

Net Income: Vale Iron Ore Mine

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| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------------------------|------------|------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Production (millions of tons) | 4.00 | 6.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| * Price per ton | 102 | 104.04 | 106.12 | 108.24 | 110.41 | 112.62 | 114.87 | 117.17 | 119.51 | 121.9 |
| = Revenues (millions US\$) | \$408.00 | \$624.24 | \$848.97 | \$865.95 | \$883.26 | \$900.93 | \$918.95 | \$937.33 | \$956.07 | \$975.20 |
| - Variable Costs | \$180.00 | \$275.40 | \$374.54 | \$382.03 | \$389.68 | \$397.47 | \$405.42 | \$413.53 | \$421.80 | \$430.23 |
| - Fixed Costs | \$125.00 | \$127.50 | \$130.05 | \$132.65 | \$135.30 | \$138.01 | \$140.77 | \$143.59 | \$146.46 | \$149.39 |
| - Depreciation | \$200.00 | \$160.00 | \$128.00 | \$102.40 | \$81.92 | \$65.54 | \$65.54 | \$65.54 | \$65.54 | \$65.54 |
| EBIT | -\$97.00 | \$61.34 | \$216.37 | \$248.86 | \$276.37 | \$299.91 | \$307.22 | \$314.68 | \$322.28 | \$330.04 |
| - Interest Expenses | \$20.25 | \$18.57 | \$16.82 | \$14.99 | \$13.10 | \$11.13 | \$9.07 | \$6.94 | \$4.72 | \$2.41 |
| Taxable Income | -\$117.25 | \$42.77 | \$199.56 | \$233.87 | \$263.27 | \$288.79 | \$298.15 | \$307.74 | \$317.57 | \$327.63 |
| - Taxes | (\$39.87) | \$14.54 | \$67.85 | \$79.51 | \$89.51 | \$98.19 | \$101.37 | \$104.63 | \$107.97 | \$111.40 |
| = Net Income (millions US\$) | -\$77.39 | \$28.23 | \$131.71 | \$154.35 | \$173.76 | \$190.60 | \$196.78 | \$203.11 | \$209.59 | \$216.24 |
| <i>Book Value and Depreciation</i> | | | | | | | | | | |
| Beg. Book Value | \$1,250.00 | \$1,050.00 | \$890.00 | \$762.00 | \$659.60 | \$577.68 | \$512.14 | \$446.61 | \$381.07 | \$315.54 |
| - Depreciation | \$200.00 | \$160.00 | \$128.00 | \$102.40 | \$81.92 | \$65.54 | \$65.54 | \$65.54 | \$65.54 | \$65.54 |
| + Capital Exp. | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| End Book Value | \$1,050.00 | \$890.00 | \$762.00 | \$659.60 | \$577.68 | \$512.14 | \$446.61 | \$381.07 | \$315.54 | \$250.00 |
| - Debt Outstanding | \$458.45 | \$415.22 | \$370.24 | \$323.43 | \$274.73 | \$224.06 | \$171.34 | \$116.48 | \$59.39 | \$0.00 |
| End Book Value of Equity | \$591.55 | \$474.78 | \$391.76 | \$336.17 | \$302.95 | \$288.08 | \$275.27 | \$264.60 | \$256.14 | \$250.00 |

A ROE Analysis

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| Year | Net Income | Beg. BV: Assets | Depreciation | Capital Expense | Ending BV: Assets | BV of Working Capital | Debt | BV: Equity | Average BV: Equity | ROE |
|--|------------|-----------------|--------------|-----------------|-------------------|-----------------------|----------|------------|--------------------|---------|
| 0 | | \$0.00 | \$0.00 | \$1,250.00 | \$1,250.00 | \$81.60 | \$500.00 | \$831.60 | | |
| 1 | (\$77.39) | \$1,250.00 | \$200.00 | \$0.00 | \$1,050.00 | \$124.85 | \$458.45 | \$716.40 | \$774.00 | -10.00% |
| 2 | \$28.23 | \$1,050.00 | \$160.00 | \$0.00 | \$890.00 | \$169.79 | \$415.22 | \$644.57 | \$680.49 | 4.15% |
| 3 | \$131.71 | \$890.00 | \$128.00 | \$0.00 | \$762.00 | \$173.19 | \$370.24 | \$564.95 | \$604.76 | 21.78% |
| 4 | \$154.35 | \$762.00 | \$102.40 | \$0.00 | \$659.60 | \$176.65 | \$323.43 | \$512.82 | \$538.89 | 28.64% |
| 5 | \$173.76 | \$659.60 | \$81.92 | \$0.00 | \$577.68 | \$180.19 | \$274.73 | \$483.13 | \$497.98 | 34.89% |
| 6 | \$190.60 | \$577.68 | \$65.54 | \$0.00 | \$512.14 | \$183.79 | \$224.06 | \$471.87 | \$477.50 | 39.92% |
| 7 | \$196.78 | \$512.14 | \$65.54 | \$0.00 | \$446.61 | \$187.47 | \$171.34 | \$462.74 | \$467.31 | 42.11% |
| 8 | \$203.11 | \$446.61 | \$65.54 | \$0.00 | \$381.07 | \$191.21 | \$116.48 | \$455.81 | \$459.27 | 44.22% |
| 9 | \$209.59 | \$381.07 | \$65.54 | \$0.00 | \$315.54 | \$195.04 | \$59.39 | \$451.18 | \$453.50 | 46.22% |
| 10 | \$216.24 | \$315.54 | \$65.54 | \$0.00 | \$250.00 | \$0.00 | \$0.00 | \$250.00 | \$350.59 | 61.68% |
| Average ROE over the ten-year period = | | | | | | | | | | 31.36% |

