Topic 6: Capital Budgeting in Practice

(a) Overview

How do we apply the NPV rule to capital budgeting? Because accounting and finance are different, it is not always straightforward. The following general rules help with some of the issues that will arise.

1. Use cash flows (not net income), and calculate cash flows after tax.

   We will need to transform accounting data into cash flows. Depreciation, for example, is not a cash flow. But, the tax effects of depreciation are tax flows.

2. Timing of cash flows is critical. It is important to record cash flows at the time the cash is received or paid out (because you can earn or pay interest). This can make a big difference if it is taking customers a long time to pay. You will then need to adjust earnings by working capital.

3. Analyze incremental cash flows. Namely include all incidental effects (if revenues or costs in any part of the business are affected then these need to be included in the calculation).

   Exclude sunk costs. These are investments that have already been made. They are irreversable. There's nothing you can do about them – let bygones be bygones.

   Include opportunity costs. Even if the firm already has the land, you need to take into account the fact that it could be rented out or sold if the project is not done.

4. Be consistent in the treatment of inflation. Discount nominal cash flows at nominal rates and real cash flows at real rates.

(b) Depreciation

To see the effect of depreciation on cash flows:

- Let R denote *additional gross revenues* from undertaking the project.
- Let C denote *additional gross operating costs*.
- Then NOI (additional net operating income) = $R - C$.
- Let t_C denote the corporate tax rate.
- In this simple example:

$$\begin{aligned}\text{After Tax Cash Flows} &= \text{NOI} - \text{Tax}\\ &= R - C - t_C(R - C)\\ &= (1 - t_C)(R - C).\end{aligned}$$

  If there's no depreciation: after-tax cash flows would just be $(1 - t_C)(R - C)$.

- So, depreciation lowers your accounting income but raises your cash flows:
  - Total taxes = $t_C(R - C - \text{Dep})$.
  - After tax CFs:

$$\begin{aligned}\text{NOI} - t_C(R - C - \text{Dep}) &= R - C - t_C(R - C) + t_C\text{Dep}\\ &= (1 - t_C)(R - C) + t_C\text{Dep}.\end{aligned}$$

- By taking depreciation out of income, we lower our taxes! The term $t_C\text{Dep}$ is called the depreciation tax shield.

Example

The Pierpont Company is thinking of building a plant to make trumpets. The plant and equipment will cost \$1 million. It will last for five years and will have no salvage value at the end. The costs of running the plant are expected to be \$100,000 per year. The revenues from selling the trumpets are expected to be \$375,000 per year. All cash flows occur at the end of the year. The firm uses straight line depreciation. Its corporate tax rate is 35% and the discount rate is 10%. The projected income statement for the project is as follows:

Revenues	\$375,000
Operating Expenses	-\$100,000
Net Operating Income	\$275,000
Depreciation	-\$200,000
Taxable Income	\$75,000
Taxes	-\$26,250
Net Income	\$48,750

Solution:

The first thing to do is to create a cash flow table:

Date:	0	1	2	3	4	5
Plant Cost	-1M					
After-Tax Operating Income		178,750	178,750	178,750	178,750	178,750
Depreciation Tax Shield		70,000	70,000	70,000	70,000	70,000

Notes:

1. After-Tax Operating Income = 0.65 (375,000 - 100,000) = 178,750.

2. Depreciation Tax Shield = 0.35 (200,000) = 70,000.

So:

$$\text{NPV} = -1M + (178{,}750 + 70{,}000)\text{AF}^5_{0.10} = -57{,}042.$$

The NPV is negative, so the firm should not undertake the project.

