Measuring Investment Returns
First Principles

Aswath Damodaran

1. Invest in projects that yield a return greater than the minimum acceptable hurdle rate.

   - The form of returns - dividends and stock buybacks - will depend upon cash to stockholders.
   - 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.
   - The hurdle rate should be higher for riskier projects and reflect the acceptable hurdle rate.

2. 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 stockholders' characteristics.
Measures of return: earnings versus cash flows

Principles Governing Accounting Earnings Measurement

Operating versus Capital Expenditures: Only expenses associated with creating revenues in the current period should be recorded as operating expenses. Expenses that create benefits over several periods are written off over multiple periods (as depreciation or amortization).

Accrual Accounting 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.

To get from accounting earnings to cash flows:

- you have to add back non-cash expenses (like depreciation)
- you have to subtract out cash outflows which are not expensed (such as capital expenditures)

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• To get from accounting earnings to cash flows:
  - you have to add back non-cash expenses (like depreciation)
  - 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).
The Return Mantra: "Time-weighted, Incremental Cash Flow Return"

Use cash flows, rather than earnings. You cannot spend earnings.

Use "incremental" cash flows relating to the investment decision, rather than total cash flows that occur as a consequence of the decision, rather than total cash flows that occur earlier, rather than value cash flows, i.e., "time weighted" returns, rather than "time weighted" returns that occur later.
The earnings and cash flows are estimated in nominal U.S. Dollars.

The theme parks to be built near Bangkok, modeled on Euro Disney in Paris, will include a "Magic Kingdom" to be constructed on the beginning of the first and third year and becoming operational immediately, and a second theme park modeled on Disney World at Orlando to be constructed on the beginning of the second year, and a second theme park modeled on Epcot Center at Orlando to be constructed beginning immediately, and becoming operational at the beginning of the fifth year. The theme parks to be built near Bangkok, modeled on Euro Disney in Paris, will include a "Magic Kingdom" to be constructed on the beginning of the first and third year and becoming operational immediately, and a second theme park modeled on Disney World at Orlando to be constructed on the beginning of the second year, and a second theme park modeled on Epcot Center at Orlando to be constructed beginning immediately, and becoming operational at the beginning of the fifth year.
Disney has already spent $500 million researching the location and getting the needed licenses for the park.

The cost of constructing Magic Kingdom will be $3 billion, with $1 billion invested upfront, and $1 billion at the end of year 1. The cost of constructing Epcot will be $1.5 billion, with $0.5 billion spent in year 2 and $0.5 billion in year 3.

Key Assumptions on Start Up and Construction
### Key Revenue Assumptions

<table>
<thead>
<tr>
<th>Year</th>
<th>Magic Kingdom</th>
<th>Epcot</th>
<th>Resort Hotels</th>
<th>Total Revenues</th>
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</table>

Revenue estimates for the parks and resort properties (in millions)

Grows at the inflation rate forever: 3%

10 on
## Key Expense Assumptions

The operating expenses are assumed to be 60% of the revenues at the parks, and 75% of revenues at the resort properties. Disney will also allocate the following portion of its general and administrative expenses to the theme parks. It is worth nothing that a third of these expenses are variable (and a function of total revenue) and that two-thirds are fixed.

<table>
<thead>
<tr>
<th>Year</th>
<th>G&amp;A Costs (in millions)</th>
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</table>

The operating expenses are assumed to be 50% of the revenues at the resort properties. Growth at initialization rate of 3%.

<table>
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<th>Year</th>
<th>G&amp;A Costs</th>
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### Depreciation and Capital Maintenance

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<th>Capital Expenditure</th>
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<td>10</td>
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After Offsetting: Depreciation = Capital Maintenance
Other Assumptions

Disney will have to maintain net working capital (primarily consisting of inventory at the theme parks and the resort properties, netted against accounts payable) of 5% of revenues, with the investments in working capital being made at the end of each year. The income from the investment will be taxed at a marginal tax rate of 36%.