US \$ ROE of 31.36% is greater than
Vale Iron Ore US\$ Cost of Equity of 11.13%

From Project ROE to Firm ROE

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- As with the earlier analysis, where we used return on capital and cost of capital to measure the overall quality of projects at firms, we can compute return on equity and cost of equity to pass judgment on whether firms are creating value to its equity investors.
- Specifically, we can compute the return on equity (net income as a percentage of book equity) and compare to the cost of equity. The return spread is then:
 - $\text{Equity Return Spread} = \text{Return on Equity} - \text{Cost of equity}$
- This measure is particularly useful for financial service firms, where capital, return on capital and cost of capital are difficult measures to nail down. For non-financial service firms, it provides a secondary (albeit a more volatile measure of performance). While it usually provides the same general result that the excess return computed from return on capital, there can be cases where the two measures diverge.
- Applied to Disney in 2013, for example, here is what we get:
 - $\text{ROE in 2013} = \text{Net Income in 2013} / \text{Book Value of Equity in 2013} = 14.62\%$
 - $\text{Cost of Equity for Disney} = 8.52\%$

An Incremental CF Analysis

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| | <i>0</i> | <i>1</i> | <i>2</i> | <i>3</i> | <i>4</i> | <i>5</i> | <i>6</i> | <i>7</i> | <i>8</i> | <i>9</i> | <i>10</i> |
|-------------------------------|------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|
| <i>Net Income</i> | | (\$77.39) | \$28.23 | \$131.71 | \$154.35 | \$173.76 | \$190.60 | \$196.78 | \$203.11 | \$209.59 | \$216.24 |
| + Depreciation & Amortization | | \$200.00 | \$160.00 | \$128.00 | \$102.40 | \$81.92 | \$65.54 | \$65.54 | \$65.54 | \$65.54 | \$65.54 |
| - Capital Expenditures | \$750.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| - Change in Working Capital | \$81.60 | \$43.25 | \$44.95 | \$3.40 | \$3.46 | \$3.53 | \$3.60 | \$3.68 | \$3.75 | \$3.82 | (\$195.04) |
| - Principal Repayments | | \$41.55 | \$43.23 | \$44.98 | \$46.80 | \$48.70 | \$50.67 | \$52.72 | \$54.86 | \$57.08 | \$59.39 |
| + Salvage Value of mine | | | | | | | | | | | \$250.00 |
| Cashflow to Equity | (\$831.60) | \$37.82 | \$100.05 | \$211.33 | \$206.48 | \$203.44 | \$201.86 | \$205.91 | \$210.04 | \$214.22 | \$667.42 |

An Equity NPV

Discounted at US\$ cost of equity of 11.13% for Vale's iron ore business

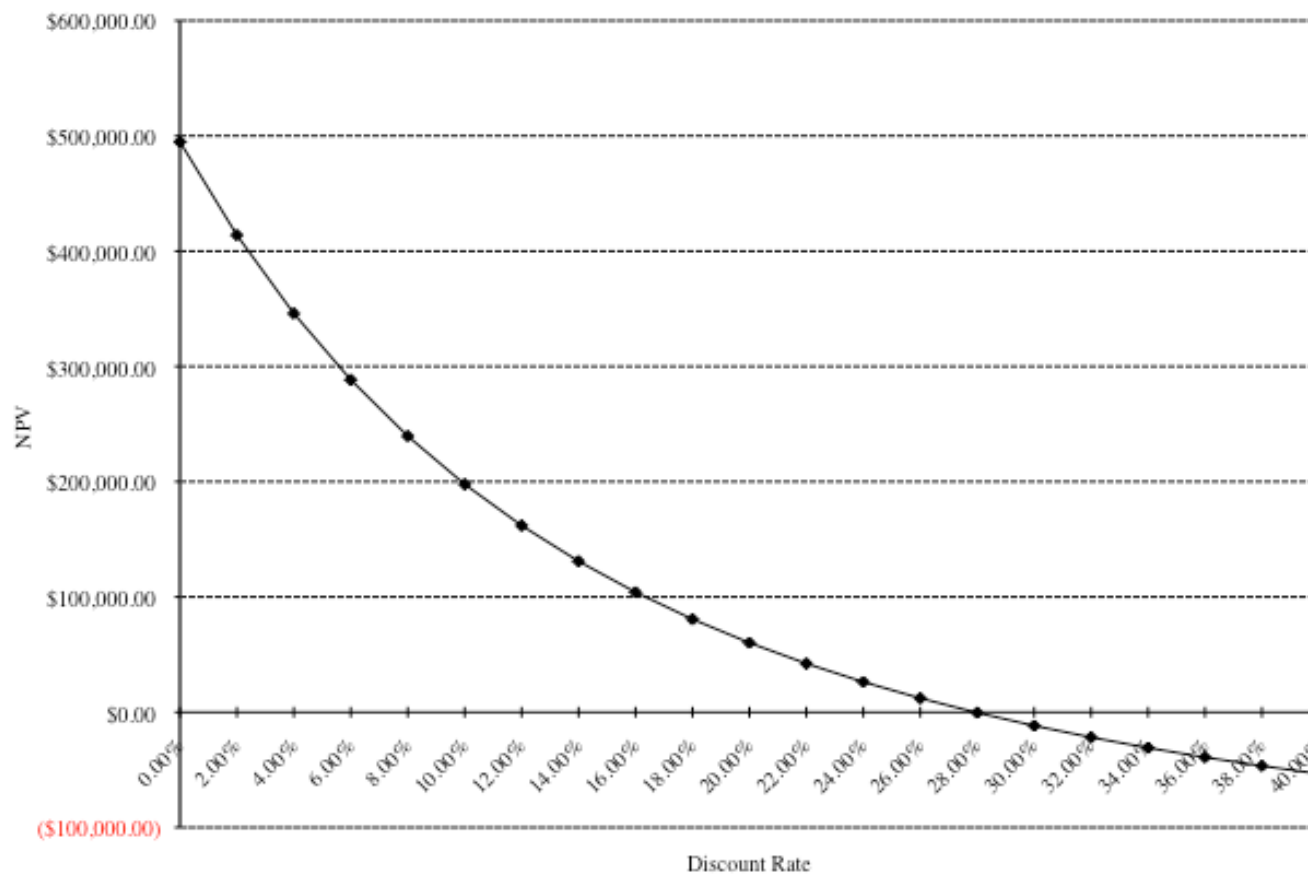
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| Year | Cash flow to equity | PV @11.13% |
|------|---------------------|------------|
| 0 | -\$831.60 | -\$831.60 |
| 1 | \$37.82 | \$34.03 |
| 2 | \$100.05 | \$81.02 |
| 3 | \$211.33 | \$153.99 |
| 4 | \$206.48 | \$135.40 |
| 5 | \$203.44 | \$120.04 |
| 6 | \$201.86 | \$107.18 |
| 7 | \$205.91 | \$98.39 |
| 8 | \$210.04 | \$90.31 |
| 9 | \$214.22 | \$82.89 |
| 10 | \$667.42 | \$232.38 |
| NPV | | \$304.04 |

