Capital Budgeting

The I in $V_{firm} = f(I, F, D)$

Capital Budgeting

- Process of deciding which long-term investments to make
- Current outlay followed by cash inflows beyond one year in the future
  - New equipment, plants, new products
  - Often replacing old equipment with new
- Expected return = required return?

Temporary assumption

- Required return is given and is the same for all projects
- k_0 = required return or the hurdle rate
- Assumption will be relaxed in the next chapter when we consider risk

5 steps to capital budgeting

1. Generation of investment proposals
2. Estimation of expected cash flows
3. Evaluation of expected cash flows
4. Selection of proposals
5. Continual reevaluation of proposals after acceptance

We are mainly concerned with 2, 3 and 4

Estimation of expected cash flows

- Incremental ➔ CF of the firm with proposal vs. CF of firm without proposal
- After-tax ➔ what actually affects the common stockholders (available for retention or payout)
- CF = Net Income + Depreciation

Incremental cash flows

$$\Delta CF = (\Delta S - \Delta C - \Delta D)(1-t) + \Delta D$$

? S = change in sales revenue

? C = change in operating costs

? D = change in depreciation

t = firm's marginal tax rate

Horizontal income statement

$$\text{Given}: (\Delta S - \Delta C - \Delta D) = \Delta(\text{before - tax profits})$$
$$\text{if } (\Delta S - \Delta C - \Delta D)(t) = \Delta\text{taxes}$$
$$\text{then } (\Delta S - \Delta C - \Delta D)(1-t) = \Delta(\text{after - tax profits})$$
$$\therefore \Delta CF = (\Delta S - \Delta C - \Delta D)(1-t) + \Delta D$$

Replacement example

Old equipment: original cost= 60,000 SV = 0

15 yr original life currently 5 yrs old with a MV = 8,000

New equipment: Cost = 40,000 SV = 4,000

10 yr life ΔS = +4,000/yr ΔC = -8,000/yr ΔNWC = 10,000

t = 50% k = 10% straight-line depr. on both

Initial Outlay

Purchase price new	$40,000
-Net proceeds sale of old	-24,000
+ΔNWC	+10,000

Initial Outlay	$26,000

Net proceeds from sale of old

Net proceeds = MV – t(MV – BV)

MV = market value, BV = book value

D_{old} = (Cost – SV)/n = (60000-0)/15 = 4000/yr

BV = 60000 – 5(4000) = 40000

Net proceeds = 8000-.50(8000-40000)

Net proceeds = 24000

Net proceeds from sale of old

Net proceeds = MV – t(MV – BV)

What if MV>BV and machine is sold for a gain? Then there is a tax on the gain equal to t(MV-BV), and this tax is subtracted from the selling price to yield the net proceeds

The formula works for gains or losses

ΔNWC

ΔNWC = Δcurrent assets – Δcurrent liabilities

ΔNWC is additional motor oil or nuts and bolts needed to service the equipment

ΔNWC is additional cash that must be kept on hand if the proposal is accepted

ΔNWC is part of the initial outlay and is also a cash inflow at the end of the life of the project

Incremental Cash Flows (ΔCF)

$\Delta CF = (\Delta S - \Delta C - \Delta D)(1 - t) + \Delta D$

ΔS = 4000/yr and ΔC = -8000/yr

D_{old} = 4000 D_{new} = (40000-4000)/10=3600

ΔD = 3600 – 4000 = -400/yr

ΔCF = [4000 – (-8000) – (-400)](1 – .5) - 400

ΔCF = 5800/yr for 10 years

Terminal cash flow

Often there is an extra cash inflow in the terminal year

Return of the ΔNWC = 10000 since the motor oil, nuts and bolts, and cash are no longer needed

Incremental salvage value $\Delta SV = SV_{new} - SV_{old}$

ΔSV = 4000 – 0

Total non-operating CF = 10000 + 4000 = 14000

Cash flow time line

-26000	5800	5800	//	5800	19800
0	1	2		9	10

Accept or reject?

Is forecasted rate of return $\geq k_0$ = 10%?

Looks like a job for time value of money

Acceptance criteria

Two discounted cash flow methods

Internal Rate of Return (IRR)

Net Present Value (NPV)

Internal Rate of Return (IRR)

IRR ➔ that discount rate that equates the present value of the expected cash inflows with the present value of the expected cash outflows

IRR ➔ that discount rate that makes $PV_{in} = PV_{out}$

Accept if $IRR >= k_0$ and reject if $IRR < k_0$

Internal Rate of Return (IRR)

$$CF_0 = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t}$$

CF_t = cash flow, end of period t

n = life of the project

r = IRR

Internal Rate of Return

$$26000 = \frac{5800}{(1+r)^1} + \frac{5800}{(1+r)^2} + \cdots + \frac{5800 + 4000 + 10000}{(1+r)^{10}}$$

