Exercise AU-101

Policy risk and investment incentives

The Economic Skills Project

1 Problem

Problem

Suppose a wind farm could be built in year 0 for $140M and would earn $10M/year in years 1-20. A government offers two incentive policies. P would raise the firms profit to $12M/year. It would be guaranteed for years 1-4 but there is a 60% chance that a future government would repeal the policy after year 4 and it would not be paid in years 5-20. Policy I would simply provide a lump sum grant of $20M in year 0. Calculate three expected NPVs, one with no incentive, and one each for incentives P and I, and indicate whether or not the firm would invest. You may assume that it uses a 5% in PV calculations.

2 Answer

Answer

Here's the solution:

Incentive	NPV	Invest?
None	-$15M	No
P	-$0.8M	No
I	+$5M	Yes

3 Method

Solution method

Here's one approach:

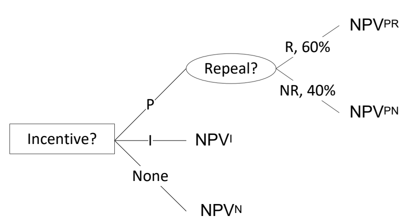
1. Draw the decision tree but leave placeholders for the payoffs.
2. Draw a cash flow diagram for each of the payoffs and compute its NPV.
3. Put those payoffs into the decision tree.
4. Evaluate the tree from right to left.

4 Solution

4.1 Step 1

Draw the decision tree

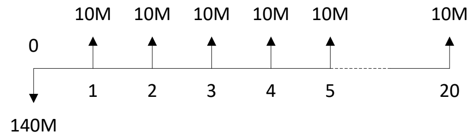
Here's the tree with net present value placeholders used for each of the payoffs. There are four cases; from bottom to top: N for no incentive, I for incentive I, PN for incentive P when it is *not* repealed, and PR for P when it *is* repealed.



4.2 Step 2

Cash flow diagrams and NPVs

Cash flow: Case N



Cash flow diagrams and NPVs, continued

NPV: Case N

The present value of the profits will be:

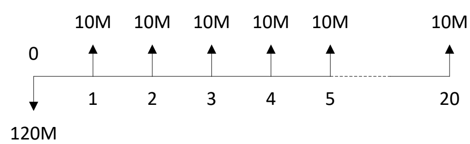
$$PVB_N = \frac{\$10M}{0.05}\left(1 - \frac{1}{1.05^{20}}\right) = \$125M$$

Since the cost of the wind farm is $140M the NPV will be:

$$NPV_N = \$125M - \$140M = -\$15M$$

Cash flow diagrams and NPVs, continued

Cash flow: Case I



The only difference between this and the cash flow for case N is that the initial cost is $20M lower.

Calculate the NPVs, continued

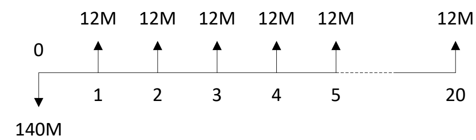
NPV: Case I

The NPV under policy I is straightforward: since the stream of incoming profits is exactly the same in as case N, it's the original benefits, PVB_N, but with the $20M reduction in the present value cost:

$$NPV_I = \$125M - \$120M = \$5M$$

Cash flow diagrams and NPVs, continued

Cash flow: Case PN (P, not repealed)



Cash flow diagrams and NPVs, continued

NPV: Case PN

The PV of profits under policy P when it is *not* repealed, PVB_{PN}, will be:

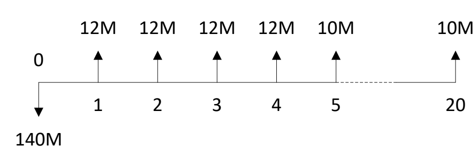
$$\text{PVB}_{\text{PN}} = \frac{\$12M}{0.05}\left(1 - \frac{1}{1.05^{20}}\right) = \$150M$$

That NPV is:

$$\text{NPV}_{\text{PN}} = \$150M - \$140M = \$10M$$

Cash flow diagrams and NPVs, continued

Cash flow: Case PR (P, repealed)



A very useful way to think about this is that it's the original profit stream, PVB_{N}, plus an extra \$2M in years 1 through 4.

Cash flow diagrams and NPVs, continued

NPV: Case PR

The PV of profits, PVB_{PR}, will be PVB_{N} plus the PV of receiving the additional $2M in each of year's 1 to 4:

$$\text{PVB}_{\text{PR}} = \$125M + \frac{\$2M}{0.05}\left(1 - \frac{1}{1.05^4}\right) = \$125M + \$7M = \$132M$$

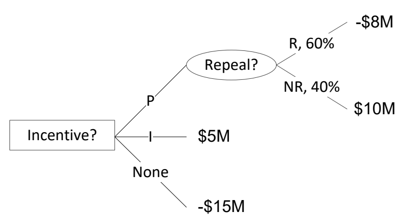
The NPV is:

$$\text{NPV}_{\text{PR}} = \$132M - \$140M = -\$8M$$

4.3 Step 3

Put the payoffs into the decision tree

Inserting the NPVs gives:



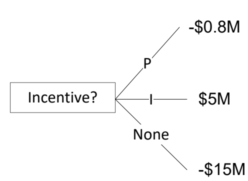
4.4 Step 4

Evalute the tree from right to left

Computing the expected value of the repeal node:

$$\text{EV} = -\$0.8M$$

Using that to replace the node gives the tree below:



Evalute the tree from right to left, continued

The best option for the wind farm is incentive I. Incentive P would be stronger ($10M rather than $5M) but it is undermined by the chance that it will be repealed.

Done!

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