An Equity IRR

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Figure 5.6: NPV Profile on Equity Investment in Paper Plant: Aracruz



Real versus Nominal Analysis

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In computing the NPV of the plant, we estimated US \$ cash flows and discounted them at the US \$ cost of equity. We could have estimated the cash flows in real terms (with no inflation) and discounted them at a real cost of equity. Would the answer be different?

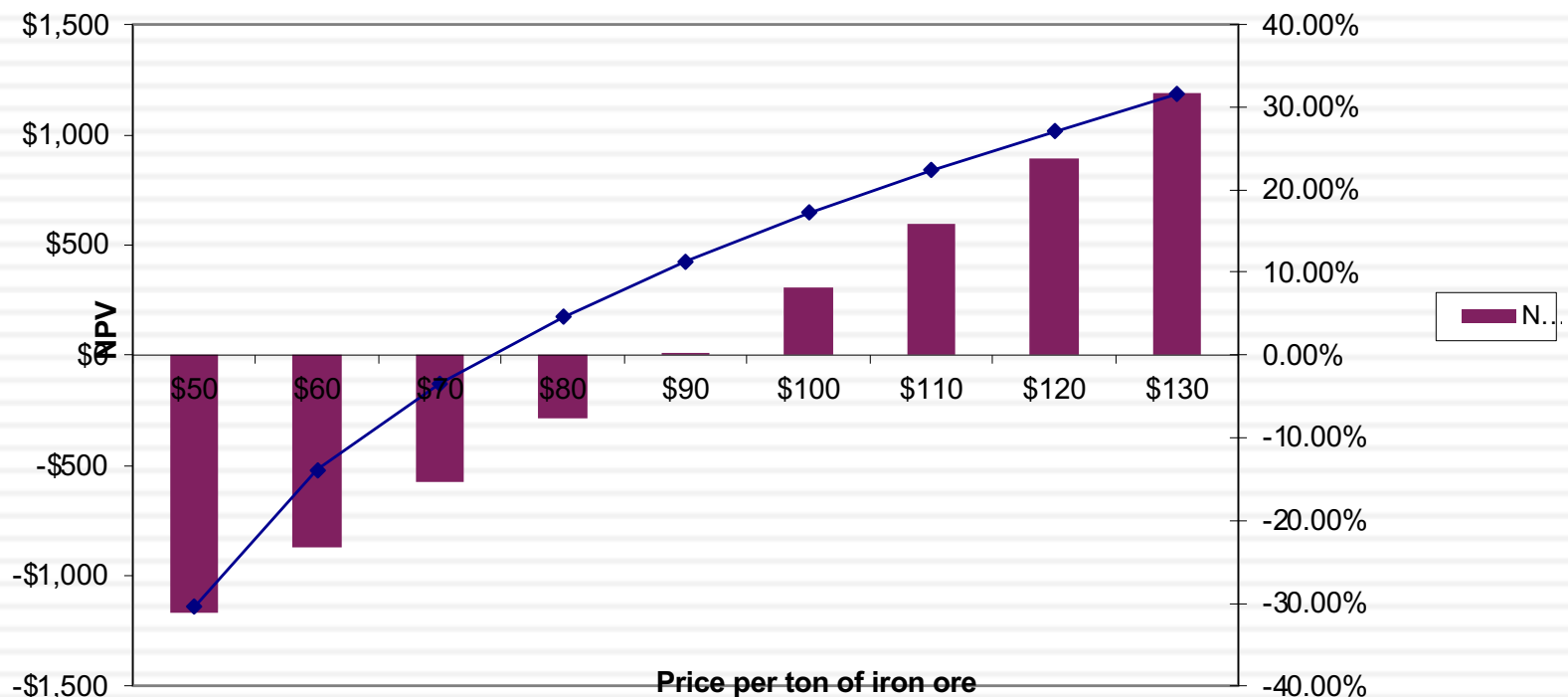
- ☐ Yes
- ☐ No
- ☐ Explain

Dealing with Macro Uncertainty: The Effect of Iron Ore Price

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- Like the Disney Theme Park, the Vale Iron Ore Mine's actual value will be buffeted as the variables change. The biggest source of variability is an external factor –the price of iron ore.

