Measuring Investment Returns

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First Principles

- Invest in projects that yield a **return** greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - **Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.**
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

Measuring Returns Right: The Basic Principles

- Use cash flows rather than earnings. You cannot spend earnings.
- Use “incremental” cash flows relating to the investment decision, i.e., cashflows that occur as a consequence of the decision, rather than total cash flows.
- Use “time weighted” returns, i.e., value cash flows that occur earlier more than cash flows that occur later.

The Return Mantra: “Time-weighted, Incremental Cash Flow Return”

Steps in Investment Analysis

- Estimate a hurdle rate for the project, based upon the riskiness of the investment
- Estimate revenues and accounting earnings on the investment.
  - Measure the accounting return to see if the investment measures up to the hurdle rate.
- Convert accounting earnings into cash flows
  - Use the cash flows to evaluate whether the investment is a good investment.
- Time weight the cash flows
  - Use the time-weighted cash flows to evaluate whether the investment is a good investment.

I. Estimating the Hurdle Rate for an Investment

- If a firm is in only one business, and all of its investments are homogeneous:
  - Use the company's costs of equity and capital to evaluate its investments.
- If the firm is in more than one business, but investments within each of business are similar:
  - Use the divisional costs of equity and capital to evaluate investments made by that division
- If a firm is planning on entering a new business:
  - Estimate a cost of equity for the investment, based upon the riskiness of the investment
  - Estimate a cost of debt and debt ratio for the investment based upon the costs of debt and debt ratios of other firms in the business

Analyzing Project Risk: Three Examples

- The Home Depot: A New Store
  - The Home Depot is a firm in a single business, with homogeneous investments (another store).
  - We will use The Home Depot's cost of equity (9.78%) and capital (9.51%) to analyze this investment.
- Boeing: A Super Jumbo Jet (capable of carrying 400+ people)
  - We will use the cost of capital of 9.32% that we estimated for the aerospace division of Boeing.
- InfoSoft: An Online Software Store
  - We will estimate the cost of equity based upon the beta for online retailers (1.725) and InfoSoft's debt ratio. We will use a much higher cost of debt for the project (7%) than InfoSoft's existing debt (6%)
  - Cost of capital = 14.49% (.9338) + 7% (1-.42)(.0662) = 13.80%

II. The Estimation Process

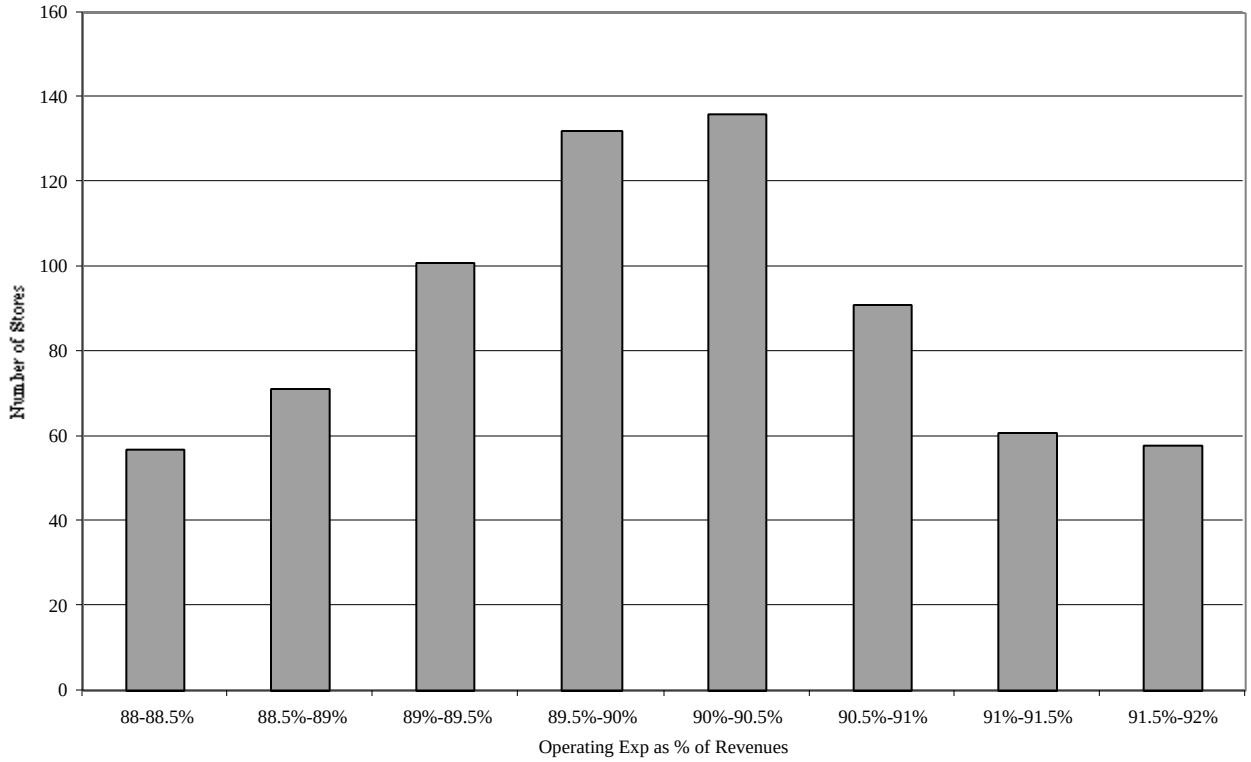
- **Experience and History**: If a firm has invested in similar projects in the past, it can use this experience to estimate revenues and earnings on the project being analyzed.
- **Market Testing**: If the investment is in a new market or business, you can use market testing to get a sense of the size of the market and potential profitability.
- **Scenario Analysis**: If the investment can be affected be a few external factors, the revenues and earnings can be analyzed across a series of scenarios and the expected values used in the analysis.

The Home Depot's New Store: Experience and History

- The Home Depot has 700+ stores in existence, at difference stages in their life cycles, yielding valuable information on how much revenue can be expected at each store and expected margins.
- At the end of 1999, for instance, each existing store had revenues of $ 44 million, with revenues starting at about $ 40 million in the first year of a store's life, climbing until year 5 and then declining until year 10.

The Margins at Existing Store

Figure 9.3: Operating Expenses as % of Revenue



Projections for The Home Depot's New Store

- For revenues, we will assume
  - that the new store being considered by the Home Depot will have expected revenues of $ 40 million in year 1 (which is the approximately the average revenue per store at existing stores after one year in operation)
  - that these revenues to grow 5% a year
  - that our analysis will cover 10 years (since revenues start dropping at existing stores after the 10^{th} year).
- For operating margins, we will assume
  - The operating expenses of the new store will be 90% of the revenues (based upon the median for existing stores)

Scenario Analysis: Boeing Super Jumbo

- We consider two factors:
  - Actions of Airbus (the competition): Produces new large capacity plane to match Boeing's new jet, Improves its existing large capacity plane (A-300) or abandons this market entirely.
  - Much of the growth from this market will come from whether Asia. We look at a high growth, average growth and low growth scenario.
- In each scenario,
  - We estimate the number of planes that Boeing will sell under each scenario.
  - We estimate the probability of each scenario.

Scenario Analysis

- The following table lists the number of planes that Boeing will sell under each scenario, with the probabilities listed below each number.

	Airbus New large plane	*Airbus A-300*	*Airbus abandons large airplane*
High Growth in Asia	120	150	200
	(0.125)	(0.125)	(0.00)
Average Growth in Asia	100	135	160
	(0.15)	(0.25)	(0.10)
Low Growth in Asia	75	110	120
	(0.05)	(0.10)	(0.10)

Expected Value = 120*0.125+150*.125+200*0+100*.15+135*.25 +160*.10+ 75*.05+110*.10+120*10 = 125 planes

III. Measures of return: Accounting Earnings

- Principles Governing Accounting Earnings Measurement
  - Accrual Accounting: Show revenues when products and services are sold or provided, not when they are paid for. Show expenses associated with these revenues rather than cash expenses.
  - Operating versus Capital Expenditures: Only expenses associated with creating revenues in the current period should be treated as operating expenses. Expenses that create benefits over several periods are written off over multiple periods (as depreciation or amortization)

From Forecasts to Accounting Earnings

- *Separate projected expenses into operating and capital expenses*: Operating expenses, in accounting, are expenses designed to generate benefits only in the current period, while capital expenses generate benefits over multiple periods.
- *Depreciate or amortize the capital expenses over time*: Once expenses have been categorized as capital expenses, they have to be depreciated or amortized over time.
- *Allocate fixed expenses that cannot be traced to specific projects*: Expenses that are not directly traceable to a project get allocated to projects, based upon a measure such as revenues generated by the project; projects that are expected to make more revenues will have proportionately more of the expense allocated to them.
- *Consider the tax effect*: Consider the tax liability that would be created by the operating income we have estimated

Boeing Super Jumbo Jet: Investment Assumptions

- Boeing has already spent $ 2.5 billion in research expenditures, developing the Super Jumbo. (These expenses have been capitalized)
- If Boeing decides to proceed with the commercial introduction of the new plane, the firm will have to spend an additional $ 5.5 billion building a new plant and equipping it for production.

Year	Investment Needed
Now	$ 500 million
1	$ 1,000 million
2	$ 1,500 million
3	$ 1,500 million
4	$ 1,000 million

- After year 4, there will be a capital maintenance expenditure required of $ 250 million each year from years 5 through 15.

Operating Assumptions

- The sale and delivery of the planes is expected to begin in the fifth year, when 50 planes will be sold. For the next 15 years (from year 6-20), Boeing expects to sell 125 planes a year. In the last five years of the project (from year 21-25), the sales are expected to decline to 100 planes a year. While the planes delivered in year 5 will be priced at $ 200 million each, this price is expected to grow at the same rate as inflation (which is assumed to be 3%) each year after that.
- Based upon past experience, Boeing anticipates that its cost of production, not including depreciation or General, Sales and Administrative (GS&A) expenses, will be 90% of the revenue each year.
- Boeing allocates general, selling and administrative expenses (G,S & A) to projects based upon projected revenues, and this project will be assessed a charge equal to 4% of revenues. (One-third of these expenses will be a direct result of this project and can be treated as variable. The remaining two-thirds are fixed expenses that would be generated even if this project were not accepted.)

Other Assumptions

- The project is expected to have a useful life of 25 years.
- The corporate tax rate is 35%.
- Boeing uses a variant of double-declining balance depreciation to estimate the depreciation each year. Based upon a typical depreciable life of 20 years, the depreciation is computed to be 10% of the book value of the assets (other than working capital) at the end of the previous year. We begin depreciating the capital investment immediately, rather than waiting for the revenues to commence in year 5.

Revenues: By Year

Year	Number of Planes	Price per plane	Expected Revenues
5	50	$ 200.00	$ 10,000.00
6	125	$ 206.00	$ 25,750.00
7	125	$ 212.18	$ 26,522.50
8	125	$ 218.55	$ 27,318.18
9	125	$ 225.10	$ 28,137.72
10	125	$ 231.85	$ 28,981.85
11	125	$ 238.81	$ 29,851.31
12	125	$ 245.97	$ 30,746.85
13	125	$ 253.35	$ 31,669.25
14	125	$ 260.95	$ 32,619.33
15	125	$ 268.78	$ 33,597.91
16	125	$ 276.85	$ 34,605.85
17	125	$ 285.15	$ 35,644.02
18	125	$ 293.71	$ 36,713.34
19	125	$ 302.52	$ 37,814.74
20	125	$ 311.59	$ 38,949.19
21	100	$ 320.94	$ 32,094.13
22	100	$ 330.57	$ 33,056.95
23	100	$ 340.49	$ 34,048.66
24	100	$ 350.70	$ 35,070.12
25	100	$ 361.22	$ 36,122.22

Operating Expenses & S,G & A: By Year

Year	Revenues	COGS	GS&A Expense
5	$10,000	$ 9,000	$ 400
6	$25,750	$23,175	$ 1,030
7	$26,523	$23,870	$ 1,061
8	$27,318	$24,586	$ 1,093
9	$28,138	$25,324	$ 1,126
10	$28,982	$26,084	$ 1,159
11	$29,851	$26,866	$ 1,194
12	$30,747	$27,672	$ 1,230
13	$31,669	$28,502	$ 1,267
14	$32,619	$29,357	$ 1,305
15	$33,598	$30,238	$ 1,344
16	$34,606	$31,145	$ 1,384
17	$35,644	$32,080	$ 1,426
18	$36,713	$33,042	$ 1,469
19	$37,815	$34,033	$ 1,513
20	$38,949	$35,054	$ 1,558
21	$32,094	$28,885	$ 1,284
22	$33,057	$29,751	$ 1,322
23	$34,049	$30,644	$ 1,362
24	$35,070	$31,563	$ 1,403
25	$36,122	$32,510	$ 1,445

