

M.I.T.  
Sloan School of Management

15.415-Fall 1998  
Professor Denis Gromb

## Problem Set 1

- Please, make sure to work in a team (3 to 5 students) and hand in only one homework per team
- To ease and speed up grading, please:
  - Answer one question per page following the questions' order
  - Staple all pages of the problem set together (use staples, not paper clips)
  - Write the names of all team members very clearly

**Question 1:** Brealey-Myers: 3.1

**Question 2:** Brealey-Myers: 3.2

**Question 3:** Brealey-Myers: 3.3

### **Question 4: IRA Accounts**

An Individual Retirement Account (IRA) allows you to set aside a limited amount of money each year for retirement. These funds will have a special tax status that depends on several factors.<sup>1</sup>

Suppose that you have \$2,000 in pretax income to contribute to the IRA at the end of each year. You will retire in 30 years, and your marginal tax rate will be 28% for all years. Suppose that the account returns a fixed 6% each year until you retire. For simplicity, assume that you withdraw all money at your retirement, and any tax-deferred income is taxed at that time.

- a) How much money will you have in 30 years if neither the contribution nor the interest income is tax-deferred?
- b) How much money will you have in 30 years if the contribution is not tax-deferred but the interest income is?
- c) How much money will you have in 30 years if both the contribution and the interest income are tax-deferred?
- d) Would you expect the benefit of tax deferral to increase or decrease as the tax rate increases? Why?

### **Question 5: Project Decisions**

As the chief financial officer of a civil engineering company, you are offered a contract by the Department of Transportation (DOT) to reconstruct and upgrade the highway network linking

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<sup>1</sup> These factors include your marital status, whether you have other sources of retirement savings, your income, etc.

several terminals of a major airport and connecting the entire complex with the city. The terms of the contract are as follows:

The DOT would advance 15% of the total value (\$16.8 million) at the signing of the contract. The company could then bill the DOT according to the following schedule (each payment is made at the end of the year):

|        |             |
|--------|-------------|
| Year 1 | \$1,100,000 |
| Year 2 | \$4,300,000 |
| Year 3 | \$4,800,000 |
| Year 4 | \$3,900,000 |
| Year 5 | \$2,700,000 |

The DOT would pay 80% of each bill received. The 20 percent deduction would be withheld for the recovery of the advance payment (15%), and the accumulation of a retention fund (5%). Half of the amount accumulated in the retention fund would be reimbursed at the time of completion (end of year 5). The second half would be repaid at the end of year 6, provided the roads did not show major flaws in their first year of use.

For the company to proceed, equipment would have to be ordered immediately so it would be available at the signing of the contract, when earth-moving would commence. The cost of the equipment would be \$4.6 million with payment due upon delivery. At the end of the project, the equipment would have no salvage value. The engineering department estimates that the cost of completing the project (not including the equipment) would be \$10.8 million. Preliminary site work would require \$700,000 to be expended by the end of year 1. The project would then proceed at estimated costs of \$2.8 million, \$3.1 million, \$2.5 million, and \$1.7 million for the subsequent years.

a) Write down the cash flows for the construction project year-by-year:

|        | COSTS | REVENUES | NET CASH FLOW |
|--------|-------|----------|---------------|
| Year 0 |       |          |               |
| Year 1 |       |          |               |
| Year 2 |       |          |               |
| Year 3 |       |          |               |
| Year 4 |       |          |               |
| Year 5 |       |          |               |
| Year 6 |       |          |               |

b) Using a discount factor of 12%, calculate the NPV of the project. Should the company take the contract?

c) The assistant to the Chief Financial Officer has decided to calculate the project's internal rate of return, the payback of the project, and the discounted payback. What are these figures? Based on these figures, will the assistant make a different recommendation?

d) Suppose that instead of having to pay the entire cost of the machine now, you can pay \$3.6 million now and \$1.13 million at the end of year 1. What is the internal rate of return of this project? Should you take this payment plan or the original payment plan?