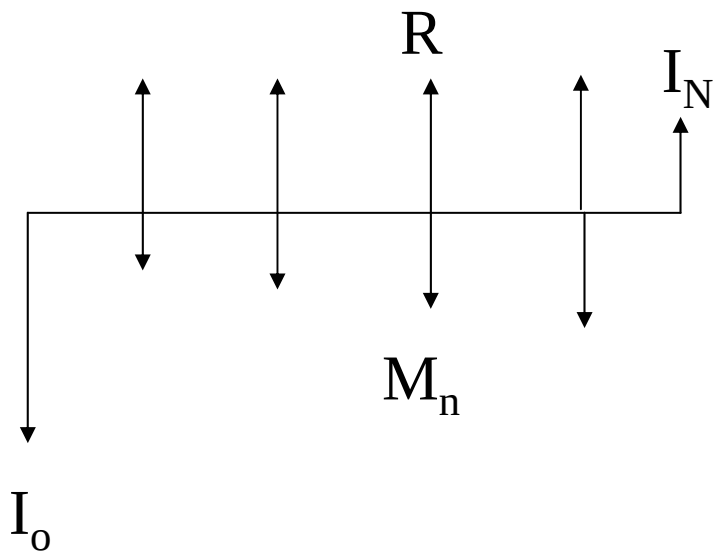
Retirement/Replacement Problems

March 15, 2004

Why consider replacing a physical asset?

- Physical impairment
- Economic obsolescence

Determining optimum economic lifetime under steady-state conditions



I_o = \$10,000
M_n = 2000 + (n-1) 1000
R = 8260
MARR = 20%

N	0	1	2	3	4	5	6	7	8
I_N	6400	3200	1600	800	400	200	100	50	25

(Ignore effect of taxes.)

Optimum economic life calculation (contd.)

Two alternative decision criteria for choosing optimal retirement age:

(1) Minimize levelized annual cost, LAC

$$LAC = I_0 (A/P,20\%, N) + I_N (A/F, 20\%, N) + 2000 + 1000 (A/G,20\%, N)$$

(2) Minimize present worth of net receipts, PW

$$PW = -I_o + I_N (P/F, 20\%, N) + R (P/A,20\%, N) + 2000 (P/A,20\%, N) + 1000(P/G,$$

N	LAC	PW (net receipts)
1	10800	-2118
2	8273	-18
3	7405	1795
4	7062	3101
5	**6958**	3898
6	6976	4273
7	7060	**4326**
8	7181	4143

Question: Which one of the two criteria gives the correct result?

Retirement of asset in a changing environment

Example:

"Defender"

Bought 3 yrs ago for $1700

Expected life at that time = 10 yrs

NSV=0

Levelized operating cost for remaining 7 years = $281/yr

Market value today = $1000

"Challenger"

Purchase price = $2000

Economic lifetime = 10 years

NSV = $600

Annual operating cost = $100.yr

Assume:

