

CHAPTER 4: FINANCIAL ANALYSIS OVERVIEW

In the financial analysis examples in this book, you are generally given the all of the data you need to analyze the problem. In a real-life situation, you would need to frame the question, determine the type of analysis to do, and collect the data yourself. Only then can you apply the procedures you have learned in the previous chapters. The first section in this chapter discusses the overall process of conducting a financial analysis, of which calculating a present or future value is only a small part. Selecting an interest rate to use in a financial analysis can be one of the most difficult steps, usually with no clear-cut right or wrong choice. The second section of the chapter provides some guidelines to consider in selecting an interest rate.

Chapters 2 and 3 focused largely on the details of how to discount in a variety of different situations. We have not focused much on how the results of a financial analysis should be interpreted and how they should be used in decision making. The third section in this chapter discusses three criteria that are used for assessing the financial merits of projects: the net present value, the benefit/cost ratio, and the internal rate of return. In general, the net present value is the preferred criterion. However, each can provide useful information.

A final section of this chapter discusses some ethical concerns that have been expressed regarding discounting and its implications for long-term investments, such as those that are often required in forest management.

1. Steps in Financial Analysis

In a real-life management situation, conducting a financial analysis involves far more than simply calculating a net present value. Generally, you will need to identify the data to use in the analysis. Often, you will have to decide for yourself which data are relevant and should be included. Part of the analysis process is sifting through all of the potentially relevant information to identify what is most important. Sometimes it is not even clear what the question is. The following is a list of general steps typically involved in a financial analysis. It is intended to give you an idea of how you might work your way through the overall process.

1. Identify exactly what the question is.

This step is often called “framing the question.” It may seem like a trivial step; however, it is perhaps the most important. Usually, a financial analysis is done to provide input into some decision-making process. Here are some questions that should be asked:

! What is the decision that needs to be made? Was there a problem which precipitated the need for a decision? What issues need to be addressed by the decision?

! Who will be affected by the decision? Have all potential stakeholders been considered?

! How will the results of the financial analysis be used in making the decision?
Have all of the possible alternatives been considered?

2. Establish the scope of the financial analysis problem.

It is generally not necessary, or even desirable, to consider everything that might affect a project. Part of the analysis should involve identifying the key aspects of the project. The following are some basic questions that should be considered before initiating any financial analysis problem.

! Which impacts will be included in the analysis? Will the analysis consider only timber-related impacts, or will it include wildlife, water quality, recreation aesthetic, or other impacts? Will the analysis consider only impacts that affect the owner of the forest land, or should the analysis also account for impacts on neighboring lands? What about the general public?

! When does the project end? Does it have an end? How far out should you go in considering impacts? What is the *time horizon* of the analysis?

3. Identify the schedule of events associated with the project.

! When are activities expected to happen? When do benefits occur? When are goods produced? When are services provided? When do costs occur?

! Are there any other significant events that should be considered?

4. Quantify and value events wherever possible.

For each good, service, cost or benefit that occurs, three pieces of information are needed: 1) the quantity, 2) the value (generally, this would be the quantity times its price), and 3) the timing of the good, service, cost or benefit (this was determined in step 3). This raises many questions:

! How will the impacts of the project be predicted? What sources of data are available? Are there published data that can be used? If existing data are not available, will original data be collected? To what extent can or should expert opinion be used? Are there models that apply to the situation? For example, how will future prices be predicted? What price data are available? How will future timber yields be predicted? How might impacts on wildlife, water, recreation, or aesthetics be predicted?

! Sometimes items are relatively easy to quantify but difficult to value; for example, the number of acres of a particular type of grouse habitat may be easy to measure, but what is its value?

! Sometimes both quantifying and valuation are difficult; e.g., aesthetics.

5. Select an alternate rate of return and calculate the project's net present value.

! Selecting the alternate rate of return is discussed in the next section of this chapter.

! Chapters 2 and 3 covered the mechanics of calculating the net present value.