An alternative way to do the calculation (which, in this case, is simpler), is to add depreciation back to income after taxes:

Revenues	\$375,000
Operating Expenses	-\$100,000
Net Operating Income	\$275,000
Depreciation	-\$200,000
Taxable Income	\$75,000
Taxes	-\$26,250
Net Income	\$48,750
(Add back) Depreciation	+\$200,000
Cash flow years 1-5	\$248,750

Calculating NPV:

$$\text{NPV} = -1M + (248{,}750)\text{AF}^{5}_{0.10} = -57,042.$$

Example The following information is from the projected income statement for the Madison Company for the next five years:

Revenues	\$100,000/year
Operating Expenses	-\$50,000/year
Net Operating Income	\$50,000/year
Depreciation	-\$30,000/year
Taxable Income	\$20,000/year
Taxes	-\$8,000/year
Net Income	\$12,000/year

In an attempt to improve projected performance, the firm is considering replacing one of their assets. This is not expected to affect revenues, but the company's operating expenses would be reduced by 10%. The old machine was purchased 3 years ago for \$42,000. At that time, it was estimated to have an eight year economic life. It could now be sold for \$25,000. Annual straight-line depreciation on this asset is 1/6 of the firm's total annual depreciation. The new machine costs \$30,000, has a five year economic life, and has no expected salvage value. If the firm's required rate of return is 16% should it purchase the new machine?

Solution

Here, we investigate whether the NPV of selling the old machine and replacing it with the new machine is positive.

Cash Flow at End of Year:	0	1	2	3	4	5
Old Machine:						
1. Sale of old machine	25,000					
2. Loss of depreciation tax shield		-2,000	-2,000	-2,000	-2,000	-2,000
3. Loss of expected salvage value						-2,000
4. Tax benefit from book loss	800					
New Machine:						
5. Cost	-30,000					
6. Depreciation tax shield		2,400	2,400	2,400	2,400	2,400
7. Reduction in operating expense		3,000	3,000	3,000	3,000	3,000

Calculations:

Old Machine – purchased 3 years ago for \$42,000:

1. Sale of old machine: \$25,000 (from question).

2. Loss of tax shield from depreciation of old machine:

   - The question specifies that the depreciation on the machine is one sixth of the firm's total (30K).

   $$\text{Annual Depreciation} = \frac{1}{6}(\text{Firm's Total Depreciation}) = \frac{30{,}000}{6} = 5{,}000.$$

   - t_C = Taxes/Taxable Income = 8,000/20,000 = 40%.
   - Thus the annual tax shield from depreciation = 0.4(5,000) = 2,000.

3. Loss of expected salvage value:

   - To compute the salvage value, first compute

   $$\text{Total accumulated depreciation} = \text{Economic life} \times \text{Annual depreciation} = 8(5{,}000) = 40{,}000.$$

- Then

$$\begin{aligned}\text{Salvage value} &= \text{Purchase price} - \text{Total accumulated depreciation}\\ &= 42{,}000 - 40{,}000 = 2{,}000.\end{aligned}$$

  Note: You are selling the asset at book value, so there is no loss or gain and therefore no tax.

4. Tax benefit from book loss (or gain) when machine is sold:

   - Accumulated depreciation = 3 years * 5,000 = 15,000.
   - Book Value = Purchase Price - Accumulated Depr. = 42,000 - 15,000 = 27,000.
   - Sale Value = 25,000.
   - Book Loss = Book Value - Sale Value = 27,000 - 25,000 = 2,000.
   - Tax Benefit (from loss on sale) = Book Loss * Tax Rate = 0.4 * 2000 = 800.
   - Note: the reason we multiply by the tax rate here is similar to that with the tax shield from depreciation.

New Machine – 5 year life and no salvage value:

5. Cost: 30,000 (from question).

6. Tax benefit from depreciation shield:

   - We compute annual depreciation from the purchase price (30K), the salvage value (0), and the fact that the machine has a 5-year life:

$$\text{Annual depreciation} = (30{,}000 - 0)/5 = 6{,}000.$$

     Thus the depreciation tax shield is $t_C(6{,}000) = 2{,}400$.

7. Net savings resulting from reduction in operating expenses:

   - Operating expense reduction if new machine is purchased = 0.10 * 50,000 = 5,000.
   - Net reduction in operating expenses after tax = 0.6 * 5,000 = 3,000.