Solve for r

Accept if r = k_0 Reject if r<k_0

Finding IRR using a financial calculator:

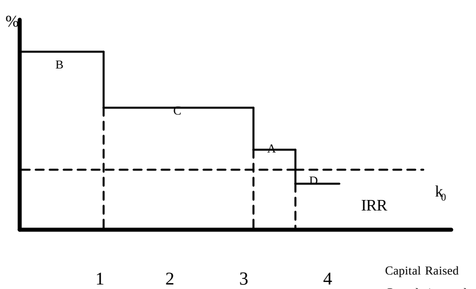
-26000➔CF_j 5800➔CF_j 9➔N_j

19800➔CF_j IRR=20.58%

Slate of possible projects

Project	Outlay	IRR
B	1,000,000	30%
C	2,000,000	20%
A	500,000	13%
D	500,000	7%

IRR Schedule



Net Present Value (NPV)

NPV ➔ present value of the expected cash inflows minus the present value of the expected cash outflows when all cash flows are discounted at the required rate k_0

Accept if NPV = 0

Reject if NPV<0

Net Present Value (NPV)

$$NPV = -CF_0 + \frac{CF_1}{(1+k_0)^1} + \frac{CF_2}{(1+k_0)^2} + \cdots + \frac{CF_n}{(1+k_0)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+k_0)^t}$$

CF_t = cash flow, end of period t

n = life of the project

k_0 = required rate of return

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$$NPV = -26000 + \frac{5800}{(1.10)^1} + \frac{5800}{(1.10)^2} + \cdots + \frac{5800 + 4000 + 10000}{(1.10)^{10}}$$

Solve for NPV

Accept if NPV = 0   Reject if NPV<0

Finding NPV using a financial calculator:

-26000➔CF_j 5800➔CF_j 9➔N_j

19800➔CF_j I/YR➔10 NPV=15,036.10

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Another definition of IRR

Since NPV = PV_{in} - PV_{out}
and IRR makes PV_{in} = Pv_{out}

k_0

IRR can be defined as the discount rate that makes NPV = 0

Quick summary

Two **alternative** methods:
NPV = $PV_{inflows} - PV_{outflows}$ discount at rate k_0
IRR: $PV_{inflows}$ = $PV_{outflows}$ solve for IRR

Accept if NPV = 0 or IRR = k_0
Reject if NPV<0 or IRR<k_0

Quick summary of example

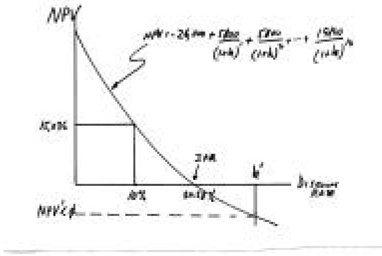
$$NPV = -26000 + \frac{5800}{(1.10)^1} + \frac{5800}{(1.10)^2} + \cdots + \frac{5800 + 4000 + 10000}{(1.10)^{10}}$$

$$NPV = 15,036$$

$$26000 = \frac{5800}{(1+IRR)^1} + \frac{5800}{(1+IRR)^2} + \cdots + \frac{5800 + 4000 + 10000}{(1+IRR)^{10}}$$

$$IRR = 20.58\%$$

Single project: Same result



Why IRR = k_0 or NPV = 0?

Pretend entire $26,000 outlay is financed by a 10 yr loan at interest rate = 10%

Annual uniform payment to retire loan:

26000 = R($PVIF_a$-10%-10) R=$4231/yr

Annual CF=5800 plus extra 14000 in yr 10

(5800-4231)($PVIF_a$-10%-10) + 14000/$(1.10)^{10}$ = 15036

Possible conflict

Period	Project A	Project B
0	-23616	-23616
1	10000	0
2	10000	5000
3	10000	10000
4	10000	32675
NPV(k_0=10%)	8083	10347
IRR	25%	22%

Assumed reinvestment rates

IRR→All CF's reinvested at the IRR
NPV→All CF's reinvested at k_0

NPV: more realistic, more conservative, more consistent

Normally choose project with higher NPV

Modified IRR (MIRR)

Eliminates flaw of regular IRR method

Assumes all CF's reinvested at k_0

Compute sum of CF's at terminal point assuming reinvestment at k_0

Solve for MIRR: discount rate that equates the PV of this terminal sum with initial outlay

Modified IRR (MIRR)

$FV_{A,4}$ = 10000(FVIFa-10%-4) = 46,410
23616 = 46410 / $(1 + MIRR_A)^4$ $MIRR_A$=18.4%

$FV_{B,4} = 5000(1.10)^2 + 10000(1.10)^1 + 32675$
$FV_{B,4}$ = 49,725
23616 = 49725 / $(1 + MIRR_B)^4$ $MIRR_B$=20.5%
Choose project B