There is an amusing story of a drunk who was found, late at night, looking for something under a street lamp. The person who found the drunk asked him what he had lost. The drunk replied, “My keys.” The person then asked: “Is this where you lost them?” Again, the drunk replied, “No, but the light is better here.” Often, the same thing happens with financial analyses. Wildlife, water, aesthetics and recreation may have very high values, but such values are difficult to quantify. On the other hand, we typically have relatively good information about timber. Thus, we end up analyzing the timber values, ignoring the potentially larger, but less quantifiable values associated with other forest resources. This book also falls into this trap, partly because “that’s where the light is.” Many of these other values *can* be quantified and valued, but it is difficult, and foresters and forest economists are still learning how.

2. Selecting an Interest Rate

In this book, you are generally given the interest rate to use in solving each problem. As a forest manager or consultant, you may have to decide for yourself what rate you should use when conducting financial analyses. Often, in a real-world situation, there is no clear right or wrong interest rate to use. However, there are some basic principles that you should consider in selecting an interest rate.

Recall one of the terms that is commonly used to describe the discount rate: the *alternate rate of return* (ARR). This term reflects the first rule in selecting a discount rate:

- ☞ The applicable discount rate for a financial analysis is the rate the investor (you, your client, your company, the government, etc.) can earn in their best comparable alternative investment.

The word “comparable” is important here because some alternatives are not really equivalent. A comparable investment will be similar in terms the five factors discussed in Chapter 3 that affect the real rate of return, namely: risk, liquidity, transactions costs, taxes and the time period of the investment. It is generally impossible to find a perfectly comparable alternative investment, so some judgement will usually be required. Thus, if the risk associated with the alternative investment is not similar to the risk associated with the investment under consideration, then the rate of return on that alternate investment may need some adjustment before it is used as an alternate rate of return.

A key consideration when selecting a discount rate is the financial position of the person or company for whom the analysis is being done.

- ☞ If the person (or company) is going to borrow money to carry out the project, then the rate of interest on the loan is usually the best discount rate.
- ☞ If the person (or company) is going to invest their own money in the project, then the ideal discount rate would be the rate of return on the investment that the money would be used for if the project was not pursued.

Finally, many organizations have a set discount rate that they require you to use for any financial analyses you conduct for them. If the organization you are working for has a specified rate, then obviously that is the rate you should use.

Again, be sure you know whether the rate you choose is a real rate or a nominal rate, and make sure you project real future values if and only if you are going to use a real discount rate and nominal future values if and only if you are going to use a nominal discount rate. This is an extremely important point. If you apply the wrong kind of rate, your analysis will be worse than no analysis at all!

3. Alternative Financial Criteria for Project Evaluation

The primary purpose of doing a financial analysis of a project is to evaluate the project's profitability or cost-effectiveness relative to some alternative project or investment. Frequently, the results of the financial analysis are used to compare alternative projects to select which ones should be implemented. Sometimes projects are mutually exclusive, such as alternate prescriptions for a stand. In this case, only one project will be selected and the task is solely to determine which of the choices is best. In other cases, any or all of the projects can be implemented, and the task is to identify all of the projects which should be pursued. Several different financial criteria have been proposed for comparing different projects. This section reviews three that are commonly used. Most economists agree that the net present value is the best, but all have some value. Of course, financial criteria will generally not be the only criteria used in deciding which project or projects to select.

Net Present Value (NPV)

The NPV is the sum of all of the discounted net benefits (benefits minus costs) associated with a project. It is the most widely accepted criterion for selecting between projects.

$$NPV = \sum_{t=0}^T \frac{Revenue_t - Cost_t}{(1+i)^t}$$

The criterion for project acceptability is $NPV > 0$. A $NPV > 0$ indicates that the project will be able to pay interest on all of the capital invested in the project, plus earn an excess return (or true profit) equal to the NPV. As a general rule, all projects with a positive NPV should be pursued. If all non-mutually exclusive projects with a positive NPV cannot be pursued due to limited capital, then capital is really more scarce than implied by the interest rate, and the alternate rate of return used in the calculations does not reflect the true cost of capital. In this case, a higher discount rate should be used.