- Note: here we multiply by $(1-t)$ since the before-tax cash flow is reduced by taxes at rate t. This contrasts with depreciation, where only taxes are reduced, and the before-tax cash flow remains the same.

Calculation of NPV from Cash Flows

$$\begin{aligned}\text{NPV} &= 25000 + 800 - 30000 - 2000(\text{DF}^5_{0.16}) + (-2000 + 2400 + 3000)(\text{AF}^5_{0.16}) \\ &= 5980 > 0.\end{aligned}$$

Therefore, the firm should sell the old machine and purchase the new machine.

What was nice about the example above? The remaining life of the old machine was the same as the life of the new. We look next at how to solve problems if this is not the case.

(c) Inflation and Capital Budgeting

Example Assume: interest rate $r = 10\% \Rightarrow$ invest 100 today, get 110 next year. However, what you really care about is what you can buy with that. Suppose you really like apples:

- This year: 1 apple costs \$0.50 $\Rightarrow$ \$100 buys 200 apples this year.
- Next year: 1 apple costs \$0.55 $\Rightarrow$ \$110 buys 200 apples next year.

$$\text{Real Interest Rate } = 200/200 - 1 = 0.$$

This leads us next to the definition for inflation rate:

Definition

$$\textit{Inflation rate } = \frac{\textit{price of goods at } t+1}{\textit{price of goods at } t} - 1$$

where inflation rate is the % increase in prices.

Economists typically use a so-called typical basket of goods to measure the rate of inflation. The consumer price index (CPI) is a basket of goods a consumer buys. The producer price index (PPI) is the basket of goods that companies, or producers of goods, buy.

Over the past 50 years or so, the inflation rate $\approx 4\%$ on average.

A simple equation relates the real interest rate to the nominal rate and inflation rate:

- Let rr = real interest rate.
- Let r = nominal interest rate.
- Let i = inflation.

Result.

$$1 + rr = \frac{1+r}{1+i}.$$

Let's see how this works in the context of our example. Assume apples are the only goods. Then the inflation rate is

$$i = 0.55/0.50 - 1 = 10\%.$$

Because

$$r = 10\%,$$

the real interest rate is given by

$$rr = (1 + 0.1)/(1 + 0.1) - 1 = 0\%$$

which confirms our intuition.

Application to Discounting

Two ways to discount:

1. Discount nominal payoffs at nominal rates.
2. Discount real payoffs at real rates.

$\Rightarrow$ Same answer!

Example Assume:

- Nominal cash flows: $C_0 = -\$100$, $C_1 = 30$, $C_2 = 150$.
- $r = 10\%$.
- Projected $i = 4\%$.

Method 1:

$$\text{NPV} = -100 + \frac{30}{1.1} + \frac{150}{1.1^2} = 51.24.$$

Method 2: Put everything in today's dollars:

$$\frac{C_1}{1+i} = \frac{30}{1.04} = 28.85.$$

$$\frac{C_2}{(1+i)^2} = \frac{150}{(1.04)^2} = 138.68.$$

Note that we divide by $(1+i)^2$! This is because dividing once by $(1+i)$ puts us in year 1 dollars , and dividing once more puts us in year 0 dollars.

$$rr = \frac{1.1}{1.04} - 1 = 0.0577$$

$$\text{NPV} = -100 + \frac{28.85}{1.0577} + \frac{138.68}{(1.0577)^2} = 51.24$$

Note: C_0 remains unchanged. That's because it is already in today's dollars. The two calculations yield the same answer.

Sometimes people are too lazy to do this calculation, so they use the following approximation, which holds *when inflation is small*:

$$rr \approx r - i.$$

You could derive this as a first-order approximation around $i = 0$. Above, we saw $rr \approx r - i = 0.10 - 0.04 = 0.06$.

If we handle inflation consistently, we get the same answer. Then, why worry about inflation at all? Why not just write cash flows in nominal terms, like we've been doing?

Reason: For capital budgeting, we need to forecast cash flows (revenues and costs) into the future. It is often easier to think about these cash flows in real rather than nominal terms.