Weighted average after tax cost of capital = 10%

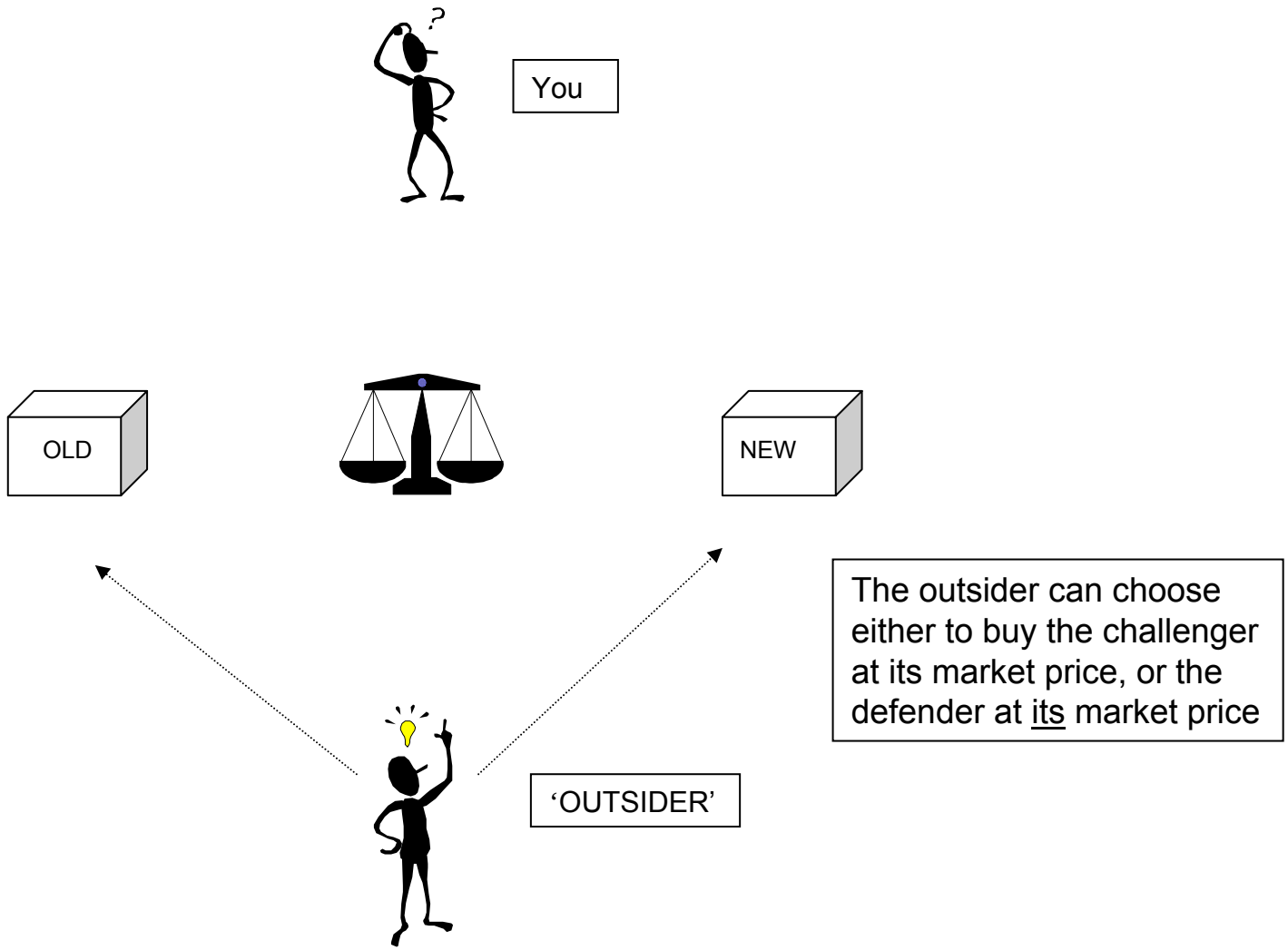
Marginal tax rate = 50%

Question: Should we replace the defender with the challenger?

Retirement of asset in changing environment (contd.)

- Two common mistakes
  - #1: Comparing projects over different time horizons
  - #2: Allowing ‘sunk costs’ to influence the investment decision

Asset retirement decision: It is helpful to adopt the perspective of an 'outsider'



The outsider's choices:
Choice #1 -- Buy the defender for $1000

Suppose the defender today is expected to have the following economic characteristics over the next several years:

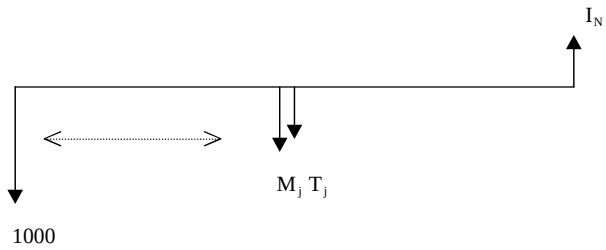
Years to retirement	Salvage Value (I_N)	Operating Cost (levelized)
1	600	220
2	50j0	230
3	400	240
4	300	250
5	200	260
6	100	270
7	0	280

Find the lifetime of the defender for which the levelized annual cost is minimized

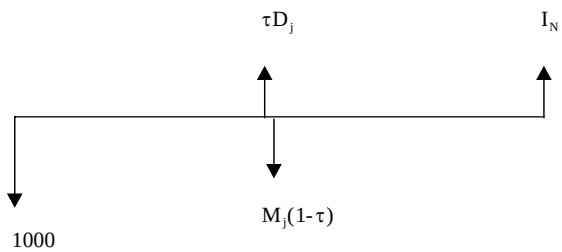
I_N

The outsider's choices:
Choice #1 -- Buy the defender for $1000 (contd.)

Find the lifetime of the defender for which the levelized annual cost is minimized



Convert to modified cash flow diagram

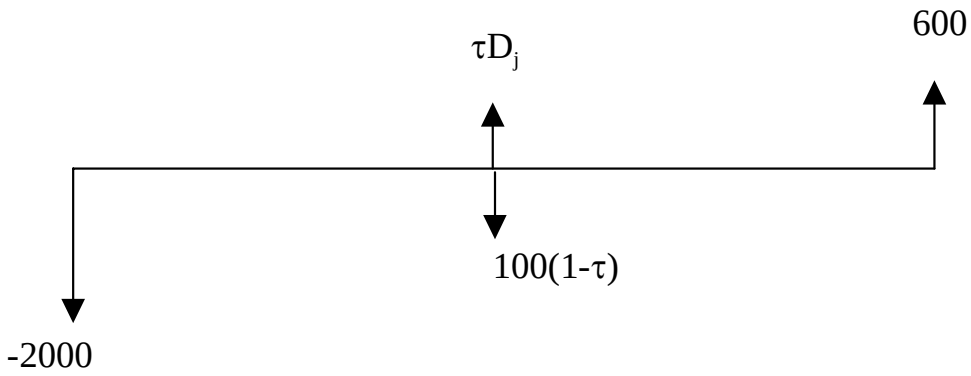


$$LAC_{defender} = -1000\,(A/P,x,N) + I_N\,(A/F,x,N) + \tau\,\frac{(1000 - I_N)}{N} - M_L\,(1-\tau)$$

N	$LAC_{defender}$
3	-301
4	-288
5	**-281**
6	-287

The outsider's choices:
Choice #2 -- Buy the challenger for $2000

Modified cash flow diagram:



$$LAC_{challenger} = -2000(A/P,10\%,10) + 600(A/F,10\%,10) - (1-\tau)100 + \tau\left(\frac{2000-600}{10}\right)$$

= -$268

Thus we might conclude that the challenger is the preferred choice.

BUT: This would not be correct because we have different time horizons in the two cases.

The outsider's choice (contd.)

- Approaches to achieving consistency in time horizons:
  - Sell the challenger at 5 years
  - Modify the defender scenario by replacing the defender after 5 years with another challenger and selling the latter off after another 5 years (i.e. at the end of year 10)
  - Assume that the defender could be replaced by another 5 year replica of itself