In general, for mutually exclusive projects, a project with a higher NPV is better than a project with a lower NPV. This is not a rule that should be applied blindly, however. One project may have a higher NPV simply because it is a bigger project, with proportionally large

investment requirements. The Benefit/Cost Ratio is also useful because it takes into account the relative size of the investment.

Benefit/Cost Ratio (B/C)

The B/C is the ratio of the discounted benefits over the discounted costs. It measures the size of the benefits of a project relative to the costs of the project.

$$B / C = \sum_{t=0}^T \frac{Revenue_t}{(1+i)^t} \bigg/ \sum_{t=0}^T \frac{Cost_t}{(1+i)^t}$$

The criterion for project acceptability is $B/C > 1$; that is, the discounted project benefits should be greater than the discounted project costs. As with the NPV, all non-mutually exclusive projects meeting this criterion should be pursued. Note that all of the projects with a $B/C > 1$ will also have $NPV > 0$. However, the ranking of projects may be quite different under the two criteria.

What should be done when the NPV and the B/C result in conflicting recommendations for choosing among a set of mutually exclusive projects? In other words, what if two mutually exclusive projects are ranked differently by these two criteria – one having the higher NPV and the other having the higher B/C ratio? The answer will generally be the project with the higher NPV. The project with the higher NPV will generally have higher capital requirements, but, assuming that the cost of this capital has been properly accounted for, the capital required by this project will be well-invested. Keep in mind, however, that the financial analysis seldom captures all of the relevant information about the projects under consideration, and these financial criteria are usually not be the sole factor in selecting a preferred alternative. In ambiguous cases where different financial criteria point toward different conclusions, the factors not included in the financial analysis may tip the balance toward one project or the other.

Internal Rate of Return (IRR)

The IRR is the discount rate for which the NPV of a project is 0. The criterion for project acceptability is that $IRR > ARR$. It is widely used, largely because it seems easy to interpret.

The IRR is not generally a good way to evaluate investment alternatives. The IRR assumes that all of the profits (net revenues after accounting for costs) from a project should be counted as a return to the capital used in the project. However, if the correct alternate rate of return is known, then this rate is the only payment that should be attributed to the capital used in the project. For example, if all of the capital used for a given project is borrowed at a given interest rate, then the interest paid on the borrowed capital is the true and total cost of the capital. It is not necessary to pay any more than this for the use of the capital. If a project has a positive net present value when the appropriate alternate rate of return is used, then this positive net present value should be interpreted as “true profits.” Generally, the true profits of

a project should be attributed to the skill of the designers and managers of the project. (Sometimes these true profits are attributed to the land, as when we calculate a land expectation value. This makes some sense when we are trying to assess the value of a piece of forest land. However, if we know what the land is worth, or what it would rent for, then attributing the excess profits to the land would also be incorrect.)

Another problem with the IRR has to do with how intermediate costs or returns are treated. The IRR assumes that funds to cover intermediate costs are borrowed at the IRR and that intermediate returns can be reinvested at the IRR. This is perhaps the most serious shortcoming of the IRR, as the borrowing rate and the reinvestment rate will usually be independent of the project under consideration. To properly calculate an IRR, therefore, you need to explicitly account for the rate paid for borrowed money and the rate received on reinvested intermediate returns. However, if you know what these rates are, then you already have all the information you need to select an appropriate alternate rate of return to use in calculating the NPV.

You will sometimes get different results from the maximum NPV criterion than from the maximum IRR criterion. So, which investment is the best: the one that maximizes the NPV or the one that maximizes the IRR? The answer is usually the one that maximizes the NPV.

Even though the IRR should generally not be used to decide which of two or more projects is best, it does give some useful information about a project and you should know what it is and how to calculate it. Frequently there is no direct way to calculate an IRR, so in practice the IRR is calculated iteratively by calculating a net present value with different interest rates until the resulting net present value is approximately zero. A solve-for function (**Tools ► Goal Seek** in Microsoft Excel) is available in most spreadsheet packages which can be very useful for finding a precise IRR. Most spreadsheets also have an IRR function that can be used to solve directly for the IRR of a stream of costs and revenues.