Disney will have to maintain net working capital (primarily consisting of inventory at the theme parks and the resort properties, netted against accounts payable) of 5% of revenues, with the investments in working capital being made at the end of each year. The income from the investment will be taxed at a marginal tax rate of 36%.
## Earnings on Project

<table>
<thead>
<tr>
<th>Year</th>
<th>Magic Kingdom</th>
<th>Second Theme Park</th>
<th>Resort &amp; Property</th>
<th>Total</th>
<th>Operating Expenses</th>
<th>Other Expenses</th>
<th>Operating Income</th>
<th>Taxes</th>
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### And the Accounting View of Return

<table>
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<tr>
<th>Year</th>
<th>EB(1-t)</th>
<th>Bg Ex</th>
<th>Deprecn</th>
<th>Cap Ex</th>
<th>AVE BV</th>
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<td><strong>$5,032</strong></td>
<td><strong>$0</strong></td>
<td><strong>$0</strong></td>
</tr>
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</table>
Would lead use to conclude that...

Do not invest in this park. The return on capital of 7.60% is lower than the cost of capital for theme parks of 12.32%; this would suggest that the project should not be taken.

Given that we have computed the average over an arbitrary period of 10 years, while the theme park itself would have a life greater than 10 years, would you feel comfortable with this conclusion?

Yes ☐
No ☐

Do not invest in this park. The return on capital of 7.60% is lower than the cost of capital for theme parks of 12.32%; this would suggest that the project should not be taken.

Would lead use to conclude that...
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 of return on capital to the cost of capital at the firm level can be made at the firm level, to judge whether the existing projects of the firm are adding or destroying value. This can be converted into a dollar figure by multiplying by the capital invested, in which case it is called economic value added.

Disney, in 1996, had earnings before interest and taxes of $5,559 million, a book value of equity of $11,368 million and a book value of debt of $7,663 million. With a tax rate of 36%, we get

\[
\text{Return on Capital} = \frac{5559 \times (1 - 0.36)}{11,368 + 7,663} = 18.69\%
\]

\[
\text{Cost of Capital} = \frac{5599 \times 1.36}{11,368 + 7,663} = 18.69\%
\]

\[
\text{Excess Return} = 18.69\% - 18.69\% = 0\%
\]

\[
\text{EVA} = (18.69\% - 12.22\%) \times (11,368 + 7,663) = $1,232 \text{ million}
\]

In 1997, Disney's return on capital was 18.69%, which is equal to its cost of capital. This indicates that the firm is not adding or destroying value. The economic value added (EVA) of $1,232 million indicates the firm's performance relative to its cost of capital.
For the most recent period for which you have data, compute the after-tax return on capital earned by your firm:

\[
\text{After-tax ROC} = \frac{\text{EBIT} \times (1 - \text{tax rate})}{(\text{BV of debt} + \text{BV of equity})_{\text{previous year}}}
\]

Return spread earned by your firm:

\[
\text{Return spread} = \text{After-tax ROC} - \text{Cost of Capital}
\]

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

\[
\text{EVA} = \text{Return spread} \times (\text{BV of debt} + \text{BV of equity})_{\text{previous year}}
\]
The cash flow view of this project...

To get from income to cash flow, we added back all non-cash charges such as depreciation and amortization and subtracted out the capital expenditures. This gives us:

- Operating Income after Taxes
- Depreciation & Amortization
- Capital Expenditures
- Change in Working Capital

Cash Flow on Project

<table>
<thead>
<tr>
<th>Year</th>
<th>Operating Income</th>
<th>Depreciation</th>
<th>Capital Expenditures</th>
<th>Change in WC</th>
<th>Cash Flow on Project</th>
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</thead>
<tbody>
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<td>-</td>
<td>-</td>
<td>651</td>
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</table>

The cash flow view of this project...
The Depreciation Tax Benefit

While depreciation reduces taxable income and taxes, it does not reduce the cash flows. Effect on cash flows.