Depreciation and Amortization: By Year

Year	*Capital Expenditures*	*Depreciaton*	*Book Value*	*R&D Investment*	*Amortization*	*Ending Value of R&D*	Deprecn & Amortization
0	$ 500		$ 500	2500	0	2500	
1	$ 1,000	$ 50	$ 1,450	$ 2,500	$ 167	$ 2,333	$217
2	$ 1,500	$ 145	$ 2,805	$ 2,333	$ 167	$ 2,167	$312
3	$ 1,500	$ 281	$ 4,025	$ 2,167	$ 167	$ 2,000	$447
4	$ 1,000	$ 402	$ 4,622	$ 2,000	$ 167	$ 1,833	$569
5	$ 250	$ 462	$ 4,410	$ 1,833	$ 167	$ 1,667	$629
6	$ 250	$ 441	$ 4,219	$ 1,667	$ 167	$ 1,500	$608
7	$ 250	$ 422	$ 4,047	$ 1,500	$ 167	$ 1,333	$589
8	$ 250	$ 405	$ 3,892	$ 1,333	$ 167	$ 1,167	$571
9	$ 250	$ 389	$ 3,753	$ 1,167	$ 167	$ 1,000	$556
10	$ 250	$ 375	$ 3,628	$ 1,000	$ 167	$ 833	$542
11	$ 250	$ 363	$ 3,515	$ 833	$ 167	$ 667	$529
12	$ 250	$ 351	$ 3,413	$ 667	$ 167	$ 500	$518
13	$ 250	$ 341	$ 3,322	$ 500	$ 167	$ 333	$508
14	$ 250	$ 332	$ 3,240	$ 333	$ 167	$ 167	$499
15	$ 250	$ 324	$ 3,166	$ 167	$ 167	$ -	$491
16	$ -	$ 317	$ 2,849				$317
17	$ -	$ 285	$ 2,564				$285
18	$ -	$ 256	$ 2,308				$256
19	$ -	$ 231	$ 2,077				$231
20	$ -	$ 208	$ 1,869				$208
21	$ -	$ 187	$ 1,683				$187
22	$ -	$ 168	$ 1,514				$168
23	$ -	$ 151	$ 1,363				$151
24	$ -	$ 136	$ 1,227				$136
25	$ -	$ 123	$ 1,104				$123

Earnings on Project

Year	Revenues	COGS	GS&A Expense	Deprecn & Am	EBIT	EBIT(1-t)
0						
1	$0	$0	$0	$217	($217)	($141)
2	$0	$0	$0	$312	($312)	($203)
3	$0	$0	$0	$447	($447)	($291)
4	$0	$0	$0	$569	($569)	($370)
5	$10,000	$9,000	$400	$629	($29)	($19)
6	$25,750	$23,175	$1,030	$608	$937	$609
7	$26,523	$23,870	$1,061	$589	$1,003	$652
8	$27,318	$24,586	$1,093	$571	$1,068	$694
9	$28,138	$25,324	$1,126	$556	$1,132	$736
10	$28,982	$26,084	$1,159	$542	$1,197	$778
11	$29,851	$26,866	$1,194	$529	$1,262	$820
12	$30,747	$27,672	$1,230	$518	$1,327	$862
13	$31,669	$28,502	$1,267	$508	$1,392	$905
14	$32,619	$29,357	$1,305	$499	$1,458	$948
15	$33,598	$30,238	$1,344	$491	$1,525	$991
16	$34,606	$31,145	$1,384	$317	$1,760	$1,144
17	$35,644	$32,080	$1,426	$285	$1,854	$1,205
18	$36,713	$33,042	$1,469	$256	$1,946	$1,265
19	$37,815	$34,033	$1,513	$231	$2,038	$1,325
20	$38,949	$35,054	$1,558	$208	$2,129	$1,384
21	$32,094	$28,885	$1,284	$187	$1,739	$1,130
22	$33,057	$29,751	$1,322	$168	$1,815	$1,180
23	$34,049	$30,644	$1,362	$151	$1,891	$1,229
24	$35,070	$31,563	$1,403	$136	$1,968	$1,279
25	$36,122	$32,510	$1,445	$123	$2,045	$1,329

And the Accounting View of Return

Year	EBIT(1-t)	Beginning BV	Capital Exp	Depreciation	Ending BV	Average BV	Working Capital	Return on Capital
1	($140.83)	$3,000.00	$1,000.00	$216.67	$3,783.33	$3,391.67	$0.00	-4.15%
2	($202.58)	$3,783.33	$1,500.00	$311.67	$4,971.67	$4,377.50	$0.00	-4.63%
3	($290.66)	$4,971.67	$1,500.00	$447.17	$6,024.50	$5,498.08	$0.00	-5.29%
4	($369.93)	$6,024.50	$1,000.00	$569.12	$6,455.38	$6,239.94	$0.00	-5.93%
5	($18.77)	$6,455.38	$250.00	$628.87	$6,076.51	$6,265.95	$1,000.00	-0.26%
6	$609.28	$6,076.51	$250.00	$607.65	$5,718.86	$5,897.69	$2,575.00	7.19%
7	$651.82	$5,718.86	$250.00	$588.55	$5,380.31	$5,549.58	$2,652.25	7.95%
8	$694.02	$5,380.31	$250.00	$571.36	$5,058.94	$5,219.63	$2,731.82	8.73%
9	$736.04	$5,058.94	$250.00	$555.89	$4,753.05	$4,906.00	$2,813.77	9.53%
10	$778.01	$4,753.05	$250.00	$541.97	$4,461.08	$4,607.06	$2,898.19	10.37%
11	$820.06	$4,461.08	$250.00	$529.44	$4,181.64	$4,321.36	$2,985.13	11.22%
12	$862.32	$4,181.64	$250.00	$518.16	$3,913.47	$4,047.55	$3,074.68	12.11%
13	$904.89	$3,913.47	$250.00	$508.01	$3,655.46	$3,784.47	$3,166.93	13.02%
14	$947.88	$3,655.46	$250.00	$498.88	$3,406.58	$3,531.02	$3,261.93	13.95%
15	$991.39	$3,406.58	$250.00	$490.66	$3,165.92	$3,286.25	$3,359.79	14.92%
16	$1,143.84	$3,165.92	$0.00	$316.59	$2,849.33	$3,007.63	$3,460.58	17.68%
17	$1,204.91	$2,849.33	$0.00	$284.93	$2,564.40	$2,706.86	$3,564.40	19.21%
18	$1,265.13	$2,564.40	$0.00	$256.44	$2,307.96	$2,436.18	$3,671.33	20.71%
19	$1,324.76	$2,307.96	$0.00	$230.80	$2,077.16	$2,192.56	$3,781.47	22.18%
20	$1,384.00	$2,077.16	$0.00	$207.72	$1,869.45	$1,973.30	$3,894.92	23.58%
21	$1,130.16	$1,869.45	$0.00	$186.94	$1,682.50	$1,775.97	$3,209.41	22.67%
22	$1,179.86	$1,682.50	$0.00	$168.25	$1,514.25	$1,598.38	$3,305.70	24.06%
23	$1,229.47	$1,514.25	$0.00	$151.43	$1,362.83	$1,438.54	$3,404.87	25.38%
24	$1,279.15	$1,362.83	$0.00	$136.28	$1,226.54	$1,294.68	$3,507.01	26.64%
25	$1,329.04	$1,226.54	$0.00	$122.65	$1,103.89	$1,165.22	$3,612.22	27.82%
Average	$777.73					$3,620.52	$2,637.26	12.75%

Would lead use to conclude that...

- Invest in the Super Jumbo Jet The **return on capital of 12.75%** is greater than the **cost of capital for aerospace of 9.32%**; This would suggest that the project should not be taken.

From Project to Firm Return on Capital

- Just as a comparison of project return on capital to the cost of capital yields a measure of whether the project is acceptable, a comparison can be made at the firm level, to judge whether the existing projects of the firm are adding or destroying value.

	Boeing	Home Depot	InfoSoft
Return on Capital	5.82%	16.37%	23.67%
Cost of Capital	9.17%	9.51%	12.55%
ROC - Cost of Capital	-3.35%	6.87%	11.13%

Application Test: Assessing Investment Quality

- For the most recent period for which you have data, compute the after-tax return on capital earned by your firm, where after-tax return on capital is computed to be

After-tax ROC = EBIT (1-tax rate)/ (BV of debt + BV of Equity)$_{\text{previous year}}$

- For the most recent period for which you have data, compute the return spread earned by your firm:

Return Spread = After-tax ROC - Cost of Capital

- For the most recent period, compute the EVA earned by your firm

EVA = Return Spread * (BV of Debt +BV of Equity)

IV. From Earnings to Cash Flows

- To get from accounting earnings to cash flows:
  - you have to add back non-cash expenses (like depreciation and amortization)
  - you have to subtract out cash outflows which are not expensed (such as capital expenditures)
  - you have to make accrual revenues and expenses into cash revenues and expenses (by considering changes in working capital).
- For the Boeing Super Jumbo, we will assume that
  - The depreciation used for operating expense purposes is also the tax depreciation.
  - Working capital will be 10% of revenues, and the investment has to be made at the beginning of each year.

Estimating Cash Flows: The Boeing Super Jumbo

Year	EBIT(1-t)	Depreciation	Cap Ex	Change in WC	Salvage Value	FCFF
0			$ 3,000			$ (3,000)
1	$ (141)	$ 217	$ 1,000	$ -		$ (924)
2	$ (203)	$ 312	$ 1,500	$ -		$ (1,391)
3	$ (291)	$ 447	$ 1,500	$ -		$ (1,343)
4	$ (370)	$ 569	$ 1,000	$ 1,000		$ (1,801)
5	$ (19)	$ 629	$ 250	$ 1,575		$ (1,215)
6	$ 609	$ 608	$ 250	$ 77		$ 890
7	$ 652	$ 589	$ 250	$ 80		$ 911
8	$ 694	$ 571	$ 250	$ 82		$ 933
9	$ 736	$ 556	$ 250	$ 84		$ 958
10	$ 778	$ 542	$ 250	$ 87		$ 983
11	$ 820	$ 529	$ 250	$ 90		$ 1,010
12	$ 862	$ 518	$ 250	$ 92		$ 1,038
13	$ 905	$ 508	$ 250	$ 95		$ 1,068
14	$ 948	$ 499	$ 250	$ 98		$ 1,099
15	$ 991	$ 491	$ 250	$ 101		$ 1,131
16	$ 1,144	$ 317	$ -	$ 104		$ 1,357
17	$ 1,205	$ 285	$ -	$ 107		$ 1,383
18	$ 1,265	$ 256	$ -	$ 110		$ 1,411
19	$ 1,325	$ 231	$ -	$ 113		$ 1,442
20	$ 1,384	$ 208	$ -	$ (686)		$ 2,277
21	$ 1,130	$ 187	$ -	$ 96		$ 1,221
22	$ 1,180	$ 168	$ -	$ 99		$ 1,249
23	$ 1,229	$ 151	$ -	$ 102		$ 1,279
24	$ 1,279	$ 136	$ -	$ 105		$ 1,310
25	$ 1,329	$ 123	$ -	$ -	$ 4,716	$ 6,168

The Depreciation Tax Benefit

- While depreciation reduces taxable income and taxes, it does not reduce the cash flows.
- The benefit of depreciation is therefore the tax benefit. In general, the tax benefit from depreciation can be written as:

  Tax Benefit = Depreciation * Tax Rate
- For example, in year 2, the tax benefit from depreciation to Boeing from this project can be written as:

  Tax Benefit in year 2 = $ 217 million (.35) = $ 76 million
- **Proposition 1**: The tax benefit from depreciation and other non-cash charges is greater, the higher your tax rate.
- **Proposition 2**: Non-cash charges that are not tax deductible (such as amortization of goodwill) and thus provide no tax benefits have no effect on cash flows.

Depreciation Methods

- Broadly categorizing, depreciation methods can be classified as straight line or accelerated methods. In straight line depreciation, the capital expense is spread evenly over time, In accelerated depreciation, the capital expense is depreciated more in earlier years and less in later years. Assume that you made a large investment this year, and that you are choosing between straight line and accelerated depreciation methods. Which will result in higher net income this year?
  - Straight Line Depreciation
  - Accelerated Depreciation

  Which will result in higher cash flows this year?
  - Straight Line Depreciation
  - Accelerated Depreciation

The Capital Expenditures Effect

- Capital expenditures are not treated as accounting expenses but they do cause cash outflows.
- Capital expenditures can generally be categorized into two groups
  - New (or Growth) capital expenditures are capital expenditures designed to create new assets and future growth
  - Maintenance capital expenditures refer to capital expenditures designed to keep existing assets.
- Both initial and maintenance capital expenditures reduce cash flows
- The need for maintenance capital expenditures will increase with the life of the project. In other words, a 25-year project will require more maintenance capital expenditures than a 2-year asset.

To cap ex or not to cap ex

- Assume that you run your own software business, and that you have an expense this year of $ 100 million from producing and distribution promotional CDs in software magazines. Your accountant tells you that you can expense this item or capitalize and depreciate. Which will have a more positive effect on income?
  - Expense it
  - Capitalize and Depreciate it

  Which will have a more positive effect on cash flows?
  - Expense it
  - Capitalize and Depreciate it

The Working Capital Effect

- Intuitively, money invested in inventory or in accounts receivable cannot be used elsewhere. It, thus, represents a drain on cash flows
- To the degree that some of these investments can be financed using suppliers credit (accounts payable) the cash flow drain is reduced.
- Investments in working capital are thus cash outflows
  - Any increase in working capital reduces cash flows in that year
  - Any decrease in working capital increases cash flows in that year
- To provide closure, working capital investments need to be salvaged at the end of the project life.

V. From Cash Flows to Incremental Cash Flows

- The incremental cash flows of a project are the difference between the cash flows that the firm would have had, if it accepts the investment, and the cash flows that the firm would have had, if it does not accept the investment.
- The Key Questions to determine whether a cash flow is incremental:
  - What will happen to this cash flow item if I accept the investment?
  - What will happen to this cash flow item if I do not accept the investment?
- If the cash flow will occur whether you take this investment or reject it, it is not an incremental cash flow.

Sunk Costs

- Any expenditure that has already been incurred, and cannot be recovered (even if a project is rejected) is called a sunk cost
- When analyzing a project, sunk costs should not be considered since they are incremental
- By this definition, market testing expenses and R&D expenses are both likely to be sunk costs before the projects that are based upon them are analyzed. If sunk costs are not considered in project analysis, how can a firm ensure that these costs are covered?

Allocated Costs

- Firms allocate costs to individual projects from a centralized pool (such as general and administrative expenses) based upon some characteristic of the project (sales is a common choice)
- For large firms, these allocated costs can result in the rejection of projects
- To the degree that these costs are not incremental (and would exist anyway), this makes the firm worse off.
  - Thus, it is only the incremental component of allocated costs that should show up in project analysis.
- How, looking at these pooled expenses, do we know how much of the costs are fixed and how much are variable?

