nominal rate of return (compounded once per annum)?

Solution

5. ***NPV and IRR.***

ABC Company is considering the purchase of a depreciable asset that requires an initial investment and then generates $100 per annum in after tax operating profit during its life. The expected life of the asset is 5 years. ABC can take CCA at the rate of 20% per annum. Salvage is 50% of the original purchase price. ABC's tax rate is 40%. ABC has many assets in this class, and therefore, terminal losses and/or recaptures will not arise as the result of disposal. The cost of capital is 10% per annum.

a) What is the maximum amount that ABC should be willing to pay for the depreciable asset?

b) Suppose that the actual selling price is that which you have calculated in (a) above. What is the IRR on the investment?

Solution

6. ***NPV and IRR***

A firm has two mutually exclusive investments: the investments are of equivalent risk, and therefore, they have the same discount factor. Hypothetically, if the discount factor were 5% per annum, the NPVs of investments A and B would be $10,000 and $5,000 respectively. On the other hand, if the discount rate were 15%, the NPVs of investments A and B would be $1,000 and $2,000 respectively. What is your best estimate for the IRR for each of these investments. (Use a linear approximation to the NPV schedules). Which of these investments should be chosen by the firm?

Solution

7. ***Payback Period and After Tax Cash Flows.***

Suppose you purchase a class 7 depreciable asset (CCA rate is 15%) for a new business investment investment. The cost of the asset is $100,000. Your corporate tax rate is 40%. The investment generates $30,000 per annum in incremental before tax operating profits. Recognizing CCA and the half-year rule, what is the payback period on this investment?

Solution

8. ***Real Asset and Financial Asset Investment.***

Discuss the following assertion: "It is harder to find financial assets with positive NPV than it is to find real assets with positive NPV."

Solution

9. ***Inflation.***

You have just finished a business investment analysis for a new venture within your firm. As the result of your keen sense of business investment, your firm has accepted your recommendation and the investment has now been accepted. The depreciable assets have been purchased and funds have been set aside for the trade capital needs of the new investment. If inflation in the future is greater than you had anticipated, which component of your discounted cashflow analysis (leading to your recommendation for the acceptance of the investment) is likely to be more affected: (i) the present value of per annum operating (cash) profits or (ii) the present value of capital cost allowance tax shields? Explain and discuss. Use no numerical examples in your response.

Solution

10. ***Net Present Value Schedules.***

Your firm is considering two business investments that are of approximately the same risk. Neither investment has multiple internal rates of return. Both investments are typical types of real assets investments that require an initial investment and then return the benefit of that investment in the indefinite future. Hypothetically, the two investments have the same Net Present Values when the cost of capital is 8% per annum. Investment A has a payback period of 5 years, whereas investment B has a payback period of 10 years. Which investment is more likely to have the higher internal rate of return? Under what conditions will investment A be accepted over investment B and vice versa? Under what conditions are both investments acceptable? Explain and discuss.

Solution

11. ***Opportunity Costs.***

Consider a particular firm. Rank this firm's yield to maturity on its bonds, market capitalization rate on its common equity, and cost of capital on its business investments from the highest to lowest. Explain why and the criterion you use for your ranking. A complete response is required for full marks. Use no numerical examples in your response.

12. IRR and Mutually Exclusive Investments

ABC Company Ltd., is considering two real asset investments that are of approximately the same risk. In either case, the per annum after tax operating cash flow of the investment (net of all expenses) begins one year from today and then continues each year thereafter. Project A requires an investment today of $1,000,000. The non-growing incremental after tax operating cash flow is $A per annum into the indefinite future. Project B, on the other hand, requires an investment today of $300,000. The non-growing incremental after tax operating cash flow is $B per annum into the indefinite future. Ignore CCA, CCA tax shields, and maintenance capital expenditures in this problem. The payback period for project A is 10 years and the payback period for project B is 8 years. Project A and B are mutually exclusive.

Required: Over what range for a hypothetical cost of capital should ABC Company Ltd. choose project A over project B, project B over project A, or neither project? Explain.

Solution

13. Modified IRR

ABC company is planning a business investment that requires an initial expenditure of $120,000. Forecast incremental FCF for this investment is $283,200 in one year and -$166,656 in two years. Because this last number is negative, the investment has two IRRs. ABC has determined that the Modified IRR (MIRR) for this investment is 20.1332593% per annum. The MIRR recognizes reinvestment of the intermediate cashflow, $283,200, at a financial market rate.
Required: Should ABC make the investment or not? Explain.

Solution

14. Cost of Capital and Market to Book Ratio

ABC Company Ltd., is considering a possible business investment that requires an $A investment today. Forecast incremental free cash flow (FCF) is $B per annum indefinitely (the first of these amounts is one year from today). The payback period is 5 years. ABC plans to start this new venture because its NPV is positive. Immediately after the $A investment required to start operations, the new venture's market to book ratio (value to expenditure) is 1.25.
Required: What is the new venture's cost of capital?

Solution

15. Dis-Investment

ABC Hotels Ltd. is considering "out-sourcing" it's laundry, which it now cleans "in-house." Currently, ABC trucks soiled bedding, towels, wash-cloths, etc., for all ABC hotels to a central laundry and once cleaned, these items are then returned. As an alternative, ABC is considering selling its laundry operations to an independent business. The independent business has offered ABC $1,000,000 for the laundry operation. Thereafter, ABC expects to pay $150,000 per annum indefinitely (net of expenses and taxes) to the independent business for ABC Hotel laundry services.

Required:

(c) What is the IRR on this "dis-investment" by ABC?

(d) For what values of the cost of capital should ABC Hotels proceed with the laundry outsourcing and for what values should they not? Explain, briefly.

Solution

16. Mutually Exclusive Investments

ABC Company Ltd., is considering two possible business investments that are of approximately the same risk. These investments are mutually exclusive. In either case, their incremental free cash-flow begins one year from today. Investment A requires an expenditure today of $1,000,000. You forecast incremental free cash flow one year from today to be $100,000. Thereafter, free cash flow grows indefinitely at 2% per annum. Investment B requires an expenditure today of $1,500,000. You forecast incremental free cash flow one year from today to be $200,000. Thereafter, free cash flow grows indefinitely at 2% per annum. Ignore capital cost allowance and depreciation in this problem. ABC has asked for your advice on which project they should choose. How do you respond? Describe the circumstances that would lead you to recommend one of these investments and which one. Full marks require a complete explanation.

Solution

(9.12) Chapter Index

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