Proposition 2: Non-cash charges that are not tax deductible (such as amortization of goodwill) and thus provide no tax benefits have no

Proposition 1: The tax benefit from depreciation and other non-cash charges is greater, the higher your tax rate.

For example, in year 2, the tax benefit from depreciation to Disney from this project can be written as:

\[ \text{Tax Benefit in year 2} = \$ 375 \text{ million} \times (0.36) = \$ 135 \text{ million} \]

From this project can be written as:

\[ \text{Tax Benefit} = \text{Depreciation} \times \text{Tax Rate} \]

The benefit of depreciation reduces taxable income and taxes, it does not reduce the cash flows.

The Depreciation Tax Benefit
Depreciation Methods

Broadly classifying, 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, capital expense is spread over time, in earlier years and less in later years. Assume that you made a large investment this year, and that you will use the capital expense is depreciated more in earlier years and less in later years. Which will result in higher cash flows this year?

- Accelerated Depreciation
- Straight Line Depreciation

Which will result in higher net income this year?

- Accelerated Depreciation
- Straight Line Depreciation

Which will result in higher cash flows this year?

- Straight Line Depreciation
- Accelerated Depreciation
Capital expenditures are not treated as accounting expenses but they do cause cash outflows. 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.

Both initial and maintenance capital expenditures reduce cash flows:
- Maintain existing assets.
- Keep existing assets.
- Create new assets and future growth.
- New (or Growth) capital expenditures are capital expenditures designed to do cause cash outflows.

Capital expenditures can generally be categorized into two groups:
- New (or Growth) capital expenditures.
- Maintenance capital expenditures.

The Capital Expenditures Effect
Aswath Damodaran

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 distributing promotional CD's 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? 

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.

Proposition 1: The failure to consider working capital in a capital budgeting project will overstate cash flows on that project and make it look more attractive than it really is.

Proposition 2: Other things held equal, a reduction in working capital requirements will increase the cash flows on all projects for a firm.

Any increase in working capital reduces cash flows in that year.
Any decrease in working capital increases cash flows in that year.

The Working Capital Effect
The incremental cash flows on the project

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flow on Project</th>
<th>+ Sunk Costs</th>
<th>+ Non-Incr. Alloc Cost (1-t)</th>
<th>+ Incremental Cash Flow on Project</th>
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<tr>
<td>5</td>
<td>$651</td>
<td></td>
<td></td>
<td>$1,746</td>
</tr>
</tbody>
</table>

To get from cash flow to incremental cash flows, we

- Added back the non-incremental allocated costs (in after-tax terms)
- Taken out of the sunk costs from the initial investment

The incremental cash flows on the project.
Any expenditure that has already been incurred, and cannot be recovered, is called a sunk cost. When analyzing a project, sunk costs should not be considered since they are incurred 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?
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). How, looking at these pooled expenses, do we know how much of the costs are fixed and how much are variable?

Thus, it is only the incremental component of allocated costs that should show up in project analysis. By the degree that these costs are not incremental (and would exist anyway), this makes the firm worse off.

For large firms, these allocated costs can result in the rejection of projects. How, looking at these pooled expenses, do we know how much of the costs are fixed and how much are variable?

• Thus, it is only the incremental component of allocated costs that should show up in project analysis.

Allocated Costs
### Incremental Cash Flows

<table>
<thead>
<tr>
<th>Year</th>
<th>Operating Income after Taxes</th>
<th>Depreciation &amp; Amortization</th>
<th>Capital Expenditures</th>
<th>Change in Working Capital</th>
<th>Non-increment Allocated Cost(t-1)</th>
<th>Cashflow to Firm</th>
<th>Operating Income after Taxes</th>
<th>Depreciation &amp; Amortization</th>
<th>Capital Expenditures</th>
<th>Change in Working Capital</th>
<th>Non-increment Allocated Cost(t-1)</th>
<th>Cashflow to Firm</th>
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<tbody>
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<td>$315</td>
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</tr>
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<td>$315</td>
<td>$658</td>
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<tr>
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<td>$315</td>
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<td>$658</td>
<td>$315</td>
<td>$305</td>
<td>$315</td>
<td>$315</td>
<td>$315</td>
<td>$658</td>
</tr>
</tbody>
</table>
To Time-Weighted Cash Flows