Boeing: Super Jumbo Jet

- The $2.5 billion already expended on the jet is a sunk cost, as is the amortization related that expense. (Boeing has spent the first, and it is entitled to the latter even if the investment is rejected)
- Two-thirds of the S,G&A expenses are fixed expenses and would exist even if this project is not accepted.

The Incremental Cash Flows: Boeing Super Jumbo

Year	EBIT(1-t)	Depreciation	Cap Ex	Change in WC	Salvage Value	FCFF	Sunk Cost	Fixed GS&A(1-t)	Incremental FCFF
0	$0	$0	$3,000	$0	$0	($3,000)	($2,500)		($500)
1	($33)	$50	$1,000	$0	$0	($983)	$0	$0	($983)
2	($94)	$145	$1,500	$0	$0	($1,449)	$0	$0	($1,449)
3	($182)	$281	$1,500	$0	$0	($1,402)	$0	$0	($1,402)
4	($262)	$402	$1,000	$1,000	$0	($1,859)	$0	$0	($1,859)
5	$90	$462	$250	$1,575	$0	($1,273)	$0	$173	($1,100)
6	$718	$441	$250	$77	$0	$831	$0	$446	$1,278
7	$760	$422	$250	$80	$0	$852	$0	$460	$1,312
8	$802	$405	$250	$82	$0	$875	$0	$474	$1,349
9	$844	$389	$250	$84	$0	$899	$0	$488	$1,387
10	$886	$375	$250	$87	$0	$925	$0	$502	$1,427
11	$928	$363	$250	$90	$0	$952	$0	$517	$1,469
12	$971	$351	$250	$92	$0	$980	$0	$533	$1,513
13	$1,013	$341	$250	$95	$0	$1,010	$0	$549	$1,558
14	$1,056	$332	$250	$98	$0	$1,041	$0	$565	$1,606
15	$1,100	$324	$250	$101	$0	$1,073	$0	$582	$1,655
16	$1,144	$317	$0	$104	$0	$1,357	$0	$600	$1,956
17	$1,205	$285	$0	$107	$0	$1,383	$0	$618	$2,001
18	$1,265	$256	$0	$110	$0	$1,411	$0	$636	$2,048
19	$1,325	$231	$0	$113	$0	$1,442	$0	$655	$2,098
20	$1,384	$208	$0	($686)	$0	$2,277	$0	$675	$2,952
21	$1,130	$187	$0	$96	$0	$1,221	$0	$556	$1,777
22	$1,180	$168	$0	$99	$0	$1,249	$0	$573	$1,822
23	$1,229	$151	$0	$102	$0	$1,279	$0	$590	$1,869
24	$1,279	$136	$0	$105	$0	$1,310	$0	$608	$1,918
25	$1,329	$123	$0	$0	$4,716	$6,168	$0	$626	$6,794

VI. To Time-Weighted Cash Flows

- Incremental cash flows in the earlier years are worth more than incremental cash flows in later years.
- In fact, cash flows across time cannot be added up. They have to be brought to the same point in time before aggregation.
- This process of moving cash flows through time is
  - discounting, when future cash flows are brought to the present
  - compounding, when present cash flows are taken to the future
- The discount rate is the mechanism that determines how cash flows across time will be weighted.

Present Value Mechanics

Cash Flow Type	Discounting Formula	Compounding Formula
1. Simple CF	$CF_n / (1+r)^n$	$CF_0 (1+r)^n$
2. Annuity	$A\left[\frac{1 - \frac{1}{(1+r)^n}}{r}\right]$	$A\left[\frac{(1+r)^n - 1}{r}\right]$
3. Growing Annuity	$A(1+g)\left[\frac{1 - \frac{(1+g)^n}{(1+r)^n}}{r-g}\right]$	
4. Perpetuity	A/r	
5. Growing Perpetuity	A(1+g)/(r-g)	

Discounted cash flow measures of return

- **Net Present Value (NPV)**: The net present value is the sum of the present values of all cash flows from the project (including initial investment).

  NPV = Sum of the present values of all cash flows on the project, including the initial investment, with the cash flows being discounted at the appropriate hurdle rate (cost of capital, if cash flow is cash flow to the firm, and cost of equity, if cash flow is to equity investors)

  - Decision Rule: Accept if NPV > 0

- **Internal Rate of Return (IRR)**: The internal rate of return is the discount rate that sets the net present value equal to zero. It is the percentage rate of return, based upon incremental time-weighted cash flows.

  - Decision Rule: Accept if IRR > hurdle rate

Closure on Cash Flows

- In a project with a finite and short life, you would need to compute a **salvage value**, which is the expected proceeds from selling all of the investment in the project at the end of the project life. It is usually set equal to book value of fixed assets and working capital
- In a project with an infinite or very long life, we compute cash flows for a reasonable period, and then compute a **terminal value** for this project, which is the present value of all cash flows that occur after the estimation period ends..

Salvage Value on Boeing Super Jumbo

- We will assume that the salvage value for this investment at the end of year 25 will be the book value of the investment.

Book value of capital investments at end of year 25 = $1,104 million

Book value of working capital investments: yr 25 = $3,612 million

Salvage Value at end of year 25 = $4,716 million

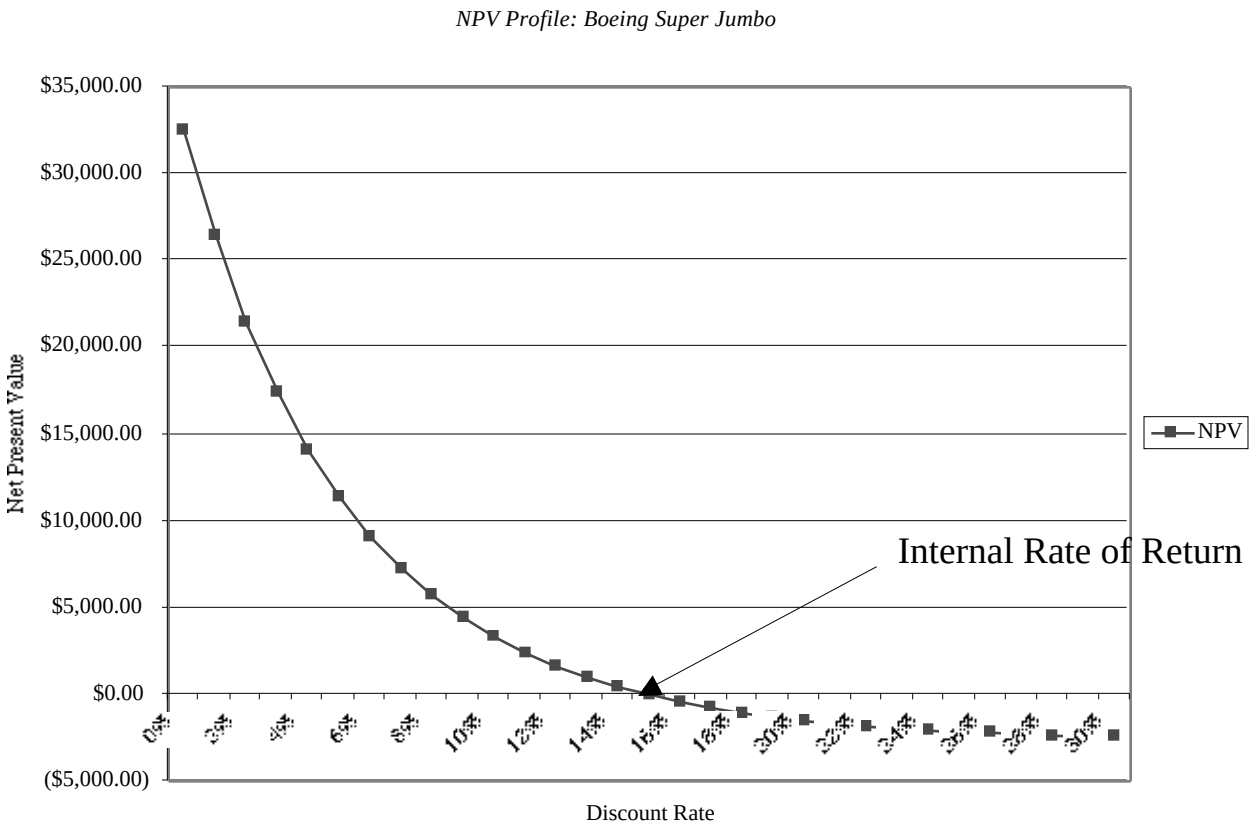
Considering all of the Cashflows… The NPV

Year	FCFF	Salvage Value	FCFF + Salvage	Present Value (@9.32%)
0	$ (500)	$ -	$ (500)	$ (500)
1	$ (983)	$ -	$ (983)	$ (899)
2	$(1,449)	$ -	$ (1,449)	$ (1,213)
3	$(1,402)	$ -	$ (1,402)	$ (1,073)
4	$(1,859)	$ -	$ (1,859)	$ (1,302)
5	$(1,100)	$ -	$ (1,100)	$ (704)
6	$ 1,278	$ -	$ 1,278	$ 749
7	$ 1,312	$ -	$ 1,312	$ 703
8	$ 1,349	$ -	$ 1,349	$ 661
9	$ 1,387	$ -	$ 1,387	$ 622
10	$ 1,427	$ -	$ 1,427	$ 585
11	$ 1,469	$ -	$ 1,469	$ 551
12	$ 1,513	$ -	$ 1,513	$ 519
13	$ 1,558	$ -	$ 1,558	$ 489
14	$ 1,606	$ -	$ 1,606	$ 461
15	$ 1,655	$ -	$ 1,655	$ 435
16	$ 1,956	$ -	$ 1,956	$ 470
17	$ 2,001	$ -	$ 2,001	$ 440
18	$ 2,048	$ -	$ 2,048	$ 412
19	$ 2,098	$ -	$ 2,098	$ 386
20	$ 2,952	$ -	$ 2,952	$ 497
21	$ 1,777	$ -	$ 1,777	$ 274
22	$ 1,822	$ -	$ 1,822	$ 257
23	$ 1,869	$ -	$ 1,869	$ 241
24	$ 1,918	$ -	$ 1,918	$ 226
25	$ 2,078	$ 4,716	$ 6,794	$ 732
			Net Present Value =	$ 4,019

Which makes the argument that..

- **The project should be accepted**. The positive net present value suggests that the project will add value to the firm, and earn a return in excess of the cost of capital.
- By taking the project, Boeing will increase its value as a firm by $4,019 million.

The IRR of this project



The IRR suggests..

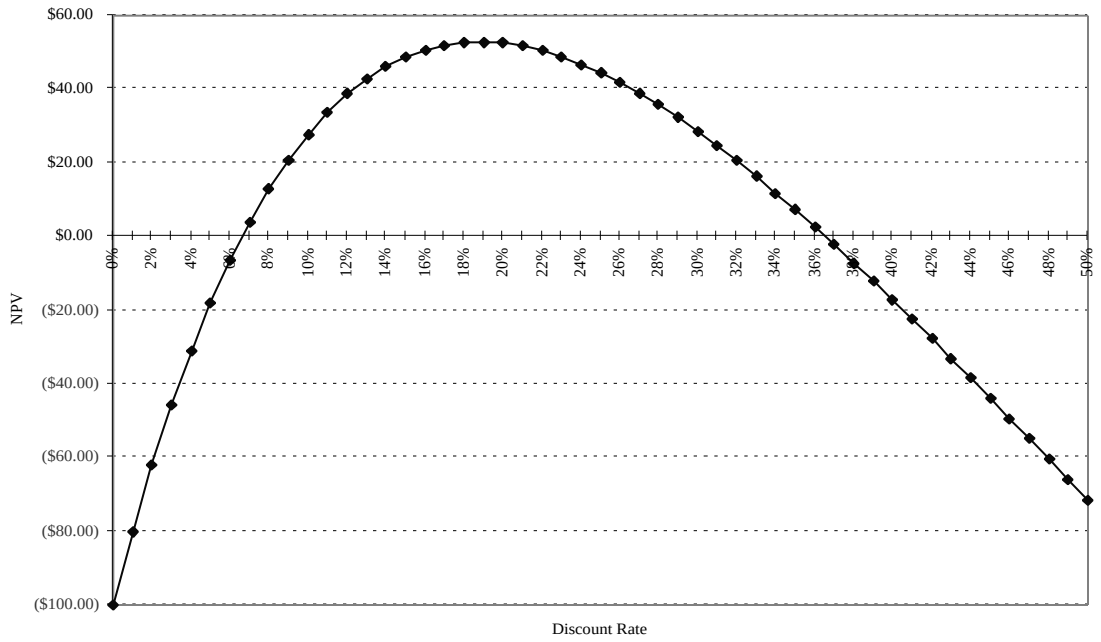
- **The project is a good one**. Using time-weighted, incremental cash flows, this project provides a return of 14.88%. This is greater than the cost of capital of 9.32%.
- The IRR and the NPV will yield **similar results** most of the time, though there are differences between the two approaches that may cause project rankings to vary depending upon the approach used.

Case 1: IRR versus NPV

- Consider a project with the following cash flows:

Year	*Cash Flow*
0	-1000
1	800
2	1000
3	1300
4	-2200

Project's NPV Profile



What do we do now?

- This project has two internal rates of return. The first is 6.60%, whereas the second is 36.55%.
- Why are there two internal rates of return on this project?

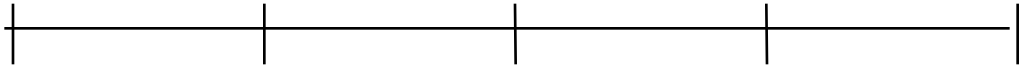
- If your cost of capital is 12.32%, would you accept or reject this project?
  - I would reject the project
  - I would accept this project

Explain.