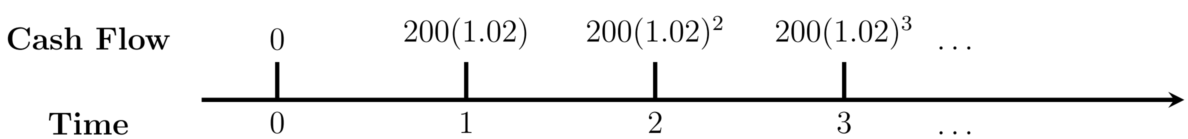
Example

A machine that makes ping-pong balls can make 200 balls per year forever. Demand for ping-pong balls is the same every year $\rightarrow$ can sell for \$1/ball in today's dollars.

Assume: $r = 10\%$, $i = 2\% \Rightarrow rr = 0.0784$, so:

$$\text{PV} = 200/rr = 2550.$$

Or we could do the calculation in nominal terms. We have a growing perpetuity:



$$PV = 200(1.02)/(0.1 - 0.02) = 2550.$$

Important note: Nominal income is taxed, not real income. In problems with depreciation, you need to convert to nominal terms to figure out the tax shield.

(d) Investments of Different Lives: EAC Method

Example Machines A and B have identical capacity and do the same job but have different lives: A lasts 2 years, while B lasts 1. The benefits of the machines are the same. The cost of these machines at dates 0, 1 and 2, in real terms, are:

Machine	t=0	1	2	PV at 10%
A	20	6	4	28.76
B	10	5		14.55

B has the lower PV(cost). Should we choose it? Not necessarily. We have to replace it a year earlier, and our calculations haven't accounted for the cost in the extra year. Notice that this problem wouldn't have occurred if A and B had the same lives.

One suggestion in dealing with this is to assume that the machines are replaced by identical ones until we reach a point where the machines wear out together:

Machine	t=0	1	2	PV at 10%
A	20	6	4	28.76
B	10	5+10=15	5	27.76

In this case, investing in B can be seen to be best. We can always use this method, but for more complicated lives, there may be a lot of tedious calculation. For example, with lives of 8 and 9 years, we would need to calculate $8 \times 9 = 72$ periods ahead. However, there is a simpler way – can calculate an annuity equivalent. An annuity equivalent is like an average, but it takes into account the time value of money.

For A:

Machine	t=0	1	2	PV at 10%
A	20	6	4	28.76
Annuity		16.57	16.57	28.76

What annual payment over the next two years would be equivalent to 28.76 (PV of the machine's costs)?

$$\text{PV} = \text{Equivalent Annual Cost } \times \text{AF}^2_{0.10}$$

Rearranging and substituting:

$$\text{Equivalent Annual Cost} = \frac{\text{PV}}{\text{AF}^2_{0.10}} = \frac{28.76}{1.736} = 16.57.$$

The constant annual cost or annuity equivalent of machine A is 16.57.

For B:

Machine	t=0	1	PV at 10%
B	10	5	14.55
Annuity		16.005	14.55

What annual payment over the next two years would be equivalent to 14.55 (PV of the machine's costs)?

$$\text{Equivalent Annual Cost} = 14.55/0.909 = 16.005.$$

Hence, the annuity equivalent or the equivalent annual cost of B is 16.005.

In this case: $16.005 < 16.57 \Rightarrow$ again B is preferable.

The annuity equivalent allows us to calculate the constant annual cost of the machines, and we can compare them on this basis.

Do you think this would be a good methodology for software? Probably not – we're implicitly assuming here there's no technological change. If there were rapid change, you'd have to take that into account by going back to our original overlapping method. It is important to work in real terms except when inflation is negligible; otherwise, you will not be comparing like with like.

(e) Working Capital

Remember that revenue goes up when a sale is made, not when cash is received. But in calculating NPV, we care about actual cash flow. This may be of particular concern at a project's start. It is offset somewhat by an increase in accounts payable (suppliers may not need to be paid immediately). Also, inventories will need to be increased, and this money needs to come from somewhere. Working capital adjusts for all of these things.