- Expected uncertainty: Higher uncertainty -> Higher Discount Rate
- Expected real rate: Higher real rate -> Higher Discount Rate
- Expected inflation: Higher inflation -> Higher Discount Rates

The discounting and compounding is done at a discount rate that will reflect:
- Compounding, when present cash flows are taken to the future
- Discounting, when future cash flows are brought to the present

This process of moving cash flows through time is brought to the same point in time before aggregation.

In fact, cash flows across time cannot be added up. They have to be incremental cash flows in later years.

Incremental cash flows in the earlier years are worth more than...
<table>
<thead>
<tr>
<th>Cash Flow Type</th>
<th>Discounting Formula</th>
<th>Compounding Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple CF</td>
<td>( \frac{CF_n}{(1+r)^n} )</td>
<td>( \frac{\frac{1}{1 - \frac{1}{(1+r)^n}}}{1} ) CF ( u )</td>
</tr>
<tr>
<td>Annuity</td>
<td>( \frac{A}{r} )</td>
<td>( \frac{\frac{1}{1 - \frac{1}{(1+g)^n}}}{1} ) CF ( u )</td>
</tr>
<tr>
<td>Growing Annuity</td>
<td>( \frac{A(1+g)}{r-g} ) ( \frac{\frac{1}{1 - \frac{1}{(1+g)^n}}}{1} ) CF ( u )</td>
<td>( \frac{\frac{1}{1 - \frac{1}{(1+g)^n}}}{1} ) CF ( u )</td>
</tr>
<tr>
<td>Growing Perpetuity</td>
<td>( \frac{1}{r} )</td>
<td>( \frac{\frac{1}{1 - \frac{1}{(1+g)^n}}}{1} ) CF ( u )</td>
</tr>
<tr>
<td>Perpetuity</td>
<td>( \frac{A}{r} )</td>
<td>( \frac{\frac{1}{1 - \frac{1}{(1+g)^n}}}{1} ) CF ( u )</td>
</tr>
</tbody>
</table>
Discounted cash flow measures of return

Discounted cash flow measures involve estimating future cash flows and discounting them back to their present values. Two primary measures are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Each measure provides a different perspective on the profitability of an investment.

**Net Present Value (NPV):** The sum of the present values of all cash flows, including the initial investment, discounted at the appropriate rate.

- **Decision Rule:** Accept if $NPV > 0$

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

- **Decision Rule:** Accept if $IRR >$ hurdle rate

Discounted cash flow measures are widely used in capital budgeting to evaluate the attractiveness of potential investments. They help in deciding whether an investment is worth pursuing based on the expected returns and the cost of capital.
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 assets at the end of the project life. If it is unusually set investment in the project at the end of the project life, it is usually set to book value or the expected proceeds from selling all of the assets. In a project with a finite and short life, you would need to compute a salvage value.

Terminal Value

Assuming the project lasts forever, and that cash flows after year 9 grow 3% (the inflation rate) forever, the present value of all cash flows that occur after the estimation period ends.

Terminal Value = CF in year 10/(Cost of Capital - Growth Rate)

= 822/(.1232-.03) = $ 8,821 million

Note that this is the terminal value in year 9. So cash flow in year 10 is used.
Which yields a NPV of $818.
Which makes the argument that...

By taking the project, Disney will increase its value as a firm by $818 million. 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. The project should be accepted. The positive net present value makes the argument that...