Case 2: NPV versus IRR

Project A

Cash Flow $ 350,000 $ 450,000 $ 600,000 $ 750,000

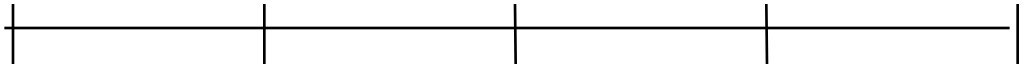


Investment $ 1,000,000

NPV = $467,937
IRR= 33.66%

Project B

Cash Flow $ 3,000,000 $ 3,500,000 $ 4,500,000 $ 5,500,000



Investment $ 10,000,000

NPV = $1,358,664
IRR=20.88%

Which one would you pick?

- Assume that you can pick only one of these two projects. Your choice will clearly vary depending upon whether you look at NPV or IRR. You have enough money currently on hand to take either. Which one would you pick?
  - Project A. It gives me the bigger bang for the buck and more margin for error.
  - Project B. It creates more dollar value in my business.

If you pick A, what would your biggest concern be?

If you pick B, what would your biggest concern be?

Capital Rationing, Uncertainty and Choosing a Rule

- If a business has limited access to capital, has a stream of surplus value projects and faces more uncertainty in its project cash flows, it is much more likely to use IRR as its decision rule.

  Small, high-growth companies and private businesses are much more likely to use IRR.

- If a business has substantial funds on hand, access to capital, limited surplus value projects, and more certainty on its project cash flows, it is much more likely to use NPV as its decision rule.

  As firms go public and grow, they are much more likely to gain from using NPV.

An Alternative to IRR with Capital Rationing

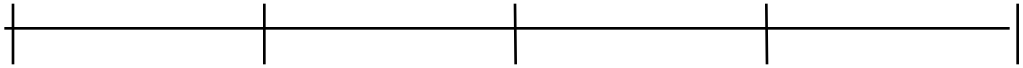
- The problem with the NPV rule, when there is capital rationing, is that it is a dollar value. It measures success in absolute terms.
- The NPV can be converted into a relative measure by dividing by the initial investment. This is called the profitability index.
  - Profitability Index (PI) = NPV/Initial Investment
- In the example described, the PI of the two projects would have been:
  - PI of Project A = $467,937/1,000,000 = 46.79%
  - PI of Project B = $1,358,664/10,000,000 = 13.59%

  Project A would have scored higher.

Case 3: NPV versus IRR

Project A

Cash Flow $ 5,000,000 $ 4,000,000 $ 3,200,000 $ 3,000,000

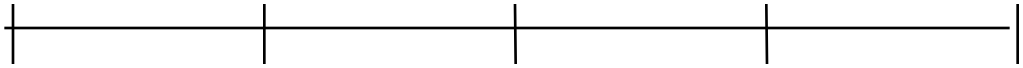


Investment $ 10,000,000

NPV = $1,191,712
IRR=21.41%

Project B

Cash Flow $ 3,000,000 $ 3,500,000 $ 4,500,000 $ 5,500,000



Investment $ 10,000,000

NPV = $1,358,664
IRR=20.88%

Why the difference?

These projects are of the same scale. Both the NPV and IRR use time-weighted cash flows. Yet, the rankings are different. Why?

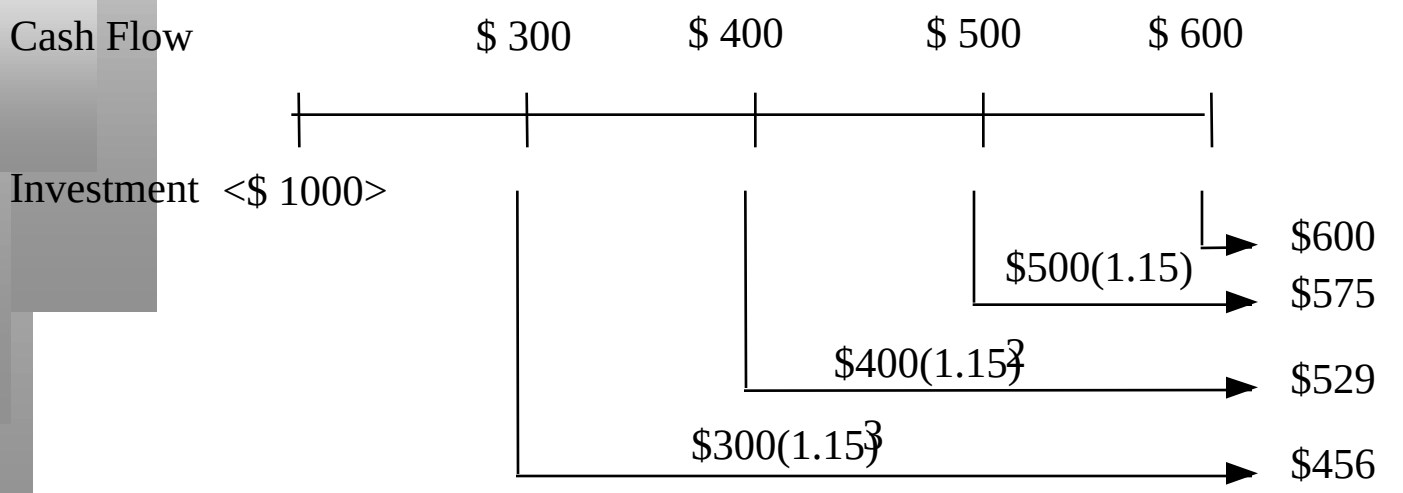
Which one would you pick?

- Project A. It gives me the bigger bang for the buck and more margin for error.
- Project B. It creates more dollar value in my business.

NPV, IRR and the Reinvestment Rate Assumption

- The NPV rule assumes that intermediate cash flows on the project get reinvested at the hurdle rate (which is based upon what projects of comparable risk should earn).
- The IRR rule assumes that intermediate cash flows on the project get reinvested at the IRR. Implicit is the assumption that the firm has an infinite stream of projects yielding similar IRRs.
- Conclusion: When the IRR is high (the project is creating significant surplus value) and the project life is long, the IRR will overstate the true return on the project.

Solution to Reinvestment Rate Problem



Terminal Value = $2160

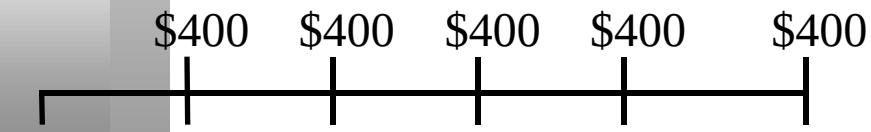
Internal Rate of Return = 24.89%
Modified Internal Rate of Return = 21.23%

Why NPV and IRR may differ..

- A project can have only one NPV, whereas it can have more than one IRR.
- The NPV is a dollar surplus value, whereas the IRR is a percentage measure of return. The NPV is therefore likely to be larger for “large scale” projects, while the IRR is higher for “small-scale” projects.
- The NPV assumes that intermediate cash flows get reinvested at the “hurdle rate”, which is based upon what you can make on investments of comparable risk, while the IRR assumes that intermediate cash flows get reinvested at the “IRR”.

Case: NPV and Project Life

Project A



-$1000

NPV of Project A = $ 442

Project B

-$1500

NPV of Project B = $ 478

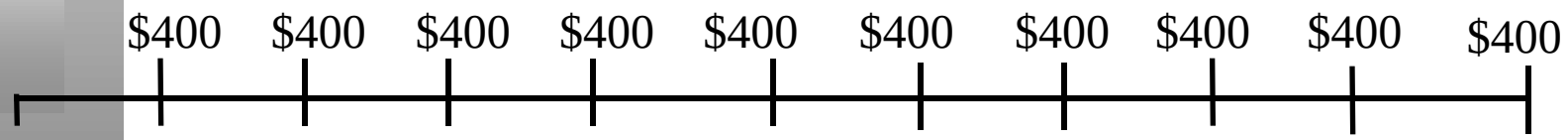
Hurdle Rate for Both Projects = 12%

Choosing Between Mutually Exclusive Projects

- The net present values of mutually exclusive projects with different lives cannot be compared, since there is a bias towards longer-life projects.
- To do the comparison, we have to
  - replicate the projects till they have the same life (or)
  - convert the net present values into annuities

Solution 1: Project Replication

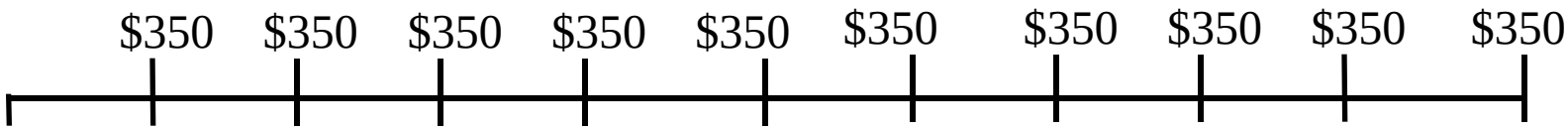
Project A: Replicated



-$1000 -$1000 (Replication)

NPV of Project A replicated = $ 693

Project B



-$1500

NPV of Project B= $ 478

Solution 2: Equivalent Annuities

- Equivalent Annuity for 5-year project
  = $442 * PV(A,12%,5 years)
  = $ 122.62
- Equivalent Annuity for 10-year project
  = $478 * PV(A,12%,10 years)
  = $ 84.60

What would you choose as your investment tool?

- Given the advantages/disadvantages outlined for each of the different decision rules, which one would you choose to adopt?
  - Return on Investment (ROE, ROC)
  - Payback or Discounted Payback
  - Net Present Value
  - Internal Rate of Return
  - Profitability Index

What firms actually use ..

Decision Rule	*% of Firms using as primary decision rule in*	
	1976	1986
IRR	53.6%	49.0%
Accounting Return	25.0%	8.0%
NPV	9.8%	21.0%
Payback Period	8.9%	19.0%
Profitability Index	2.7%	3.0%

Boeing 747: What about exchange rate risk?

- A substantial portion of Boeing's cash flows on the Super Jumbo will come from sales to foreign airlines. Assuming that the price is set in U.S. dollars, this exposes Boeing to exchange rate risk. Should there be a premium added on to the discount rate for exchange rate risk? (Should we use a cost of capital higher than 9.32%?)
  - Yes
  - No

Should there be a risk premium for projects with substantial foreign exposure?

- The exchange rate risk may be diversifiable risk (and hence should not command a premium) if
  - the company has projects is a large number of countries (or)
  - the investors in the company are globally diversified.

  For Boeing, it can be argued that this risk is diversifiable.
- The same diversification argument can also be applied against political risk, which would mean that it too should not affect the discount rate. It may, however, affect the cash flows, by reducing the expected life or cash flows on the project.

For Boeing, this risk too is assumed to not affect the cost of capital. Any expenses associated with protecting against political risk (say, insurance costs) can be built into the cash flows.

Equity Analysis: The Parallels

- The investment analysis can be done entirely in equity terms, as well. The returns, cashflows and hurdle rates will all be defined from the perspective of equity investors.
- If using accounting returns,
  - Return will be Return on Equity (ROE) = Net Income/BV of Equity
  - ROE has to be greater than cost of equity
- If using discounted cashflow models,
  - Cashflows will be cashflows after debt payments to equity investors
  - Hurdle rate will be cost of equity

A New Store for the Home Depot

- It will require an initial investment of $20 million in land, building and fixtures.
- The Home Depot plans to borrow $ 5 million, at an interest rate of 5.80%, using a 10-year term loan.
- The store will have a life of 10 years. During that period, the store investment will be depreciated using straight line depreciation. At the end of the tenth year, the investments are expected to have a salvage value of $ 7.5 million.
- The store is expected to generate revenues of $40 million in year 1, and these revenues are expected to grow 5% a year for the remaining 9 years of the store's life.
- The pre-tax operating margin, at the store prior to depreciation, is expected to be 10% for the entire period.

Interest and Principal Payments

Year	Outstanding debt	Interest Expense	Total Payment	Principal Repaid	Remaining Principa
1	$5,000,000.00	$290,000.00	$672,917.36	$382,917.36	$4,617,082.64
2	$4,617,082.64	$267,790.79	$672,917.36	$405,126.57	$4,211,956.08
3	$4,211,956.08	$244,293.45	$672,917.36	$428,623.91	$3,783,332.17
4	$3,783,332.17	$219,433.27	$672,917.36	$453,484.09	$3,329,848.08
5	$3,329,848.08	$193,131.19	$672,917.36	$479,786.17	$2,850,061.91
6	$2,850,061.91	$165,303.59	$672,917.36	$507,613.77	$2,342,448.14
7	$2,342,448.14	$135,861.99	$672,917.36	$537,055.37	$1,805,392.77
8	$1,805,392.77	$104,712.78	$672,917.36	$568,204.58	$1,237,188.19
9	$1,237,188.19	$71,756.92	$672,917.36	$601,160.44	$636,027.75
10	$636,027.75	$36,889.61	$672,917.36	$636,027.75	$0.00

Net Income on The Home Depot Store

Year	Revenues	Operating Expenses	Depreciation	EBIT	Interest Expense	Taxable Income	Taxes	Net Income
1	$40,000,000	$36,000,000	$1,250,000	$2,750,000	$290,000	$2,460,000	$861,000	$1,599,000
2	$42,000,000	$37,800,000	$1,250,000	$2,950,000	$267,791	$2,682,209	$938,773	$1,743,436
3	$44,100,000	$39,690,000	$1,250,000	$3,160,000	$244,293	$2,915,707	$1,020,497	$1,895,209
4	$46,305,000	$41,674,500	$1,250,000	$3,380,500	$219,433	$3,161,067	$1,106,373	$2,054,693
5	$48,620,250	$43,758,225	$1,250,000	$3,612,025	$193,131	$3,418,894	$1,196,613	$2,222,281
6	$51,051,263	$45,946,136	$1,250,000	$3,855,126	$165,304	$3,689,823	$1,291,438	$2,398,385
7	$53,603,826	$48,243,443	$1,250,000	$4,110,383	$135,862	$3,974,521	$1,391,082	$2,583,438
8	$56,284,017	$50,655,615	$1,250,000	$4,378,402	$104,713	$4,273,689	$1,495,791	$2,777,898
9	$59,098,218	$53,188,396	$1,250,000	$4,659,822	$71,757	$4,588,065	$1,605,823	$2,982,242
10	$62,053,129	$55,847,816	$1,250,000	$4,955,313	$36,890	$4,918,423	$1,721,448	$3,196,975

The Hurdle Rate

- The analysis is done in equity terms. Thus, the hurdle rate has to be a real cost of equity
- The cost of equity for the Home Depot is 9.78%. Since the Home Depot's investments are assumed to be homogeneous, the cost of equity for this project is also assumed to be 9.78%.