By definition:

$$\text{Working capital} = \text{short term assets} - \text{short term liabilities}$$

For example, when a sale is made, but the cash flow is not received, the customer owes the firm something. That is an increase in short-term assets.

What's important to remember is that the cash flows associated with working capital are the changes in working capital. When working capital requirements go up, there is negative cash flow (need to provide funds). When requirements go down, there is positive cash flow.

		0	1	2	3	4	5
Example	Working capital requirements	1M	1.2M	1.2M	1.3M	0.8M	0M
	Changes (CF)	-1M	-0.2M	0M	-0.1M	+0.5M	+0.8M

Notice that at the end, working capital is recovered: inventory is sold, customer pays, and the company pays suppliers. Total cash flow sums to 0. But timing is important. Working capital needs will decrease the NPV of the project and need to be taken into account.

The following are comprehensive capital budgeting examples and integrate various of the topics we have covered so far in discussing capital budgeting:

Example The Wharton Olympics Corporation is considering whether to build a new bakery to make cherry pies. The current date is 12/31/X5. The new bakery will be built over two years, will be ready to start production on 1/1/X8, and will cease production on 12/31/X9. The investment for the bakery requires a $2.5M outlay on 12/31/X5, which can be depreciated using straight line depreciation over the two years the bakery is producing. The total salvage value of all the plant and equipment on 12/31/X9 is expected to be $800,000. The land the bakery will be built on could be rented out for $200,000 per year before taxes for the four years 12/31/X5-12/31/X9 while the bakery is being built and is in production. The rental for each year is paid at the end of the year. So, for year 1 it is paid at date 1 (not date 0), and so on. The bakery will produce 1.2M cherry pies per year, which can be sold at $7 per pie. Raw material costs are $1.20 per pie, and total labor costs are $420,000 per year. These revenues and costs are expected to be the same for the two years the bakery is in production. Total working capital required 12/31/X7 to allow inventories to be financed during the first year of production is $300,000. For the second year, total working capital needs will be 10% higher. When the plant ceases production, all the working capital can be recovered. The firm has a corporate tax rate of 35%. The opportunity cost of capital for the project if it is all equity financed is 12%. Assume all cash flows occur at year's end and that the firm has other profitable ongoing operations.

Solution

The table of cash flows for the problem is as follows:

$$\text{NPV} = -2.5 - \frac{0.13M}{1.12} - \frac{0.43M}{1.12^2} - \frac{4.3885M}{1.12^3} - \frac{5.5485M}{1.12^4} = \$3.69M$$

<u>Calculations</u>:

1. Depreciation Tax Shield = 0.35 * (2.5M-0.8M)/2.

2. After Tax Land Rental = -0.65 * 200,000.

3. Revenues = 7 * 1.2M.

Item	12/31/X5	12/31/X6	12/31/X7	12/31/X8	12/31/X9
1. **Investment**	-2.5M				
2. **Salvage Value**					0.8M
3. **Depreciation Tax Shield**[1]				297,500	297,500
4. **After Tax Land Rental**[2]		-130,000	-130,000	-130,000	-130,000
5. **Revenues**[3]				8.4M	8.4M
6. **Raw Materials**[4]				1.44M	1.44M
7. **Labor Costs**				0.42M	0.42M
8. **Before-Tax Operating Profit**[5]				6.54M	6.54M
9. **After-Tax Operating Profit**[6]				4.251M	4.251M
10. **Total Working Capital Needs**			300,000	330,000	0
11. **Working Capital Cash Flow**			-300,000	-30,000	+330,000
12. **After Tax Cash Flows**[7]	-2.5M	-130,000	-430,000	4.3885M	5.5485M