Example: NPV, IRR and B/C Ratio

Consider two alternative investments. Option 1 is an example of low intensity forest management. With Option 1 you make a minimal investment of \$50 per acre to establish the stand. At the end of each year, for 30 years, you will incur an annual management expense of \$25 per acre with Option 1. At the end of 30 years, you expect to receive \$4,000 per acre in stumpage fees. Option 2 is a more intensive management option. With Option 2, your initial stand establishment investment is \$400 per acre, and your annual management expenses are projected to be \$50 per acre. With Option 2, however, you expect to receive considerably more in stumpage fees: \$8,000 per acre. Table 4.1 summarizes the cash flows for the two options.

Table 4.1. Cash flow summary for alternative investments.

	Year	Option 1	Option 2
Initial investment	0	\$50	\$400
Annual mgmt. expense	All	\$25	\$50
Final expected return	30	\$4,000	\$8,000

a. Calculate the NPV for these two investments using four interest rates: 4%, 6%, 8%, and 10%.

Answer: The general formula for the net present value in this example is:

$$NPV = -E + \frac{-R[(1+i)^{30} - 1]}{i(1+i)^{30}} + \frac{V_{30}}{(1+i)^{30}}$$

where E = the initial (establishment) investment,
 R = the annual management expense, and
 V_{30} = the final expected revenue in year 30.

Table 4.2 shows the NPVs for the two options using the four interest rates, and Figure 4.1 below shows a graph of the results.

Table 4.2. NPVs for alternative investments under several discount rates.

Interest Rate	Option 1	Option 2
4%	\$750.97	\$1,201.95
6%	\$302.32	\$304.64
8%	\$66.06	-\$167.87
10%	-\$56.44	-\$412.88

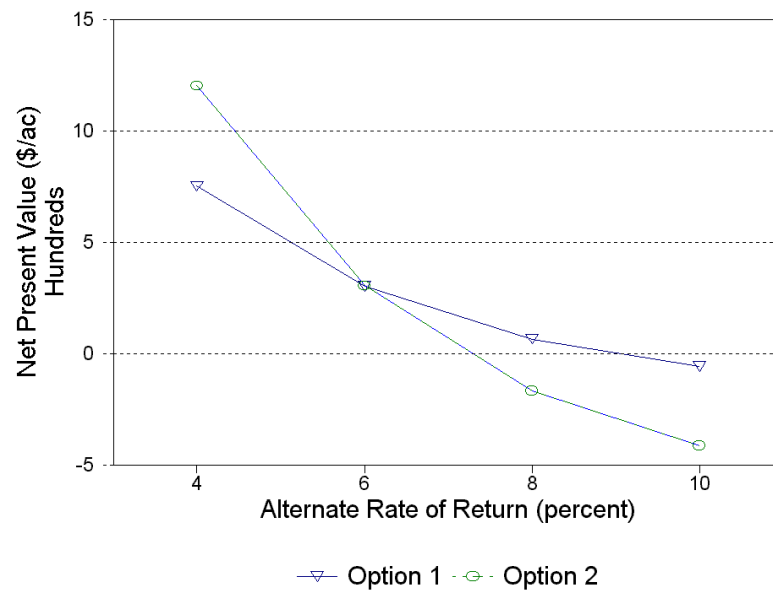


Figure 4.1. Net present value of alternative investments at several interest rates.

b. Calculate the B/C ratio these two investments using four interest rates: 4%, 6%, 8%, and 10%.

Answer: The general formula for the benefit-cost ratio in this example is:

$$B/C = \frac{V_{30}}{(1+i)^{30}} \bigg/ E + \frac{R[(1+i)^{30} - 1]}{i(1+i)^{30}}$$

where the variable definitions are the same as in part **a**.

Table 4.3 shows the B/C ratios for the two options using the four interest rates, and Figure 4.2 below shows a graph of the B/C ratios .

Table 4.3. B/Cs for alternative investments under several discount rates.