ROE on this Project

Year	Average BV of Equity	Net Income	Return on Equity
0			
1	$ 17,766,459	$1,599,000	9.00%
2	$ 17,070,481	$1,743,436	10.21%
3	$ 16,405,356	$1,895,209	11.55%
4	$ 15,772,810	$2,054,693	13.03%
5	$ 15,174,665	$2,222,281	14.64%
6	$ 14,612,846	$2,398,385	16.41%
7	$ 14,089,386	$2,583,438	18.34%
8	$ 13,606,431	$2,777,898	20.42%
9	$ 13,166,249	$2,982,242	22.65%
10	$ 12,771,236	$3,196,975	25.03%
Average	$ 15,043,592	$2,345,356	16.13%

From Project ROE to Firm ROE

- As with the earlier analysis, where we used return on capital and cost of capital to measure the overall quality of projects, we can compute return on equity and cost of equity to pass judgment on whether a firm is creating value to its equity investors.

	Boeing	Home Depot	InfoSoft
Return on Equity	7.58%	22.37%	33.47%
Cost of Equity	10.58%	9.78%	13.19%
ROE - Cost of Equity	-2.99%	12.59%	20.28%

Additional Assumptions

- Working capital is assumed to be 8% of revenues and the investment in working capital is at the beginning of each year.
- At the end of the project life, the book value of the store is assumed to be equal to the salvage value.

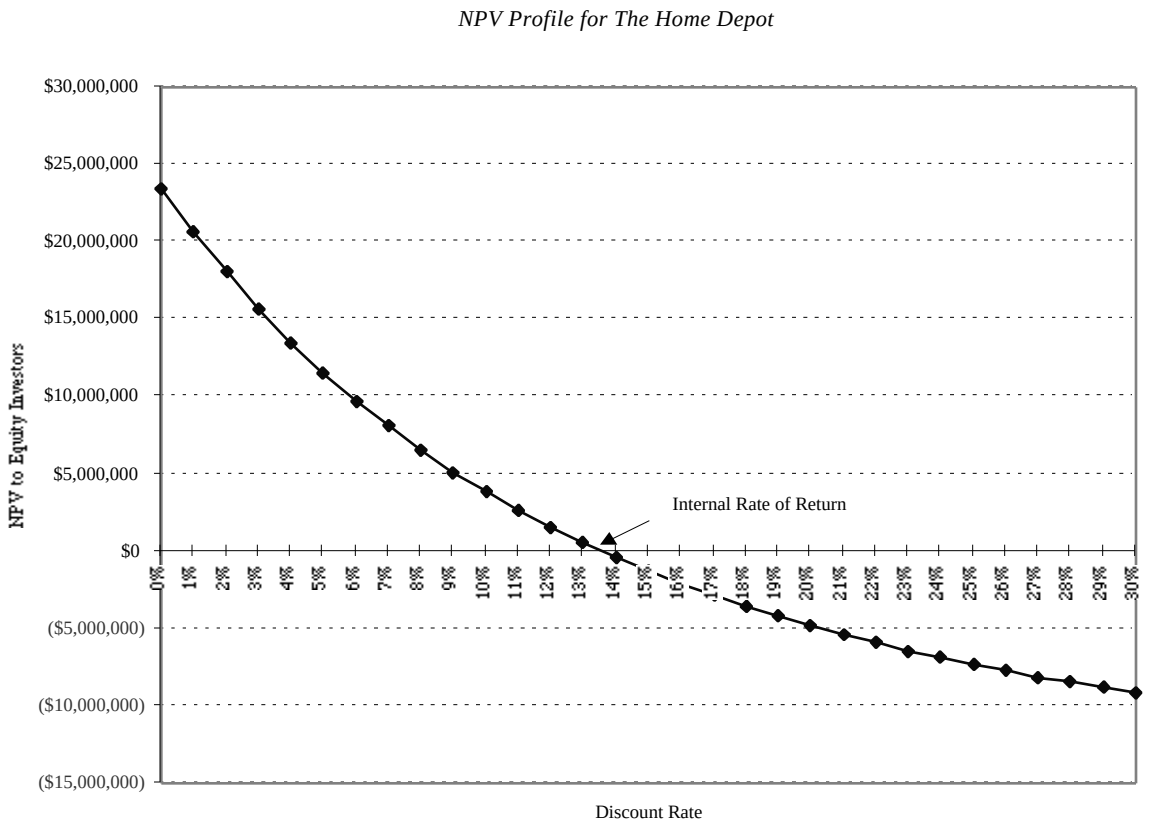
An Incremental CF Analysis

Year	Net Income	Depreciation	Capital Expenditures	sued/Principal Re	nge in Working Ca	Salvage Value	FCFE
0			($20,000,000)	$5,000,000	($3,200,000)		($18,200,000)
1	$1,599,000	$1,250,000		($382,917)	($160,000)		$2,306,083
2	$1,743,436	$1,250,000		($405,127)	($168,000)		$2,420,309
3	$1,895,209	$1,250,000		($428,624)	($176,400)		$2,540,185
4	$2,054,693	$1,250,000		($453,484)	($185,220)		$2,665,989
5	$2,222,281	$1,250,000		($479,786)	($194,481)		$2,798,014
6	$2,398,385	$1,250,000		($507,614)	($204,205)		$2,936,566
7	$2,583,438	$1,250,000		($537,055)	($214,415)		$3,081,968
8	$2,777,898	$1,250,000		($568,205)	($225,136)		$3,234,557
9	$2,982,242	$1,250,000		($601,160)	($236,393)		$3,394,689
10	$3,196,975	$1,250,000		($636,028)	$4,964,250	$7,500,000	$16,275,198

NPV of the Store

Year	FCFE	PV at Cost of Equity
0	($18,200,000)	($18,200,000)
1	$2,306,083	$2,100,640
2	$2,420,309	$2,008,281
3	$2,540,185	$1,919,976
4	$2,665,989	$1,835,547
5	$2,798,014	$1,754,825
6	$2,936,566	$1,677,646
7	$3,081,968	$1,603,856
8	$3,234,557	$1,533,307
9	$3,394,689	$1,465,855
10	$16,275,198	$6,401,681
		$4,101,613

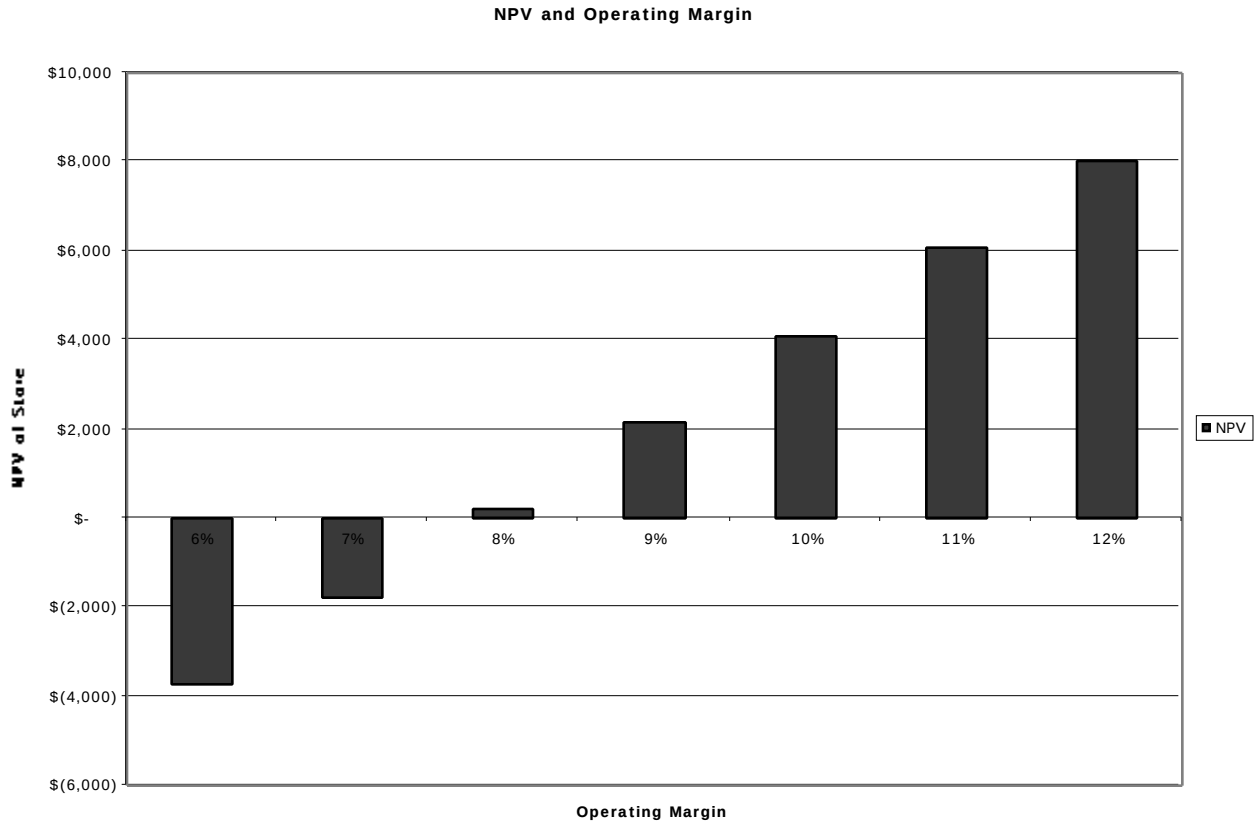
Internal Rate of Return: The Home Depot Store



The Role of Sensitivity Analysis

- Our conclusions on a project are clearly conditioned on a large number of assumptions about revenues, costs and other variables over very long time periods.
- To the degree that these assumptions are wrong, our conclusions can also be wrong.
- One way to gain confidence in the conclusions is to check to see how sensitive the decision measure (NPV, IRR..) is to changes in key assumptions.

Viability of New Store: Sensitivity to Operating Margin



What does sensitivity analysis tell us?

Assume that the manager at The Home Depot who has to decide on whether to take this plant is very conservative. She looks at the sensitivity analysis and decides not to take the project because the NPV would turn negative if the operating margin drops below 8%. Is this the right thing to do?

- Yes
- No

Explain.

The “Consistency Rule” for Cash Flows

- The cash flows on a project and the discount rate used should be defined in the same terms.
  - If cash flows are in one currency, the discount rate has to be a dollar (baht) discount rate
  - If the cash flows are nominal (real), the discount rate has to be nominal (real).
- If consistency is maintained, the project conclusions should be identical, no matter what cash flows are used.

The Home Depot: A New Store in Chile

- It will require an initial investment of 4700 million pesos for land, building and fixtures. The Home Depot plans to borrow 1880 million pesos, at an interest rate of 12.02%, using a 10-year term loan.
- The store will have a life of 10 years. During that period, the store will be depreciated using straight line depreciation. At the end of the tenth year, the investments are expected to have a salvage value of 2,350 million pesos.
- The store is expected to generate revenues of 7,050 million pesos in year 1, and these revenues are expected to grow 12% a year for the remaining 9 years.
- The pre-tax operating margin at the store, prior to depreciation, is expected to be 6% for the entire period.
- The working capital requirements are estimated to be 10% of total revenues, and investments will be made at the beginning of each year.