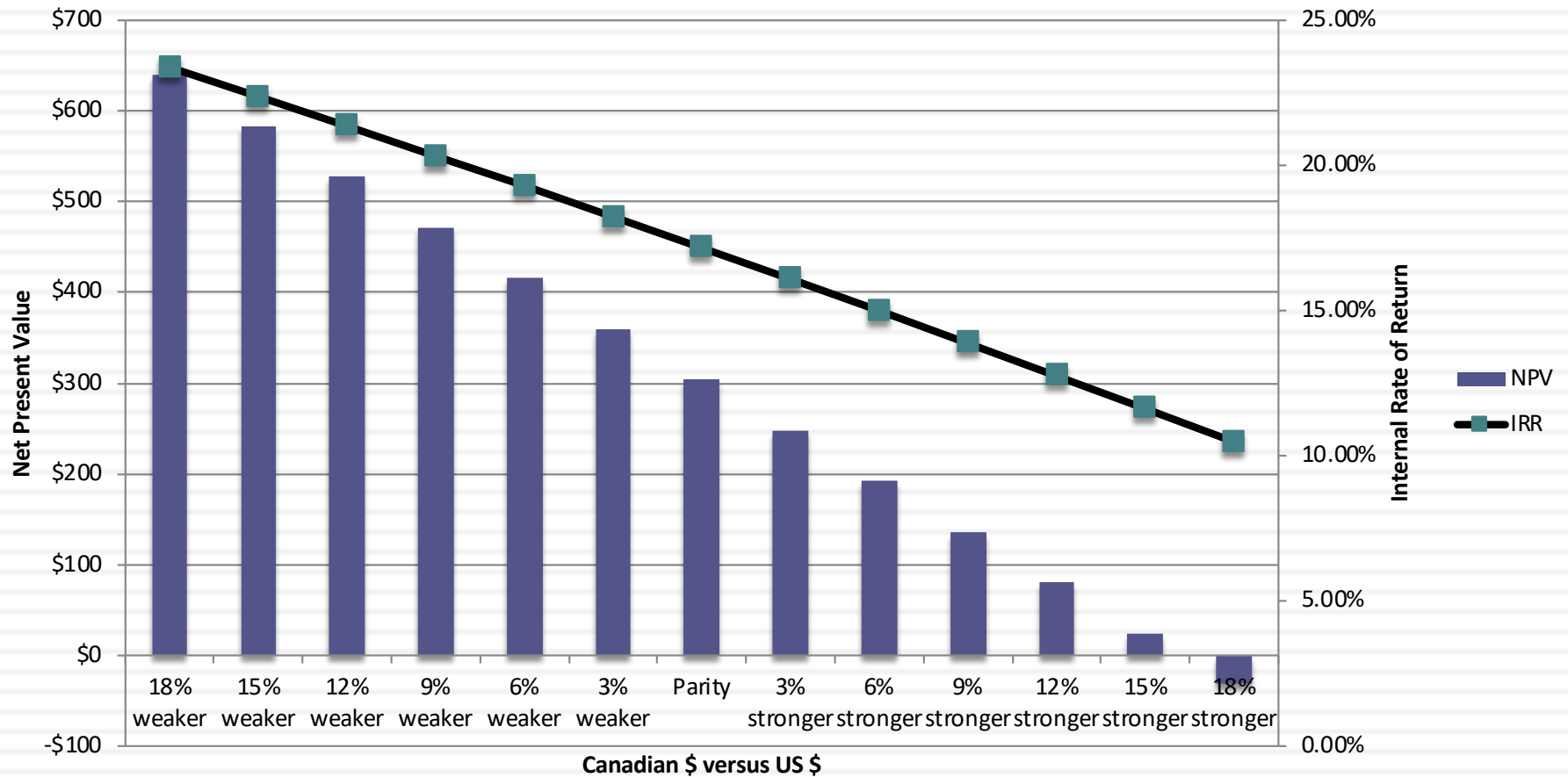
Vale Paper Plant: Effect of Changing Iron Ore Prices



And Exchange Rates...

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Exchange Rate effects on Iron Ore Plant



Should you hedge?

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- The value of this mine is very much a function iron ore prices. There are futures, forward and option markets iron ore that Vale can use to hedge against price movements. Should it?

- ▣ Yes
- ▣ No

Explain.

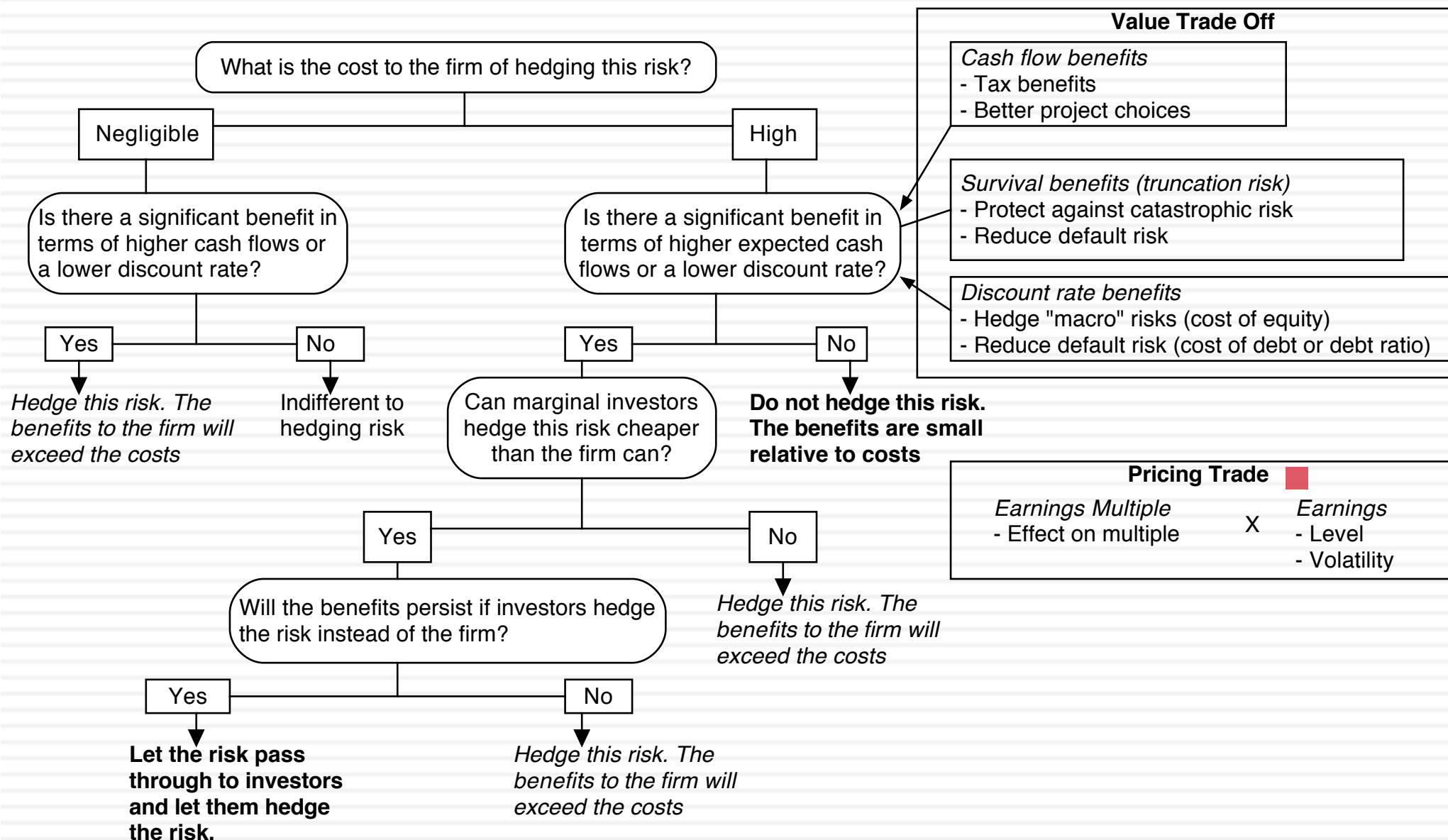
- The value of the mine is also a function of exchange rates. There are forward, futures and options markets on currency. Should Vale hedge against exchange rate risk?