Interest Rate	Option 1	Option 2
4%	2.557	1.950
6%	1.767	1.280
8%	1.199	0.826
10%	0.802	0.526

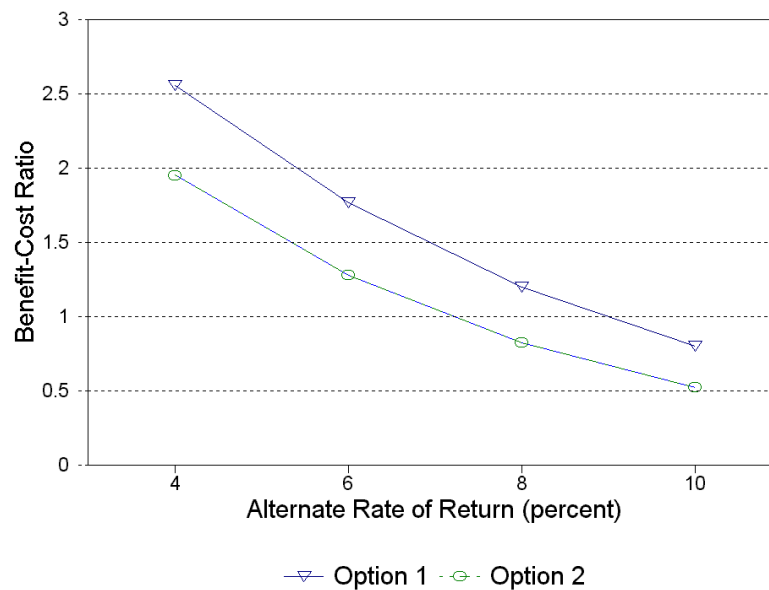


Figure 4.2. Benefit-cost ratios of alternative investments at several interest rates.

c. Estimate the internal rate of return for the two investments to the nearest hundredth of a percent.

Answer: Recall that the IRR is the interest rate at which the net present value of the investment equals zero. Looking at Figure 4.1, it is pretty clear that the IRR of Option 1 is about 9% and the IRR of Option 2 is about 7.5%. In order to calculate the IRR more precisely than this it is usually necessary to use an iterative process such as the following:

1. Start with an initial estimate at the IRR.
2. Calculate the NPV with the current estimate of the IRR.
3. If the NPV is close enough to zero, stop. If the NPV > 0, increase the estimate of the IRR and return to step 2. If the NPV < 0, decrease the estimate of the IRR and return to step 2.

This can be a laborious process if done with a calculator. However, most spreadsheets have built-in functions for calculating IRRs. Also, most spreadsheets have some kind of “solve-for” function, which allows you to use the computer to find the value of a variable that results in a function taking on some target value. I used Quattro Pro’s[®] *solve-for* function to identify the IRRs of these two investments. The IRRs are given in Table 4.4.

Table 4.4. IRRs for alternative investments.

	Option 1	Option 2
IRR	8.91%	7.13%

There are a few things you should note about this example. First, Option 1 has a higher B/C ratio at all of the interest rates considered. Furthermore, Option 1 has a higher IRR. In addition, if one's ARR is greater than 6%, Option 1 has a higher NPV. In spite of the fact that Option 1 outperforms Option 2 by all of these criteria, however, if the true cost of capital is less than or equal to 6%, then Option 2 is the better investment. This is because the NPV of Option 2 is higher than the NPV of Option 1 when the interest rate is less than or equal to 6%.

4. Is Discounting Unfair to Future Generations?

Some people believe that discounting future values is wrong – even immoral. At least one major religion, Islam, forbids paying and charging interest. Yet the American economic system is predicated on the borrowing and lending of money. Is charging and earning interest good or bad? Is charging interest ok in some situations and not others?

Islam's ban on charging interest was a reaction to the *usurious* interest rates that were common in ancient cultures. (*Usury* is charging an exorbitant amount of interest – imagine a loan shark.) A more modern argument against discounting (and implicitly against charging interest) is that it is unfair to future generations. The discount rate is determined by the current generation without any input from future generations. Since the discount rate can be interpreted as an exchange rate for the value of goods tomorrow versus the value of goods today (see Chapter 2, Section 2), then there is a tradeoff between how we value the well-being of current and future generations that is implicit in the interest rate. Interest rates are like a price set in a market where one group of traders (the current generation) gets to set the price and everyone else (all future generations) has to live with that price. Some people suggest that, while it is necessary to discount, lower interest rates should be used for investments with particularly desirable “social” benefits.