4. Raw Materials = 1.2 * 1.2M.

5. Before-Tax Operating Profit = line 5 - line 6 - line 7.

6. After-Tax Operating Profit = 0.65 * line 8.

7. After-Tax Cash Flows = lines 1-4 + line 9 + line 11.

Example Nippon Auto intends to replace one of its US plants. It has two mutually exclusive options. The first, codenamed Plan A, is to build a plant on its existing site in Indiana. The plant will be built on land the company already owns. It is estimated that the land could currently be sold for an after tax amount of $10M. Under Plan A, the cost of the new plant would be $100M to be paid now. It is expected to have a life of 15 years and a salvage value of $25M. The land can be sold after the fifteen years for an after tax amount of $12M. Revenues and costs at the end of the first year are expected to be $30M and $6M, respectively. Both are expected to stay constant for the life of the plant. The second option, codenamed Plan B, is to build a new plant in Alabama. If they choose to do this, they will have to buy the land for an after tax amount of $10M. The plant will cost $70M and last for 10 years. At the end of that time, it will have a salvage value of zero, and the land can be sold for an after tax amount of $10M. Revenues and costs at the end of the first year are expected to be $27M and $6M, respectively. Both are expected to stay constant for the life of the plant. All figures are in nominal terms and are stated in before tax terms unless otherwise indicated. The firm uses straight line depreciation and has a tax rate of 35%. It has profitable ongoing operations and an opportunity cost of capital of 12%. Which plant should be chosen if it is anticipated that it will be replaced by a plant with identical cash flows, and this will be repeated for the foreseeable future?

Solution

Since the plants have different lives and are expected to be replaced with identical plants, this problem needs to be approached on an equivalent annual basis.

Plan A

Period	0	1	...	...	15
Land	-10				12
Plant	-100				
Salvage					25
Depreciation Tax Shield[1]		1.75	1.75	1.75	1.75
After Tax Operating Income[2]		15.6	15.6	15.6	15.6

<u>Calculations</u>:

1. Depreciation Tax Shield = 0.35 * (100-25)/15.

2. After-Tax Operating Income = 0.65 * (30-6).

$$\text{NPV}_A = -10 - 100 + (12+25) * \text{DF}^{15}_{0.12} + (1.75 + 15.6) * \text{AF}^{15}_{0.12} = \$14.93mm.$$

$$\text{Equivalent annual NPV}_A = 14.93mm/\text{AF}^{15}_{0.12} = \$2.19mm.$$

Plan B

Period	0	1	...	...	10
Land	-10				10
Plant	-70				
Salvage					0
Depreciation Tax Shield[1]		2.45	2.45	2.45	2.45
After Tax Operating Income[2]		13.65	13.65	13.65	13.65

Calculations:

1. Depreciation Tax Shield = 0.45 * (70)/10.
2. After-Tax Operating Income = 0.65 * (27-6).

$$NPV_B = -10 - 70 + (10) * \text{DF}^{10}_{0.12} + (2.45 + 13.65) * \text{AF}^{10}_{0.12} = \$14.19mm.$$

$$\text{Equivalent annual } NPV_B = 14.19mm/\text{AF}^{10}_{0.12} = \$2.51mm.$$

$\Longrightarrow$ B should be chosen since it has a higher equivalent annual NPV.

Example

Kannon Textile is thinking of building a new plant, with a capacity of 5,000 garments per year. The proposed plant would be on land which it owns and is currently unused. It could do this project immediately, in which case the plant and equipment will cost $150,000 (real) on 12/31/X5, and the plant will be ready to start production on 1/1/X6. Another alternative is to wait a year, in which case a new type of equipment will be on the market which will only cost $100,000 (real) on 12/31/X6 and will be ready to start production on 1/1/X7. Both plants would be expected to be in production for 5 years and have a salvage value of $50,000 (real). The price of garments is currently $40 (real), and the cost of labor and materials in both plants is $12 (real) per garment. Prices and costs are expected to remain unchanged in real terms for as long as either plant would be in operation. A neighboring firm has offered to rent the land the plant would be built on at $120,000 (real) per year for any year the company is prepared to let it. The firm has a tax rate of 40% and uses straight-line depreciation. Revenue is received and costs paid at year's end. The expected inflation rate is 6%. What should the company do if its real discount rate for this type of project is 8%?