- ▣ Yes
- ▣ No

Explain.

- On the last question, would your answer have been different if the mine were in Brazil.

- ▣ Yes
- ▣ No



Acquisitions and Projects

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- An acquisition is an investment/project like any other and all of the rules that apply to traditional investments should apply to acquisitions as well. In other words, for an acquisition to make sense:
 - ▣ It should have positive NPV. The present value of the expected cash flows from the acquisition should exceed the price paid on the acquisition.
 - ▣ The IRR of the cash flows to the firm (equity) from the acquisition $>$ Cost of capital (equity) on the acquisition
- In estimating the cash flows on the acquisition, we should count in any possible cash flows from synergy.
- The discount rate to assess the present value should be based upon the risk of the investment (target company) and not the entity considering the investment (acquiring company).

Tata Motors and Harman International

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- Harman International is a publicly traded US firm that manufactures high end audio equipment. Tata Motors is an automobile company, based in India.
- Tata Motors is considering an acquisition of Harman, with an eye on using its audio equipment in its Indian automobiles, as optional upgrades on new cars.

Estimating the Cost of Capital for the Acquisition (no synergy)

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1. Currency: Estimated in US \$, since cash flows will be estimated in US \$.
2. Beta: Harman International is an electronic company and we use the unlevered beta (1.17) of electronics companies in the US.
3. Equity Risk Premium: Computed based on Harman's operating exposure:

| | Revenues: 2012-13 (in millions) | ERP | Weight | Weight *ERP |
|----------------|------------------------------------|-------|----------------|--------------|
| United States | \$1,181 | 5.50% | 27.48% | 1.51% |
| Germany | \$1,482 | 5.50% | 34.48% | 1.90% |
| Rest of Europe | \$819 | 7.02% | 19.06% | 1.34% |
| Asia | \$816 | 7.27% | 18.99% | 1.38% |
| <i>Harman</i> | <i>\$4,298</i> | | <i>100.00%</i> | <i>6.13%</i> |

4. Debt ratio & cost of debt: Tata Motors plans to assume the existing debt of Harman International and to preserve Harman's existing debt ratio. Harman currently has a debt (including lease commitments) to capital ratio of 7.39% (translating into a debt to equity ratio of 7.98%) and faces a pre-tax cost of debt of 4.75% (based on its BBB- rating).

$$\text{Levered Beta} = 1.17 (1 + (1 - .40) (.0798)) = 1.226$$

$$\text{Cost of Equity} = 2.75\% + 1.226 (6.13\%) = 10.26\%$$

$$\text{Cost of Capital} = 10.26\% (1 - .0739) + 4.75\% (1 - .40) (.0739) = 9.67\%$$

Estimating Cashflows- First Steps

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- Operating Income: The firm reported operating income of \$201.25 million on revenues of \$4.30 billion for the year. Adding back non-recurring expenses (restructuring charge of \$83.2 million in 2013) and adjusting income for the conversion of operating lease commitments to debt, we estimated an adjusted operating income of \$313.2 million. The firm paid 18.21% of its income as taxes in 2013 and we will use this as the effective tax rate for the cash flows.
- Reinvestment: Depreciation in 2013 amounted to \$128.2 million, whereas capital expenditures and acquisitions for the year were \$206.4 million. Non-cash working capital increased by \$272.6 million during 2013 but was 13.54% of revenues in 2013.

Bringing in growth

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- We will assume that Harman International is a mature firm, growing 2.75% in perpetuity.
- We assume that revenues, operating income, capital expenditures and depreciation will all grow 2.75% for the year and that the non-cash working capital remain 13.54% of revenues in future periods.

| | 2013 | 2014 |
|----------------------------|------------|------------|
| Revenues | \$4,297.80 | \$4,415.99 |
| Operating income | \$313.19 | \$321.80 |
| Tax rate | 18.21% | 18.21% |
| After-tax Operating income | \$256.16 | \$263.21 |
| + Depreciation | \$128.20 | \$131.73 |
| - Capital Expenditures | \$206.40 | \$212.08 |
| - Change in non-cash WC | \$272.60 | \$16.01 |
| Cash flow to the firm | -\$94.64 | \$166.85 |

Value of Harman International: Before Synergy

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- Earlier, we estimated the cost of capital of 9.67% as the right discount rate to apply in valuing Harman International and the cash flow to the firm of \$166.85 million for 2014 (next year), assuming a 2.75% growth rate in revenues, operating income, depreciation, capital expenditures and total non-cash working capital. We also assumed that these cash flows would continue to grow 2.75% a year in perpetuity.

$$\begin{aligned}\text{Value of Operating Assets} &= \frac{\text{Expected Cashflow to the firm next year}}{(\text{Cost of Capital} - \text{Stable growth rate})} \\ &= \frac{\$166.85}{(.0967 - .0275)} = \$2,476 \text{ million}\end{aligned}$$

- Adding the cash balance of the firm (\$515 million) and subtracting out the existing debt (\$313 million, including the debt value of leases) yields the value of equity in the firm:
- Value of Equity = Value of Operating Assets + Cash – Debt
= \$2,476 + \$ 515 - \$313 million = \$2,678 million
- The market value of equity in Harman in November 2013 was \$5,428 million.
- To the extent that Tata Motors pays the market price, it will have to generate benefits from synergy that exceed \$2750 million.