The Home Depot Chile Store: Cashflows in Pesos

Year	Net Income	Depreciation	Capital Expenditures	Debt Issued/Principal Repayment	Change in Working Capital	Salvage Value	FCFE
0			(4,700.00)	1,880.00	(705.00)		(3,525.00)
1	(22.83)	235.00		(107.01)	(84.60)		20.57
2	15.35	235.00		(119.87)	(94.75)		35.72
3	58.11	235.00		(134.29)	(106.12)		52.70
4	106.00	235.00		(150.43)	(118.86)		71.71
5	159.64	235.00		(168.52)	(133.12)		93.00
6	219.72	235.00		(188.78)	(149.09)		116.84
7	287.01	235.00		(211.48)	(166.99)		143.55
8	362.39	235.00		(236.91)	(187.02)		173.45
9	446.81	235.00		(265.39)	(209.47)		206.94
10	541.36	235.00		(297.30)	1,955.02	2,350.00	4,784.08

The Home Depot Chile Store: Cost of Equity in Pesos

- Cost of Equity for a U.S. store = 9.78%
- Estimating the Country Risk Premium for Chile
  - Default spread based on Chilean Bond rating = 1.1%
  - Relative Volatility of Chilean Equity to Bond Market = 2.2
  - Country risk premium for Chile = 1.1% * 2.2 = 2.42%
- Cost of Equity for a Chilean Store (in U.S. $)

  = 5% + 0.87 (5.5% + 2.42%) = 11.88%
- Assume that the expected inflation rate in Chile is 8% and the expected inflation rate in the U.S. is 2%.
- Cost of Equity for a Chilean Store (in Pesos)

= [(1 + Cost of Equity in $)* (1 + $\text{inflation}_{\text{Chile}}$)/ (1 + $\text{inflation}_{\text{US}}$)] - 1

=[1.1188* (1.08/1.02)] -1 = 18.46%

NPV in Pesos

Year	FCFE in pesos (millions	PV at Peso Cost of Equi
0	-3,525.00	-3,525.00
1	20.57	17.36
2	35.72	25.46
3	52.70	31.70
4	71.71	36.41
5	93.00	39.86
6	116.84	42.28
7	143.55	43.84
8	173.45	44.72
9	206.94	45.04
10	4,784.08	878.90
		-2,319

Converting Pesos to U.S. dollars

- This entire analysis can be done in dollars, if we convert the peso cash flows into U.S. dollars.
- If you want the analysis to yield consistent conclusions, expected exchange rates have to be estimated based upon expected inflation rates:
  - Current Exchange Rate = 470 pesos
  - Expected Rate_t = Exchange Rate* (1 + $\text{inflation}_{\text{Chile}}$)/ (1 + $\text{inflation}_{\text{US}}$)]
  - Expected Exchange Rate in year 1 = 470 pesos * (1.08/1.02) = 497.65

Analyzing the Project: U.S. Dollars

Year	FCFE in pesos (millions)	Expected Exchange Rate	FCFE in $
0	-3525	470.00	$(7,500,000)
1	21	497.65	$ 41,327
2	36	526.92	$ 67,797
3	53	557.92	$ 94,457
4	72	590.73	$ 121,391
5	93	625.48	$ 148,686
6	117	662.28	$ 176,428
7	144	701.23	$ 204,707
8	173	742.48	$ 233,612
9	207	786.16	$ 263,235
10	4784	832.40	$ 5,747,306

NPV in U.S. Dollars

Year	FCFE in $	PV at $ cost of equity
0	$ (7,500,000)	$ (7,500,000)
1	$ 41,327	$ 36,938
2	$ 67,797	$ 54,161
3	$ 94,457	$ 67,445
4	$ 121,391	$ 77,471
5	$ 148,686	$ 84,812
6	$ 176,428	$ 89,949
7	$ 204,707	$ 93,282
8	$ 233,612	$ 95,148
9	$ 263,235	$ 95,826
10	$ 5,747,306	$ 1,870,008
	NPV (in U.S. $)	$ (4,934,960)
	In Pesos	-2319

Dealing with Inflation

- In our analysis, we used nominal dollars and pesos. Would the NPV have been different if we had used real cash flows instead of nominal cash flows?
  - It would be much lower, since real cash flows are lower than nominal cash flows
  - It would be much higher
  - It should be unaffected

From Nominal to Real : The Home Depot

- To do a real analysis, you need a real cost of equity or capital
  - Nominal cost of equity for The Home Depot = 9.78%
  - Expected Inflation rate = 2%
  - Real Cost of Equity = (1.0978/1.02)-1 = 7.59%
- To estimate cash flows in real terms
  - Real Cash flow$_t$ = Nominal Cash flow$_t$ / (1+ Expected Inflation rate)^t

Nominal versus Real

Year	FCFE (nominal)	PV (nominal)	Deflation factor	FCFE (Real)	PV (Real)
0	($18,200,000)	($18,200,000)	1.0000	($18,200,000)	$ (18,200,000)
1	$2,826,083	$2,574,315	0.9801	$2,769,830	$ 2,574,315
2	$2,966,309	$2,461,331	0.9606	$2,849,397	$ 2,461,331
3	$3,113,485	$2,353,299	0.9415	$2,931,242	$ 2,353,299
4	$3,267,954	$2,250,003	0.9227	$3,015,429	$ 2,250,003
5	$3,430,077	$2,151,234	0.9044	$3,102,025	$ 2,151,234
6	$3,600,232	$2,056,796	0.8864	$3,191,098	$ 2,056,796
7	$3,778,817	$1,966,497	0.8687	$3,282,720	$ 1,966,497
8	$3,966,249	$1,880,157	0.8514	$3,376,963	$ 1,880,157
9	$4,162,966	$1,797,603	0.8345	$3,473,900	$ 1,797,603
10	$17,081,888	$6,718,984	0.8179	$13,970,716	$ 6,718,984
NPV		$8,010,219			$ 8,010,219

Side Costs and Benefits

- Most projects considered by any business create side costs and benefits for that business.
- The side costs include the costs created by the use of resources that the business already owns (opportunity costs) and lost revenues for other projects that the firm may have.
- The benefits that may not be captured in the traditional capital budgeting analysis include project synergies (where cash flow benefits may accrue to other projects) and options embedded in projects (including the options to delay, expand or abandon a project).
- The returns on a project should incorporate these costs and benefits.

Opportunity Cost

- An opportunity cost arises when a project uses a resource that may already have been paid for by the firm.
- When a resource that is already owned by a firm is being considered for use in a project, this resource has to be priced on its next best alternative use, which may be
  - a sale of the asset, in which case the opportunity cost is the expected proceeds from the sale, net of any capital gains taxes
  - renting or leasing the asset out, in which case the opportunity cost is the expected present value of the after-tax rental or lease revenues.
  - use elsewhere in the business, in which case the opportunity cost is the cost of replacing it.

Case 1: Opportunity Costs

- Assume that Boeing owns the land that will be used to build the plant for the Super Jumbo Jet already. This land is undeveloped and was acquired several years ago for $40 million. The land currently can be sold for $ 100 million, though that would create a capital gain (which will be taxed at 20%). In assessing the Boeing Super Jumbo, which of the following would you do:
  - Ignore the cost of the land, since Boeing owns its already
  - Use the book value of the land, which is $ 40 million
  - Use the market value of the land, which is $ 100 million
  - Other:

Case 2: Excess Capacity

- In the Boeing example, assume that the firm will use its existing storage facilities, which have excess capacity, to hold inventory associated with the Super Jumbo. The project analyst argues that there is no cost associated with using these facilities, since they have been paid for already and cannot be sold or leased to a competitor (and thus has no competing current use). Do you agree?
  - Yes
  - No

Estimating the Cost of Excess Capacity

- Existing Capacity = 100,000 units
- Current Usage = 50,000 (50% of Capacity); 50% Excess Capacity;
- New Product will use 30% of Capacity; Sales growth at 5% a year; CM per unit = $5/unit
- Book Value = $1,000,000 Cost of a building new capacity = $1,500,000 Cost of Capital = 12%
- Current product sales growing at 10% a year. CM per unit = $4/unit
- Basic Framework
  - If I do not take this product, when will I run out of capacity?
  - If I take thisproject, when will I run out of capacity
  - When I run out of capacity, what will I do?
    - cut back on production: cost is PV of after-tax cash flows from lost sales
    - buy new capacity: cost is difference in PVbetween earlier & later investment

Opportunity Cost of Excess Capacity

Year	Old	New	Old + New	Lost ATCF	PV(ATCF)
1	50.00%	30.00%	80.00%	$0	
2	55.00%	31.50%	86.50%	$0	
3	60.50%	33.08%	93.58%	$0	
4	66.55%	34.73%	101.28%	$5,115	$ 3,251
5	73.21%	36.47%	109.67%	$38,681	$ 21,949
6	80.53%	38.29%	118.81%	$75,256	$ 38,127
7	88.58%	40.20%	128.78%	$115,124	$ 52,076
8	97.44%	42.21%	139.65%	$158,595	$ 64,054
9	107.18%	44.32%	151.50%	$ 206,000	$ 74,286
10	117.90%	46.54%	164.44%	$ 257,760	$ 82,992
				PV(LOST SALES)=	**$ 336,734**

- PV (Building Capacity In Year 3 Instead Of Year 8) = $1{,}500{,}000/1.12^3 - 1{,}500{,}000/1.12^8 = \$\ 461{,}846$
- Opportunity Cost of Excess Capacity = $ 336,734

Product and Project Cannibalization

- When a firm makes a new investment, some of the revenues may come from existing investments of the firm. This is referred to as cannibalization. Examples would be:
  - A New Starbucks that is opening four blocks away from an existing Starbucks
  - A personal computer manufacturer like Apple or Dell introducing a new and more powerful PC
- The key question to ask in this case is
  - What will happen if we do not make this new investment?
    - If the sales on existing products would have been lost anyway (to competitors), there is no incremental effect and the lost sales should not be considered.
    - If the sales on existing products would remain intact, the cannibalization is a real cost.

Product and Project Cannibalization: A Real Cost?

Assume that in the Home Depot Store analysis, 20% of the revenues at the store are expected to come from people who would have gone to a existing store nearby. In doing the analysis of the store, would you

- Look at only incremental revenues (i.e. 80% of the total revenue)
- Look at total revenues at the park
- Choose an intermediate number

Would your answer be different if you were analyzing whether introducing the Boeing Super Jumbo would cost you sales on the Boeing 747?

- Yes
- No

Project Synergies

- A project may provide benefits for other projects within the firm. If this is the case, these benefits have to be valued and shown in the initial project analysis.
- For instance, the Home Depot, when it considers opening a new restaurant at one of its stores, will have to examine the additional revenues that may accrue to this store from people who come to the restaurant.

Other Investments

- Firms often make investments in
  - Short term assets, such as inventory and accounts receivable.
  - Marketable securities, such as
    - Government securities (Treasury Bills, bonds)
    - Corporate bonds
    - Equities of other companies
- The investment principle continues to apply to these investments. If they make a return that exceeds the hurdle rate (given their riskiness), they will create value. If not, they will destroy value.

I. Investments in Non-Cash Working Capital

- The difference between current assets and current liabilities is often titled working capital by accountants.
- We modify that definition to make it the difference between non-cash current assets and non-debt current liabilities and call it non-cash working capital.
  - We eliminate cash from current assets because large cash balances today earn a fair market return. Thus, they cannot be viewed as a wasting asset.
  - We eliminate debt from current liabilities because we consider debt to be part of our financing and include it in our cost of capital calculations.

Distinguishing between Working Capital and Non-cash Working Capital

	Boeing	*The Home Depot*
Current Assets	$16,375	$4,933
Current Liabilities	$13,422	$2,857
Working Capital	$2,953	$2,076
Non-cash Current Assets		
Inventory	$8,349	$4,293
Accounts Receivable	$5,564	$469
Non-cash Current Liabilities		
Accounts Payables	$10,733	$1,586
Other Current Liabilities	$1,820	$1,257
Non-cash Working Capital	$1,360	$1,919

Why investments in non-cash working capital matter..

- Any investment in non-cash working capital can be viewed as cash that does not earn a return. Thus, any increases in non-cash working capital can be viewed as a cash outflow, while any decreases can be viewed as a cash inflow.
- This affects
  - The analysis of investments, because the incremental cash flows on a project are after non-cash working capital cash flows.
  - Firm value, because the cash flows to a firm are also after non-cash working capital cash flows.

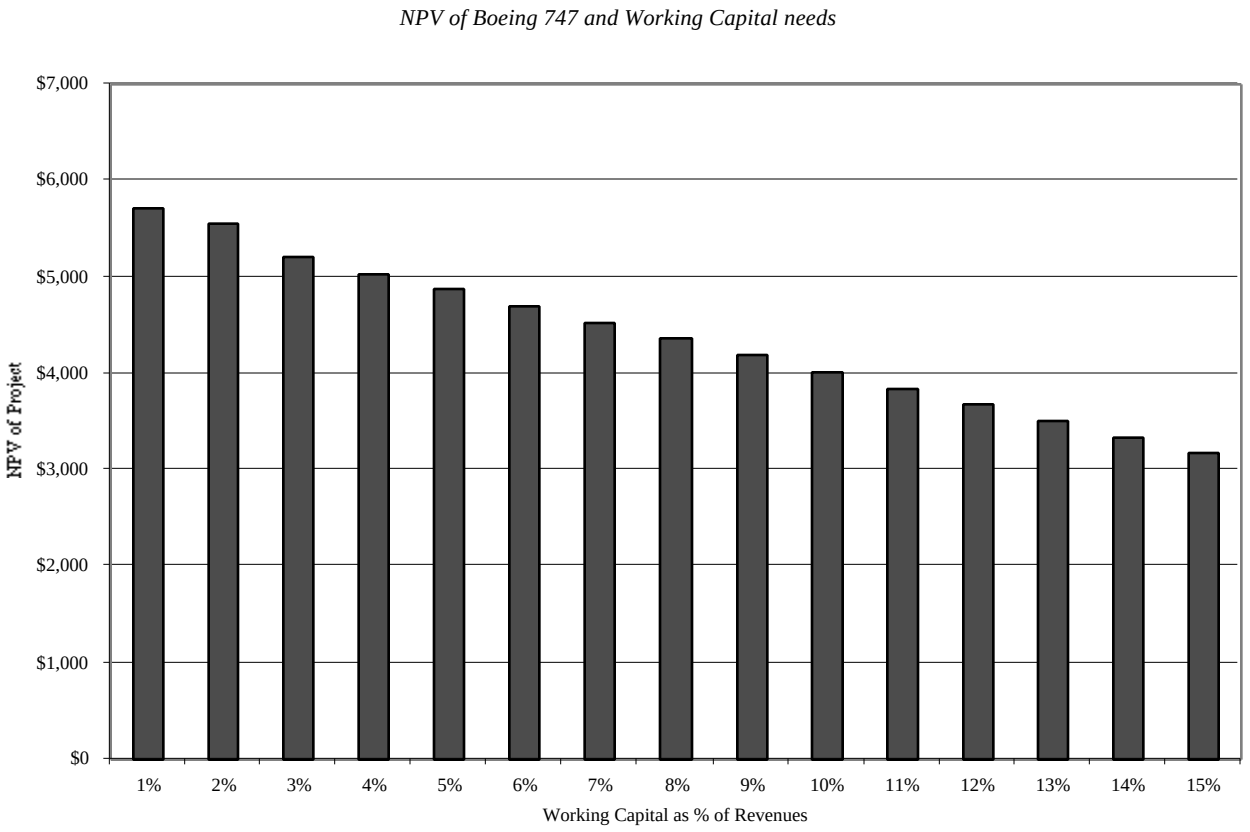
The Effect of Non-cash working capital on a Project: Boeing Super Jumbo

- Boeing is assumed to invest 10% of its revenues in non-cash working capital at the beginning of each year on the Super Jumbo project.
- At the end of the 25th year, we assume that the entire working capital investment is salvaged.
- The cost of capital for the project is 9.32%.