Solution

Work in real terms because much of the data is given in real terms.

Look first at the alternative of building the plant now:

	0	1	2	3	4	5
Plant	-150,000					
Salvage Value						50,000
Units		5,000	5,000	5,000	5,000	5,000
Unit Price		40	40	40	40	40
Unit Cost		12	12	12	12	12
After-Tax Operating Income[1]		84,000	84,000	84,000	84,000	84,000
After-Tax Opp. Cost of Land[2]		-72,000	-72,000	-72,000	-72,000	-72,000
Depreciation Tax Shield[3]		6,270	5,917	5,582	5,266	4,968

Calculations:

1. After-Tax Operating Income = (1-0.04) * (40-12) * 5,000.
2. After-Tax Opportunity Cost of Land = -(1-0.04) * 120,000.
3. The tax code is written in nominal terms, so we have to work out nominal depreciation and then translate to real as follows:
   - Nominal Salvage Value $= 50,000 * (1.06)^5 = 66,900$.
   - Nominal Depreciation $= \frac{150,000-66,900}{5} = 16,620$.
   - Nominal Tax Shield = 0.4 × 16,620 = 6,648.
   - Real Tax Shield $= \frac{6,648}{1.06^t}$.

NPV $= -150,000 + (84,000 - 72,000) * \mathrm{AF}^5_{0.08} + 50,000 * \mathrm{DF}^5_{0.08} + 6,270 * \mathrm{DF}^1_{0.08} + 5,917 * \mathrm{DF}^2_{0.08} + 5,582 * \mathrm{DF}^3_{0.08} + 5,266 * \mathrm{DF}^4_{0.08} + 4,968 * \mathrm{DF}^5_{0.08} = -45,472$.

Now look at the option of building a plant a year from now – there are only two differences:

1. Purchase Price
   - Nominal Purchase Price = 100,000(1.06) = 106,000.
   - Nominal Salvage Value $= 50,000 \times (1.06)^6 = 70,926$.
   - Nominal Depreciation $= \frac{106,000-70,926}{5} = 7,015$.
   - Nominal Tax Shield = 7,015(0.4) = 2,806.

- Real Tax Shield = $\frac{2{,}806}{1.06^t}$.

2. Depreciation Tax Shield

	1	2	3	4	5	6
Depreciation tax shield		2,497	2,356	2,223	2,097	1,978

Real PV (at t = 0) of Depreciation Tax Shields $= 2,497 * \mathrm{DF}^2_{0.08} + 2,356 * \mathrm{DF}^3_{0.08} + 2,223 * \mathrm{DF}^4_{0.08} + 2,097 * \mathrm{DF}^5_{0.08} + 1,978 * \mathrm{DF}^6_{0.08} = 8,319$.

Therefore, NPV (at t = 0): $= -100,000 * \mathrm{DF}^1_{0.08} + (84,000 - 72,000) * \mathrm{AF}^5_{0.08} * \mathrm{DF}^1_{0.08} + 50,000 * \mathrm{DF}^6_{0.08} + \$8,319 = -\$8,402$.

$\Longrightarrow$ **The company should not do either project. It should rent the land.**

Note: sometimes a quicker way to do the calculations for the tax shield is to work in nominal terms and use the nominal annuity factor:

- Nominal Discount Rate = (1.08 x 1.06)-1 = 0.1446 or 14.46%
- In the case where the plant is built now:
  - PV of Tax Shield at Date 0 $= 6,648 * \mathrm{AF}^5_{0.1446}$
  - $NPV = -150,000 + (84,000 - 72,000) * \mathrm{AF}^5_{0.08} + 50,000 * \mathrm{DF}^5_{0.08} + 6,648 * \mathrm{AF}^5_{0.1446} = -45,472$.
- For the alternative where the plant is built 1 year from now:
  - PV of Tax Shield $= 2,806 * \mathrm{AF}^5_{0.1446} * \mathrm{DF}^1_{0.1446} = 8,319$.

This may be a slightly quicker method in some circumstances.