The project should be accepted.
The IRR of this project

NPV Profile for Theme Park

Discount Rate

NPV

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 15.32%. This is greater than the cost of capital of 12.32%. Though there are differences between the two approaches that may cause project rankings to vary depending upon the approach used, the IRR and the NPV will yield similar results most of the time. The IRR suggests the project is a good one.
Consider a project with the following cash flows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1000</td>
</tr>
<tr>
<td>1</td>
<td>1800</td>
</tr>
<tr>
<td>2</td>
<td>21000</td>
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<tr>
<td>3</td>
<td>13000</td>
</tr>
<tr>
<td>4</td>
<td>-2200</td>
</tr>
</tbody>
</table>

Case 1: IRR versus NPV
Project's NPV Profile

Discount Rate

NPV
What do we do now?

Why are there two internal rates of return on this project?

This project has two internal rates of return. The first is 6.60%, whereas the second is 36.55%.

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

I would reject the project.

Explain.
### Case 2: NPV versus IRR

<table>
<thead>
<tr>
<th>Project</th>
<th>Cash Flow</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$350,000</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>B</td>
<td>$450,000</td>
<td>$600,000</td>
</tr>
<tr>
<td></td>
<td>$750,000</td>
<td>$3,000,000</td>
</tr>
<tr>
<td></td>
<td>$10,000,000</td>
<td>$3,500,000</td>
</tr>
</tbody>
</table>

**NPV and IRR Calculations**

- **Project A**
  - NPV = $467,937
  - IRR = 20.88%

- **Project B**
  - NPV = $1,358,664
  - IRR = 33.66%
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?

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

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

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

\[
\text{Profitability Index (PI)} = \frac{\text{NPV}}{\text{Initial Investment}}
\]

In the example described, the PI of the two projects would have been:

- PI of Project A = $1,358,664/1,000,000 = 13.59%
- PI of Project B = $467,937/1,000,000 = 46.79%

Project A would have scored higher.

An Alternative to IRR with Capital Rationing
### Case 3: NPV versus IRR

<table>
<thead>
<tr>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash Flow</strong></td>
<td><strong>Cash Flow</strong></td>
</tr>
<tr>
<td>$ 5,000,000</td>
<td>$ 10,000,000</td>
</tr>
<tr>
<td>$ 10,000,000</td>
<td></td>
</tr>
<tr>
<td>$ 3,000,000</td>
<td>$ 3,000,000</td>
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<tr>
<td>$ 5,000,000</td>
<td>$ 200,000</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investment</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 5,000,000</td>
<td>$ 10,000,000</td>
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<tr>
<td>$ 3,000,000</td>
<td>$ 200,000</td>
</tr>
<tr>
<td>$ 000,000</td>
<td>$ 000,000</td>
</tr>
</tbody>
</table>

**NPV**
- Project A: $1,191,712
- Project B: $1,358,664

**IRR**
- Project A: 21.41%
- Project B: 20.88%
Aswath Damodaran

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?

Project A. It gives me the bigger bang for the buck and more margin.

Project B. It creates more dollar value in my business.

Which one would you pick?

Forerror.
Aswath Damodaran

NPV, IRR and the Reinvestment Rate

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).

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.

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 = $2,160

Internal Rate of Return = 21.23%

Modified Internal Rate of Return = 21.23%
Why NPV and IRR may differ...

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 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 hurdle rate. The NPV assumes that intermediate cash flows get reinvested at the hurdle rate, while the IRR is higher for „small-scale“ projects, whereas the IRR is a percentage measure of return. The NPV is therefore likely to be larger for „large-scale“ projects, whereas the IRR is a dollar surplus value, whereas it can have more than one IRR. A project can have only one NPV, whereas it can have more than one
Hurdle Rate for Both Projects = 12%

NPV of Project A = $442
NPV of Project B = $478

Case: NPV and Project Life
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 until they have the same life (or)
- convert the net present values into annuities of projects.
Solution 1: Project Replication