Present Value Effect of Working Capital

Year	Revenues	Working Capital	Investment in Working Capital	Salvage Value	Present Value
0	$0	$0	$0		$0
1	$0	$0	$0		$0
2	$0	$0	$0		$0
3	$0	$0	$0		$0
4	$0	$0	($1,000)		($700)
5	$10,000	$1,000	($1,575)		($1,009)
6	$25,750	$2,575	($77)		($45)
7	$26,523	$2,652	($80)		($43)
8	$27,318	$2,732	($82)		($40)
9	$28,138	$2,814	($84)		($38)
10	$28,982	$2,898	($87)		($36)
11	$29,851	$2,985	($90)		($34)
12	$30,747	$3,075	($92)		($32)
13	$31,669	$3,167	($95)		($30)
14	$32,619	$3,262	($98)		($28)
15	$33,598	$3,360	($101)		($26)
16	$34,606	$3,461	($104)		($25)
17	$35,644	$3,564	($107)		($24)
18	$36,713	$3,671	($110)		($22)
19	$37,815	$3,781	($113)		($21)
20	$38,949	$3,895	$686		$115
21	$32,094	$3,209	($96)		($15)
22	$33,057	$3,306	($99)		($14)
23	$34,049	$3,405	($102)		($13)
24	$35,070	$3,507	($105)		($12)
25	$36,122	$3,612		$3,612	$389
					($1,701)

NPV of Boeing Super Jumbo and Working Capital as % of Revenues



Firm Value and Working Capital Investments

- Investments in working capital drain cash flows, and other things remaining equal, reduce the value of the firm.
- When firms reduce their investments in non-cash working capital (hold less inventory, grant less credit or use more supplier credit), they
  - Increase their cash flows, but
  - Potentially decrease revenues, cash flows and expected growth, because of lost sales; they might also make themselves riskier firms.

Working Capital and Value: A Simple Example

- A mail-order retail firm has current revenues of $ 1 billion and operating profits after taxes of $ 100 million.
- If the firm maintains no working capital, its operating profits after taxes are expected to grow 3% a year forever and the firm will have a cost of capital of 12.50%.
- As the working capital increases as a percent of revenues, the expected growth in operating profits will increase, at a decreasing rate, and the cost of capital will decrease by .05% for every 10% increase in working capital as a percent of revenues.

Firm Value Schedule as a function of Working Capital

Working Capital as a % of Revenues	*Expected Growth* in Operating Income	*Cost of Capital*	*Value of* Firm
0%	3.00%	12.50%	$ 1,084.21
10%	4.00%	12.45%	$ 1,183.43
20%	4.50%	12.40%	$ 1,208.86
30%	4.83%	12.35%	$ 1,201.77
40%	5.08%	12.30%	$ 1,174.36
50%	5.28%	12.25%	$ 1,132.06
60%	5.45%	12.20%	$ 1,077.78
70%	5.59%	12.15%	$ 1,013.29
80%	5.72%	12.10%	$ 939.73
90%	5.83%	12.05%	$ 857.87
100%	5.93%	12.00%	$ 768.23

The Trade Off on Elements of Working Capital

	Effect of Increasing Element	
Element	*Positive Aspects*	*Negative Aspects*
Inventory	Fewer lost sales Lower re-ordering costs	Storage Costs Cash tied up in inventory
Accounts Receivable	More Revenues	Bad Debts (Default) Cash tied up in receivables
Accounts Payable	Used to finance inventory & accounts receivable	Increased credit risk Implicit Cost (if there is a discount for prompt payment)

Managing Inventory

- Economic Order Quantity Models: For firms with a homogeneous products and clearly defined ordering and storage costs, the optimal level of inventory can be estimated simply by trading off the two costs.
- Peer Group Analysis: Firms can compare their inventory holdings to those of comparable firms in the sector to see if they are holding too much in inventory.

Inventory Trade Off

- For firms with a single product that knows what the demand for its product is with certainty, the optimal level of inventory can be estimated by trading off the carrying costs against the ordering costs. The optimal amount that the firm should order can be written as:
- Economic Order Quantity = $\sqrt{\frac{2 * \text{Annual Demand in Units} * \text{Ordering Cost per Order}}{\text{Carrying Cost per Unit}}}$
- If there is uncertainty about future demand, the inventory will have to be augmented by a safety inventory that will cover excess demand.

A Simple Example

- A new car dealer reports the following:
  - The annual expected sales, in units, is 1200 cars; there is some uncertainty associated with this forecast, and monthly sales are normally distributed with a mean of 100 cars and a standard deviation of 15 cars.
  - The cost per order is $ 10,000, and it takes 15 days for new cars to be delivered by the manufacturer.
  - The carrying cost per car, on an annualized basis, is $1,000.
- The Economic order quantity for this firm can be estimated as follows:

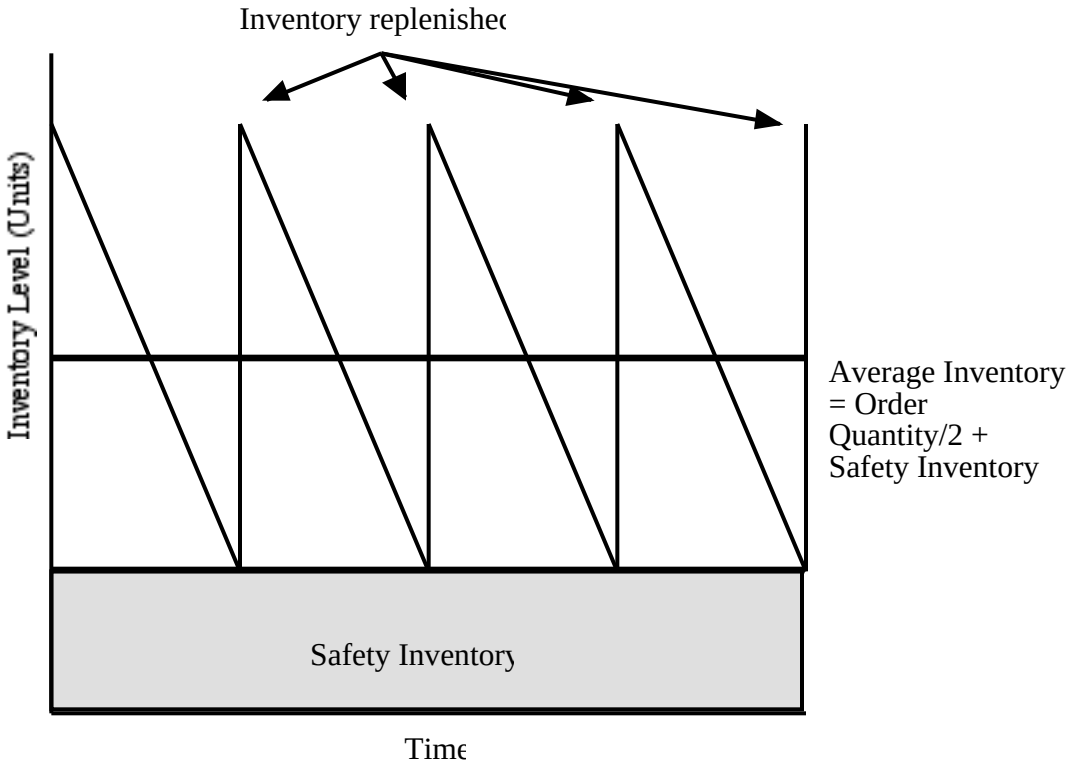
$$\text{Economic Order Quantity} = \sqrt{\frac{2 * 1200 * 10{,}000}{1000}} = 155 \text{ cars}$$

- Safety Inventory: Assuming that the firm wants to ensure, with 99% probability, that it does not run out of inventory, the safety inventory would have to be increased by 30 cars (which is twice the standard deviation).

Safety Inventory = Delivery Lag + Uncertainty = 50 + 30 = 80 cars

Inventory in an EOQ Model

Figure 13.4: Economic Order Quantity and Inventory Replenishment



Peer Group Analysis

Company Name	*Inventory/Sales*	*ln(Revenues)*	σ: *Operating Earnings*
Building Materials	10.74%	6.59	35.82%
Catalina Lighting	17.46%	5.09	52.76%
Cont'l Materials Corp	14.58%	4.59	25.15%
Eagle Hardware	20.88%	6.88	45.50%
Emco Limited	16.50%	7.14	39.68%
Fastenal Co.	19.96%	5.99	43.41%
Home Depot	14.91%	10.09	24.15%
HomeBase Inc.	21.27%	7.30	36.93%
Hughes Supply	18.43%	7.54	35.90%
Lowe's Cos.	16.91%	9.22	33.72%
National Home Centers	12.72%	5.02	70.93%
Waxman Industries. Inc.	24.76%	4.66	112.57%
Westburne Inc.	14.79%	7.76	25.14%
Wolohan Lumber	9.24%	6.05	24.56%
Average	16.65%		43.30%

Analyzing The Home Depot's Inventory

- Inventory at the Home Depot is 14.91% of sales, while the average for the sector is slightly higher at 16.65%. However, The Home Depot is larger and less risky than the average firm in the sector, which would lead us to expect a lower inventory holding at the firm.
- We regressed inventory as a percent of sales against firm size (measured as ln(Revenues)) and risk (measured using standard deviation in operating earnings) for this sector:

  Inventory/Sales = 0.056 +.0082 ln(Revenues) + 0.1283 (Standard Deviation)

  (0.87) (1.11) (2.51)
- Plugging in the values of each of these variables for the Home Depot yields a predicted inventory/sales ratio:

  $\text{Inventory/Sales}_{\text{Home Depot}} = 0.056 + .0082\ (10.09) + .1283\ (.2415) = 0.1697$
- The actual inventory/sales ratio of 14.91% is slightly lower than this predicted value.

Managing Accounts Receivable

- **Cash Flow Analysis**: Compare the present value of the cash flows (from higher sales) that will be generated from easier credit to the present value of the costs (higher bad debts, more cash tied up in accounts receivable)
- **Peer Group Analysis**: Compare the accounts receivable as a percent of revenues at a firm to the same ratio at other firms in the business.

Cash Flow Analysis: A Simple Example

- Stereo City, an electronics retailer, has historically not extended credit to its customers and has accepted only cash payments. In the current year, it had revenues of $10 million and pre-tax operating income of $ 2 million. If Stereo City offers 30-day credit to its customers, it expects these changes to occur:
  - Sales are expected to increase by $ 1 million each year, with the pre-tax operating margin remaining at 20% on these incremental sales.
  - The store expects to charge an annualized interest rate of 12% on these credit sales.
  - The bad debts (including the collection costs and net of any repossessions) are expected to be 5% of the credit sales.
  - The cost of administration associated with credit sales is expected to be $25,000 a year, along with an initial investment in a computerized credit-tracking system of $100,000. The computerized system will be depreciated straight line over 10 years.
  - The tax rate is 40%.
  - The store is expected to be in business for 10 years; at the end of that period, it is expected that 95% of the accounts receivable will be collected (and salvaged)
  - The store is expected to face a cost of capital of 10%.

The Cash Flows: Investment in System

- The initial investment needed to generate the credit consists of two outlays.
  - The first is the cost of the computerized system needed for the credit sales, which is $100,000.
  - The second is the investment of $ 1 million in accounts receivable created as a consequence of the credit sales.

Incremental After-tax Cash Flows

Incremental Revenues	$ 1,000,000	
Incremental Pre-tax Operating Income (20%)	$ 200,000	
+ Interest Income from Credit	$ 114,000	
- Bad Debts	$ 50,000	
- Annual Administrative Costs	$ 25,000	
Incremental Pre-tax Operating Profit	$ 239,000	
- Taxes (at 40%)	$ 95,600	
Incremental After-tax Operating Profit	$ 143,400	
+ Tax Benefit from Depreciation	$ 4,000	[$10,000 * 0.4]
Incremental After-tax Cash Flow	$ 147,400	

NPV of Credit Decision

- The salvage value comes from the collection of outstanding accounts receivable at the end of the store's life, which amounts to 95% of $1 million.
- We can find the present value of the credit decision, using the cost of capital of 10%:

  NPV of Credit Decision = - 1,100,000 + $147,400 (PV of Annuity, 10 years, 10%) + $950,000/1.1010 = $171,975

Investments In Marketable Securities

- Firms often invest in marketable securities. These marketable securities can range from short-term government securities (with no default or price risk) to equity in other firms (which can have substantial risk)

Riskless → Risky

Treasuries	Commercial Paper	Corporate Bonds	Equity in Publicly Traded firms	Equity in Private Businesses

Investments in Riskless Securities

- Investments in riskless securities will generally earn much lower returns than investments in risky projects.
- These low returns notwithstanding, investments in riskless securities are value neutral because the required return (hurdle rate) for these projects is the riskless rate.

Investments in Risky Securities

- Risky securities can range from securities with default risk (corporate bonds) to securities with equity risk (equity in other companies)
- The investment principle continues to apply. If the expected return on these investments is equal to the required return, these investments are value neutral.
  - If securities are fairly priced, investments in the marketable securities are value neutral.
  - If securities are under priced, investments in marketable securities can create value (have positive net present value)
  - If securities are over valued, investments in marketable securities are value destroying.