Measuring Investment Returns II. Investment Interactions, Options and Remorse...

Life is too short for regrets, right?

Independent investments are the exception...

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- In all of the examples we have used so far, the investments that we have analyzed have stood alone. Thus, our job was a simple one. Assess the expected cash flows on the investment and discount them at the right discount rate.
- In the real world, most investments are not independent. Taking an investment can often mean rejecting another investment at one extreme (mutually exclusive) to being locked in to take an investment in the future (pre-requisite).
- More generally, accepting an investment can create side costs for a firm's existing investments in some cases and benefits for others.

I. Mutually Exclusive Investments

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- We have looked at how best to assess a stand-alone investment and concluded that a good investment will have positive NPV and generate accounting returns (ROC and ROE) and IRR that exceed your costs (capital and equity).
- In some cases, though, firms may have to choose between investments because
 - ▣ They are mutually exclusive: Taking one investment makes the other one redundant because they both serve the same purpose
 - ▣ The firm has limited capital and cannot take every good investment (i.e., investments with positive NPV or high IRR).
- Using the two standard discounted cash flow measures, NPV and IRR, can yield different choices when choosing between investments.

Comparing Projects with the same (or similar) lives..

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- When comparing and choosing between investments with the same lives, we can
 - ▣ Compute the accounting returns (ROC, ROE) of the investments and pick the one with the higher returns
 - ▣ Compute the NPV of the investments and pick the one with the higher NPV
 - ▣ Compute the IRR of the investments and pick the one with the higher IRR
- While it is easy to see why accounting return measures can give different rankings (and choices) than the discounted cash flow approaches, you would expect NPV and IRR to yield consistent results since they are both time-weighted, incremental cash flow return measures.

Case 1: IRR versus NPV

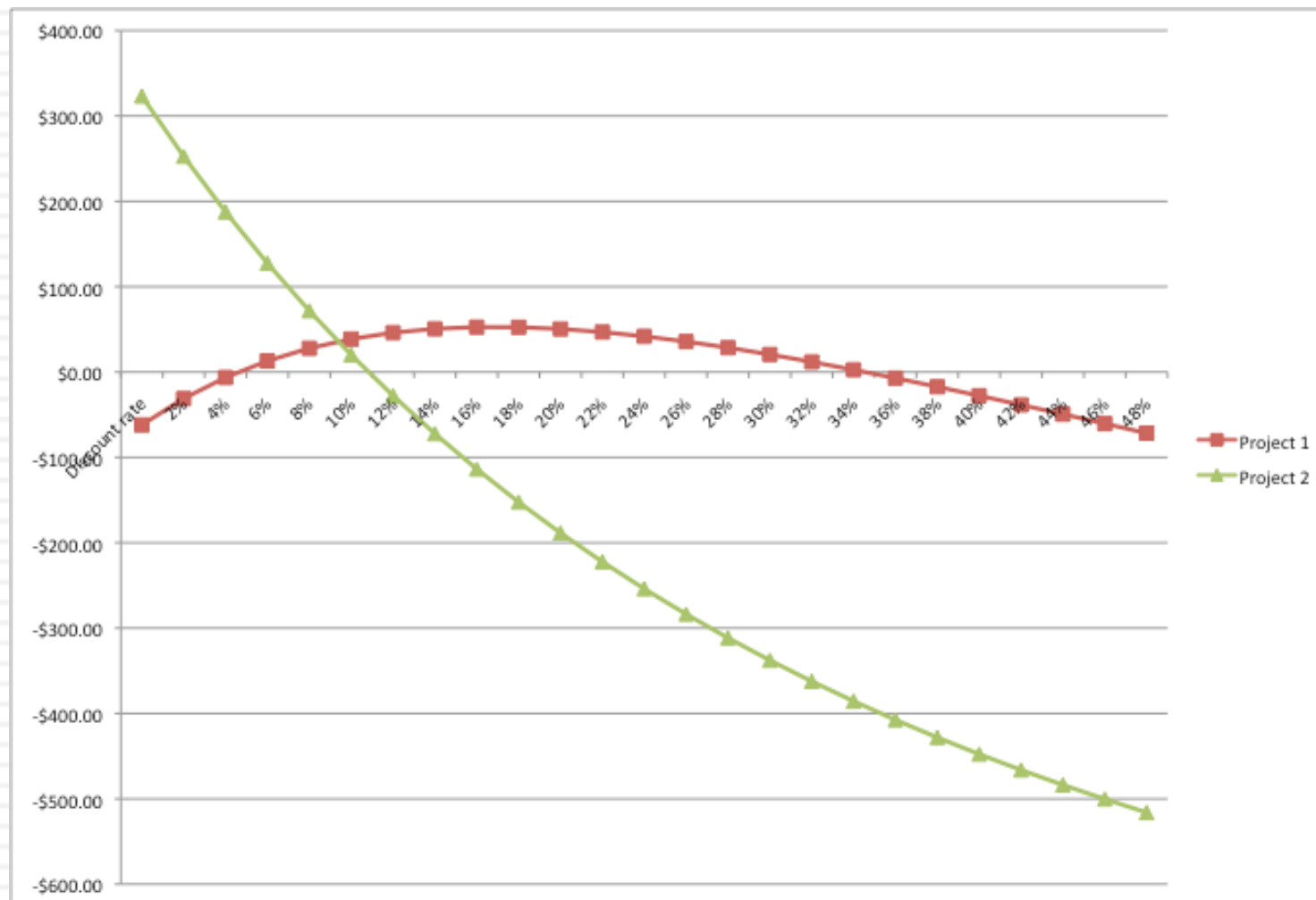
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- Consider two projects with the following cash flows:

| Year | Project 1 CF | Project 2 CF |
|------|--------------|--------------|
| 0 | -1000 | -1000 |
| 1 | 800 | 200 |
| 2 | 1000 | 300 |
| 3 | 1300 | 400 |
| 4 | -2200 | 500 |

Project's NPV Profile

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What do we do now?