I am not convinced by these arguments. First, it is not clear that low interest rates are always better for future generations. Not discounting at all is the same thing as using an interest rate of zero. When someone says they don't believe in discounting, or that they believe that discounting is unfair and should not be done, they are essentially suggesting that interest rates should be zero. However, if interest rates were zero, there would be no incentive for anyone to save money. If no one saved any money, there would be no investment, and that would not be good for future generations at all. Thus, a discount rate of zero would not necessarily be good for future generations.

So, would positive, but lower interest rates be good for future generations? Low interest rates do benefit future generations in some ways. For example, with low interest rates more

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investment projects that benefit future generations would be able to pay the interest on the capital used in the project and still show a profit. Using a lower interest rate for projects which are particularly beneficial to future generations is a way of biasing the analysis in favor of those projects. However, with low interest rates fewer people would be willing to invest their money at all, so there will be less money available for investments in general. In order to raise the capital to fund all the projects that would be profitable at lower-than-market interest rates, the government would have to subsidize these investments. This would represent a transfer from the current generation to future generations. A good argument can be made that current generations are better off than earlier generations and that future generations are likely to be even better off than we are. In that case, why should the current generation subsidize future generations? Furthermore, if these subsidies are funded by deficit spending, as is usually the case for modern governments, future generations will end up paying for the subsidies anyway.

It is best to think of an interest rate as an equilibrium price where the supply of investment money is just high enough to satisfy the need for funds from projects that can meet the given interest rate. One reason suggested for using lower-than-market interest rates for some projects is that there are benefits associated with those projects that are not accounted for in the cost-benefit analysis. This may be true; however, we should not arbitrarily bias the financial analyses of such projects for this reason. A better approach is to use financial analysis as only one of the criteria for evaluating projects. Benefits that are difficult to quantify in a financial analysis should be addressed by the other criteria used to evaluate projects.

It is probably true that an equilibrium interest rate that is lower will benefit future generations more than an equilibrium rate that is higher. But, too low an interest rate may not be fair to current generations. What then is the best interest rate – one that is fair to all generations? What mechanism should be used to lower interest rates if society decides interest rates should be lower? How should interest rates be lowered if the “ideal” interest rate were lower than the current market interest rate? These questions, while very interesting, are beyond the scope of this course.

5. Study Questions

1. What are the basic steps in performing a financial analysis? What kinds of questions should you consider? What kinds of information will you need?
2. What kind of questions should you ask yourself when considering the scope of a financial analysis?
3. What three basic pieces of information are usually needed for each good, service, cost or revenue for a financial analysis of a project?

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4. Give an example of a good or service produced by forests that is easy to quantify but difficult to value. Give an example of a good or service produced by forests that is difficult to quantify and to value.
5. Why is the discount rate sometimes called the alternate rate of return?
6. What basic principle should always be considered when selecting an interest rate?
7. How does the financial position (as a lender or borrower) of the investor affect the choice of the discount rate for a financial analysis?
8. What is the NPV? . . . the B/C? . . . the IRR?
9. What is the criterion for project acceptability for the NPV? . . . for the B/C? . . . for the IRR?
10. How is the IRR of a project generally calculated?
11. Why is the IRR generally not a good way to evaluate investment alternatives?
12. How can higher interest rates hurt future generations? How can higher interest rates help future generations?
13. Explain why not discounting at all is the same thing as using an interest rate of zero.

6. Exercises

- *1. Consider the following investment. You invest \$500 per acre to establish a stand of trees. At the end of each year for 30 years, you incur an annual management expense of \$10. At the end of 30 years, you receive \$5,000 per acre in stumpage fees.
 - a. Calculate the NPV and B/C ratio for this investment.
 - b. Calculate the internal rate of return on this investment to the nearest tenth of a percent.