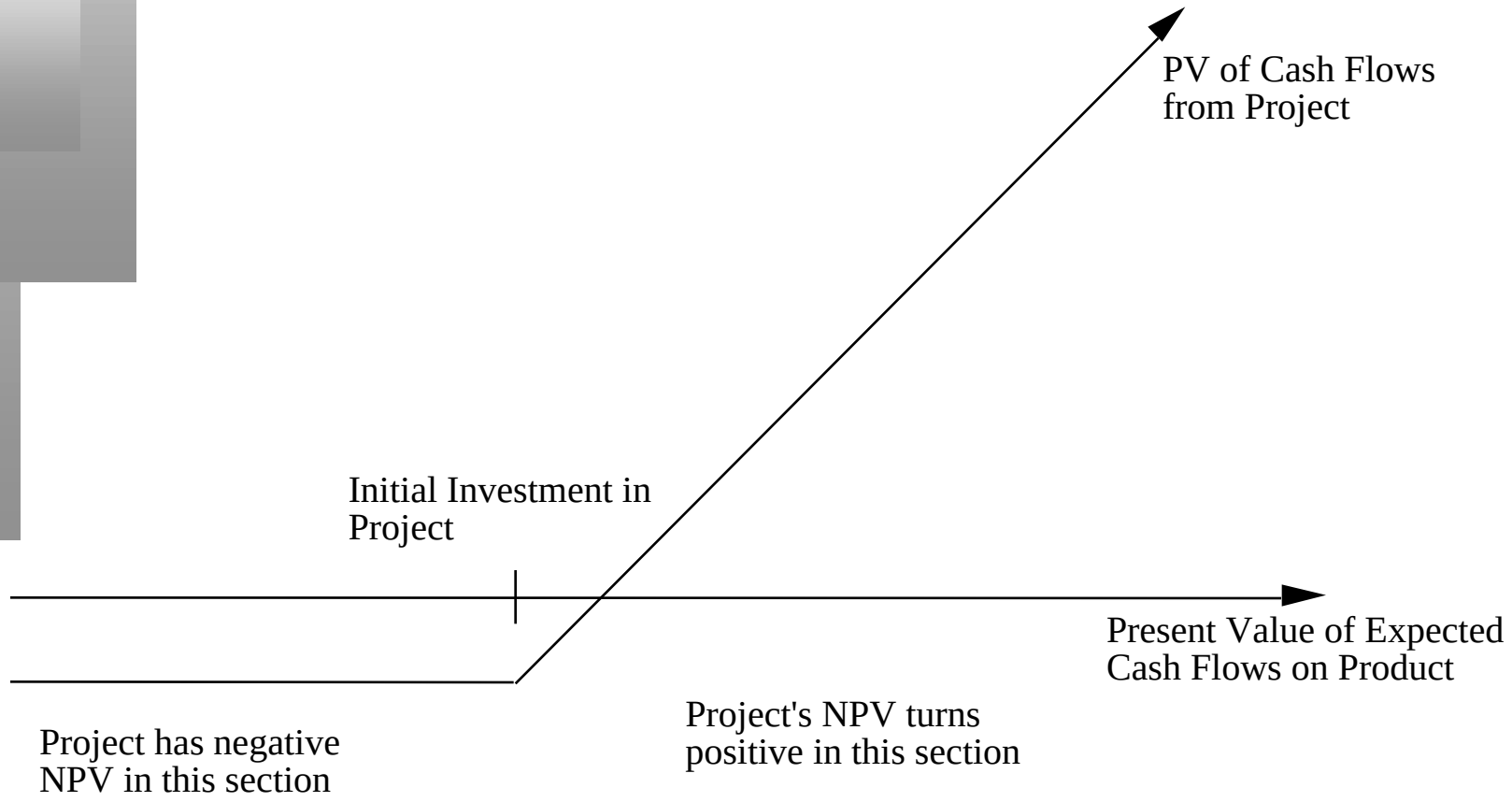
Project Options

- One of the limitations of traditional investment analysis is that it is static and does not do a good job of capturing the options embedded in investment.
  - The first of these options is the option to delay taking a project, when a firm has exclusive rights to it, until a later date.
  - The second of these options is taking one project may allow us to take advantage of other opportunities (projects) in the future
  - The last option that is embedded in projects is the option to abandon a project, if the cash flows do not measure up.
- These options all add value to projects and may make a “bad” project (from traditional analysis) into a good one.

The Option to Delay

- When a firm has exclusive rights to a project or product for a specific period, it can delay taking this project or product until a later date.
- A traditional investment analysis just answers the question of whether the project is a “good” one if taken today.
- Thus, the fact that a project does not pass muster today (because its NPV is negative, or its IRR is less than its hurdle rate) does not mean that the rights to this project are not valuable.

Valuing the Option to Delay a Project



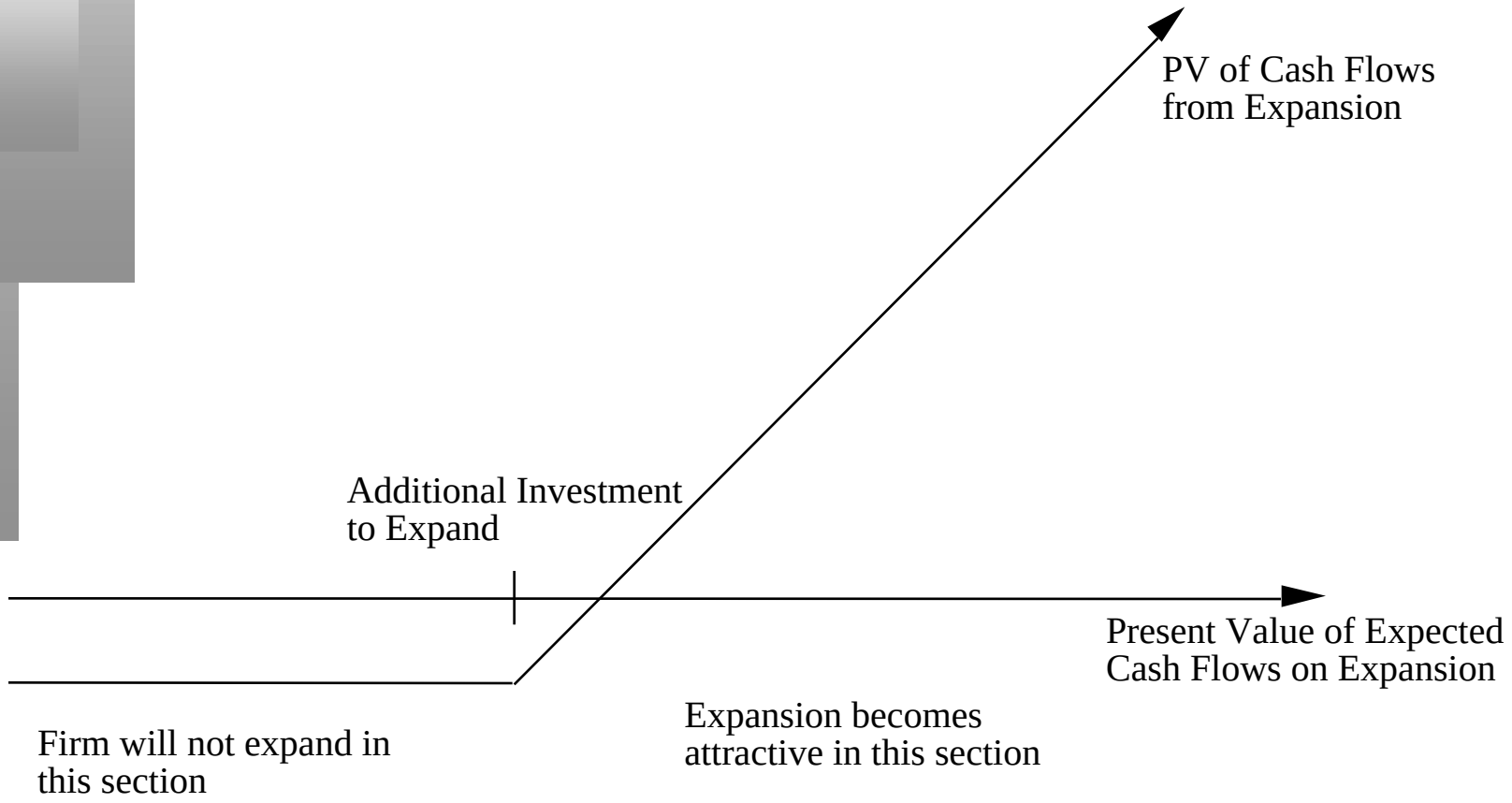
Insights for Investment Analyses

- Having the exclusive rights to a product or project is valuable, even if the product or project is not viable today.
- The value of these rights increases with the volatility of the underlying business.
- The cost of acquiring these rights (by buying them or spending money on development - R&D, for instance) has to be weighed off against these benefits.

The Option to Expand/Take Other Projects

- Taking a project today may allow a firm to consider and take other valuable projects in the future.
- Thus, even though a project may have a negative NPV, it may be a project worth taking if the option it provides the firm (to take other projects in the future) provides a more-than-compensating value.
- These are the options that firms often call “strategic options” and use as a rationale for taking on “negative NPV” or even “negative return” projects.

The Option to Expand



An Example of an Expansion Option

- Assume that The Home Depot is considering opening a small store in France. The store will cost 100 million French Francs (FF) to build, and the present value of the expected cash flows from the store is 120 million FF. Thje store has a negative NPV of 20 million FF.
- Assume, however, that by opening this store, the Home Depot will acquire the option to expand its operations any time over the next 5 years. The cost of expansion will be 200 million FF, and it will be undertaken only if the present value of the expected cash flows from expansion exceeds 200 million FF. At the moment, this present value is believed to be only 150 million FF. The Home Depot still does not know much about the market for home improvement products in France, and there is considerable uncertainty about this estimate. The variance in the estimate is 0.08.

Valuing the Expansion Option

- Value of the Underlying Asset (S) = PV of Cash Flows from Expansion, if done now =150 million FF
- Strike Price (K) =Cost of Expansion = 200 million FF
- Variance in Underlying Asset's Value = 0.08
- Time to expiration = Period for which expansion option applies = 5 years

Call Value= 150 (0.6314) -200 ($exp^{(-0.06)(20)}$ (0.3833)= 37.91 million FF

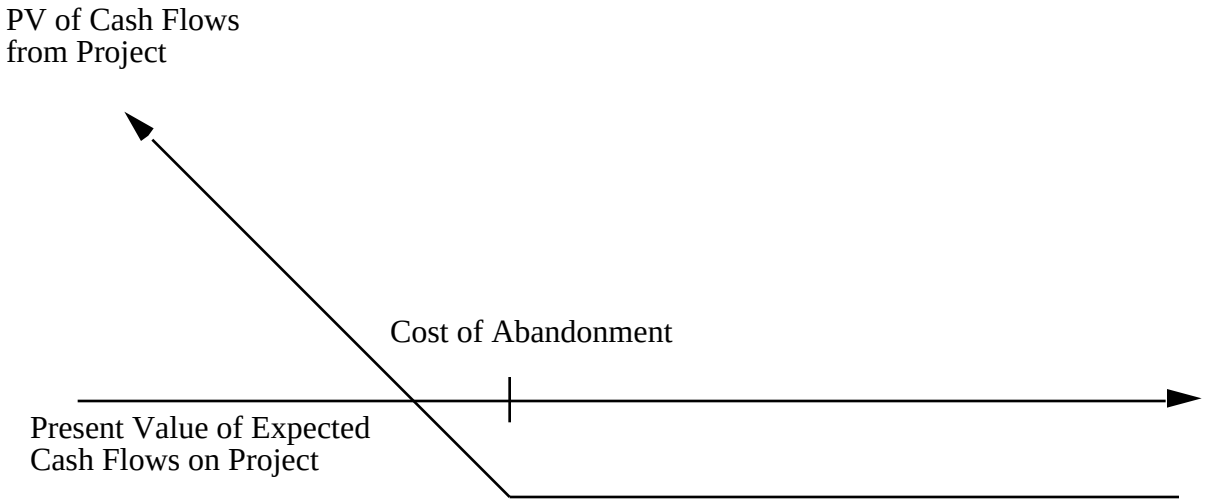
Considering the Project with Expansion Option

- NPV of Store = 80 million FF - 100 million FF = -20 million
- Value of Option to Expand = 37.91 million FF
- NPV of store with option to expand = -20 million + 37.91 million = 17.91 mil FF

Accept the project

The Option to Abandon

- A firm may sometimes have the option to abandon a project, if the cash flows do not measure up to expectations.
- If abandoning the project allows the firm to save itself from further losses, this option can make a project more valuable.



Valuing the Option to Abandon

- Assume that the Home Depot is considering a new store that requires a net initial investment of $ 9.5 million and generates cash flows with a present value of $8.563 million. The net present value of -$937,287 would lead us to reject this project.
- To illustrate the effect of the option to abandon, assume that the Home Depot has the option to close the store any time over the next 10 years and sell the land back to the original owner for $ 5 million. In addition, assume that the standard deviation in the present value of the cash flows is 22%.

Project with Option to Abandon

- Value of the Underlying Asset (S) = PV of Cash Flows from Project = $ 8,562,713
- Strike Price (K) = Salvage Value from Abandonment = $ 5 million
- Variance in Underlying Asset's Value = $0.22^2 = 0.0484$
- Time to expiration = Life of the Project = 10 years
- Dividend Yield = 1/Life of the Project = 1/10 = 0.10 (We are assuming that the project's present value will drop by roughly 1/n each year into the project)
- The riskless rate is 5%.

Should The Home Depot take this project?

- Value of Put = 5,000,000 $\exp^{(-0.05)(10)}$ (1-0.4977) - -8,562,713 $\exp^{(0.10)(10)}$ (1-0.7548) = $ 474,831
- The value of this abandonment option has to be added to the net present value of the project of -$ 937,287, yielding a total net present value that remains negative.

NPV without abandonment option =	-$937,287
Value of abandonment option =	+$474,831
NPV with abandonment option =	-$462,456

Notwithstanding the abandonment option, this store should not be opened.

First Principles

- Invest in projects that yield a **return** greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - **Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.**
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.