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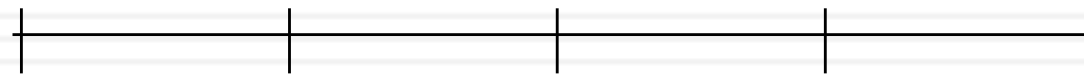
- Project 1 has two internal rates of return. The first is 6.60%, whereas the second is 36.55%. Project 2 has one internal rate of return, about 12.8%.
- Why are there two internal rates of return on project 1?
- If your cost of capital is 12%, which investment would you accept?
 - a. Project 1
 - b. Project 2
- Explain.

Case 2: NPV versus IRR

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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?

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- 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?
 - a. Project A. It gives me the bigger bang for the buck and more margin for error.
 - b. 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

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- 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.

The sources of capital rationing...

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| <i>Cause</i> | <i>Number of firms</i> | <i>Percent of total</i> |
|--|------------------------|-------------------------|
| Debt limit imposed by outside agreement | 10 | 10.7 |
| Debt limit placed by management external to firm | 3 | 3.2 |
| Limit placed on borrowing by internal management | 65 | 69.1 |
| Restrictive policy imposed on retained earnings | 2 | 2.1 |
| Maintenance of target EPS or PE ratio | 14 | 14.9 |

An Alternative to IRR with Capital Rationing

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- 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) = $\text{NPV} / \text{Initial Investment}$
- 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

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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?

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

NPV, IRR and the Reinvestment Rate Assumption

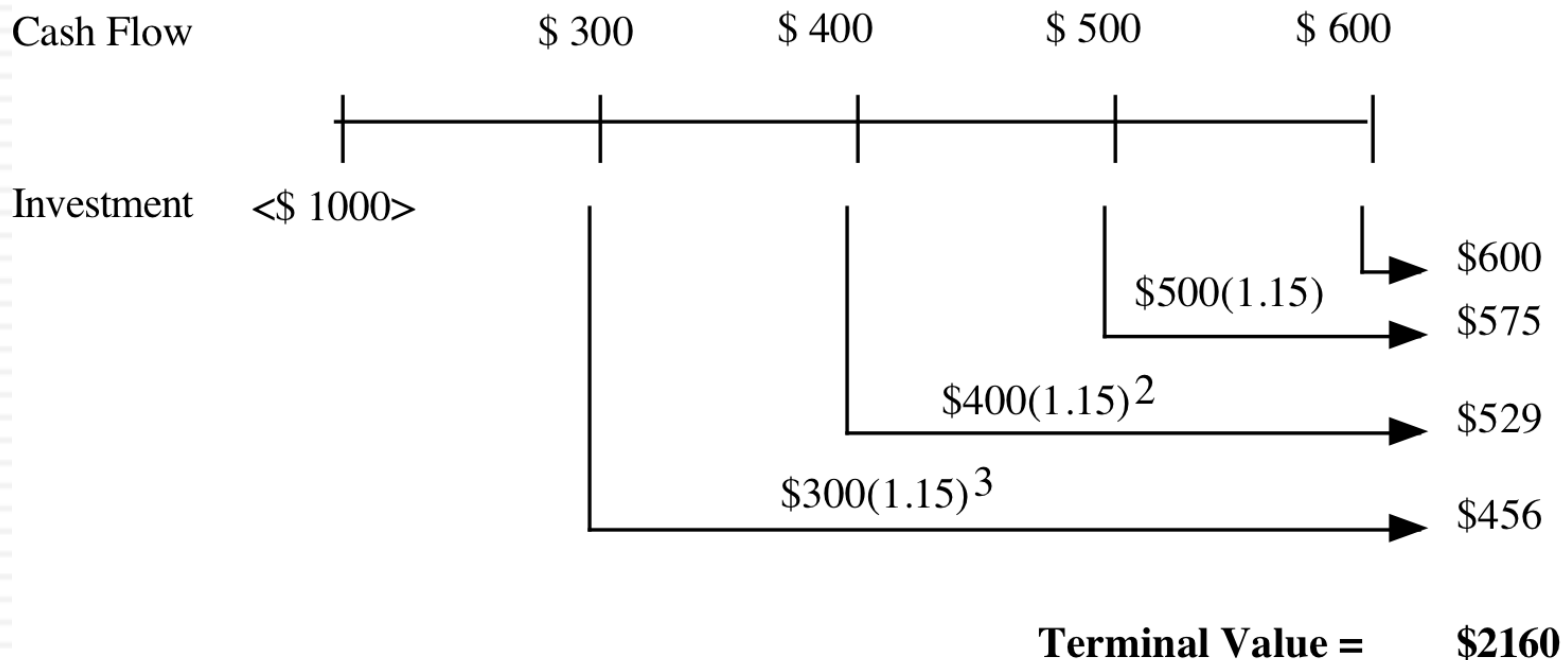
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- The NPV rule assumes that intermediate cash flows on the project get reinvested at the hurdle rate (which is based upon what projects of comparable risk should earn).
- The IRR rule assumes that intermediate cash flows on the project get reinvested 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

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Figure 6.3: IRR versus Modified Internal Rate of Return



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

Why NPV and IRR may differ.. Even if projects have the same lives

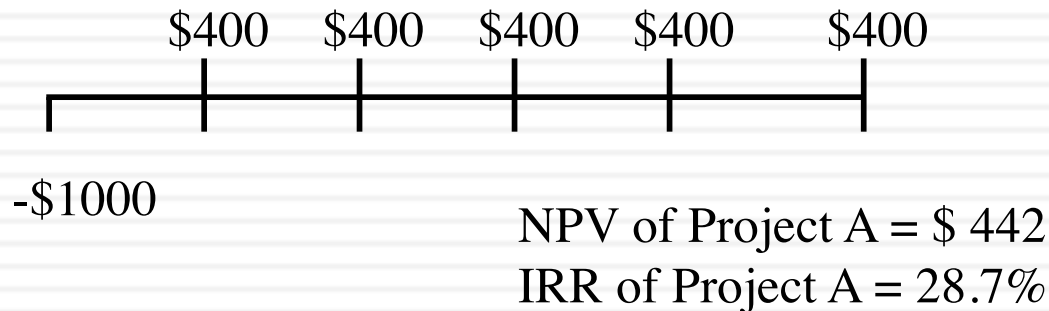
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- A project can have only one NPV, whereas it can have more than one IRR.
- The NPV is a dollar surplus value, whereas the IRR is a percentage measure of return. The NPV is therefore likely to be larger for “large scale” projects, while the IRR is 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”.

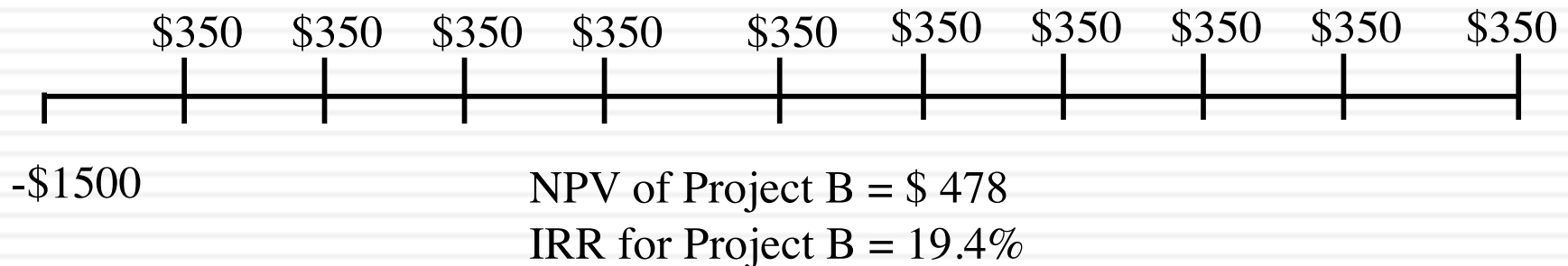
Comparing projects with different lives..

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Project A



Project B



Hurdle Rate for Both Projects = 12%

Why NPVs cannot be compared.. When projects have different lives.

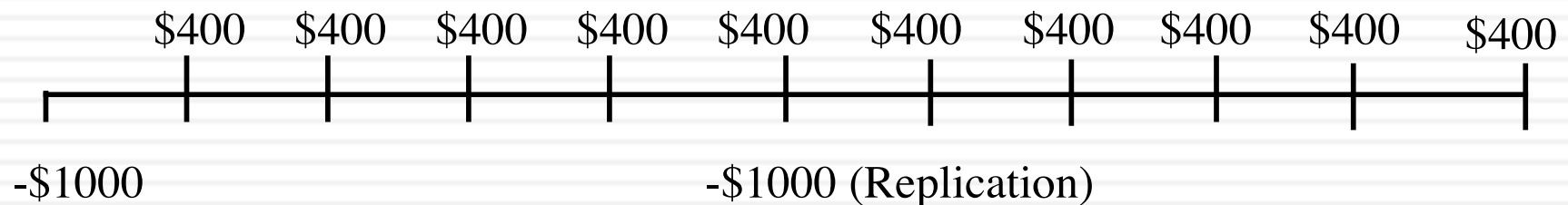
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- The net present values of mutually exclusive projects with different lives cannot be compared, since there is a bias towards longer-life projects. To compare the NPV, we have to
 - ▣ replicate the projects till they have the same life (or)
 - ▣ convert the net present values into annuities
- The IRR is unaffected by project life. We can choose the project with the higher IRR.

Solution 1: Project Replication

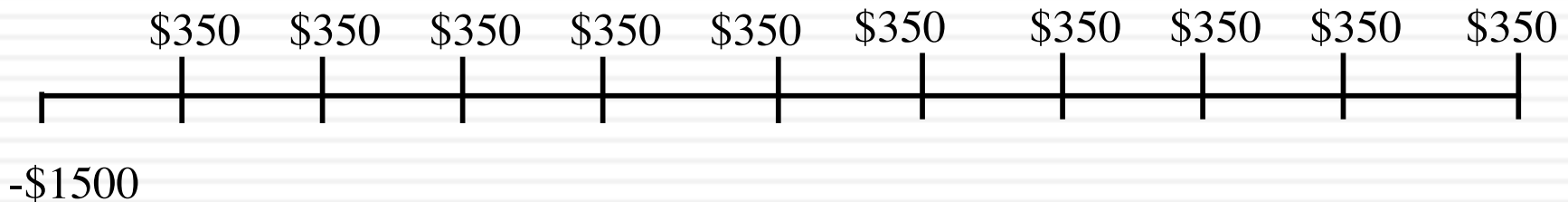
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Project A: Replicated



NPV of Project A replicated = \$ 693

Project B



NPV of Project B = \$ 478

Solution 2: Equivalent Annuities

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

What would you choose as your investment tool?

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- Given the advantages/disadvantages outlined for each of the different decision rules, which one would you choose to adopt?
 - a. Return on Investment (ROE, ROC)
 - b. Payback or Discounted Payback
 - c. Net Present Value
 - d. Internal Rate of Return
 - e. Profitability Index
- Do you think your choice has been affected by the events of the last quarter of 2008? If so, why? If not, why not?

What firms actually use ..

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| Decision Rule | % of Firms using as primary decision rule in | | |
|---------------------|--|-------|-------|
| | 1976 | 1986 | 1998 |
| IRR | 53.6% | 49.0% | 42.0% |
| Accounting Return | 25.0% | 8.0% | 7.0% |
| NPV | 9.8% | 21.0% | 34.0% |
| Payback Period | 8.9% | 19.0% | 14.0% |
| Profitability Index | 2.7% | 3.0% | 3.0% |