NPV of Project A replicated = $693

NPV of Project B = $478

NPV of Project A replicated = $1000 (Replication)
Solution 2: Equivalent Annuities

Equivalent Annuity for 5-year Project

\[ \text{Equivalent Annuity} = \frac{\text{PV} \times (1 + r)^n}{r \times (1 + r)^n - 1} \]

\[ \text{Equivalent Annuity} = \frac{\$442 \times (1 + 0.12)^5}{0.12 \times (1 + 0.12)^5 - 1} \]

\[ \text{Equivalent Annuity} = \frac{\$442 \times 1.76234}{0.12 \times 1.76234 - 1} \]

\[ \text{Equivalent Annuity} = \frac{\$784.60}{0.21148} \]

\[ \text{Equivalent Annuity} = \$3732.00 \]

Equivalent Annuity for 10-year Project

\[ \text{Equivalent Annuity} = \frac{\text{PV} \times (1 + r)^n}{r \times (1 + r)^n - 1} \]

\[ \text{Equivalent Annuity} = \frac{\$478 \times (1 + 0.12)^10}{0.12 \times (1 + 0.12)^10 - 1} \]

\[ \text{Equivalent Annuity} = \frac{\$478 \times 3.10585}{0.12 \times 3.10585 - 1} \]

\[ \text{Equivalent Annuity} = \frac{\$1478.82}{0.37069} \]

\[ \text{Equivalent Annuity} = \$3994.19 \]
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?
What firms actually use...
The cash flows on the Bangkok Disney park will be in Thai Baht. The Disney Theme Park: The Risks of International Expansion.

The discount rate of 12.32% that we used is a cost of capital for U.S. theme parks. Would you use a higher rate for this project? This will expose Disney to exchange rate risk. In addition, there are political and economic risks to consider in an investment in Thailand. The cash flows on the Bangkok Disney park will be in Thai Baht. The cash flows on the Bangkok Disney park will be in Thai Baht.
Should there be a risk premium for foreign projects?

For Disney, this risk too is assumed to not affect the cost of capital.

The exchange rate risk may be diversifiable risk, which would mean that it too should not affect the discount rate.

For Disney, this risk should not affect the cost of capital used.

The same diversification argument can also be applied against political risk. If the investors in the company are globally diversified, the company has projects in a large number of countries (or command a premium) if cash flows on the project.

However, affect the cash flows, by reducing the expected life of the project, which would mean that it too should not affect the discount rate.

For Disney, this risk too is assumed to not affect the cost of capital used.
Domestic versus International Expansion

The analysis was done in dollars. Would the conclusions have been any different if we had done the analysis in Thai Baht?
The “Consistency Rule” for Cash Flows

Aswath Damodaran
Disney Theme Park: Project Analysis in Baht

The inflation rates were assumed to be 15% in Thailand and 3% in the United States. The Baht/dollar rate at the time of the analysis was 35 Baht/dollar.

The inflation rates were assumed to be 15% in Thailand and 3% in the United States. The Baht/dollar rate at the time of the analysis was 35 Baht/dollar.

The inflation rates were assumed to be 15% in Thailand and 3% in the United States. The Baht/dollar rate at the time of the analysis was 35 Baht/dollar.

The expected exchange rate was derived from the cost of capital in dollars and the differences in inflation rates:

\[ \text{Exchange Rate} = \text{Cost of Capital} \times \left( \frac{1.15}{1.03} \right) - 1 \]

The expected growth rate after year 9 is still expected to be the Thai inflation rate. The expected exchange rate was derived from the cost of capital in Baht, but it is the 15% Thai inflation rate.

The expected exchange rate today is:

\[ \text{Expected Exchange Rate} = \text{Exchange Rate today} \times \left( \frac{1.15}{1.03} \right) \]

The expected exchange rate was derived assuming purchasing power parity. The cost of capital in Baht was derived from the cost of capital in dollars and the differences in inflation rates:

\[ \text{Baht Cost of Capital} = \left(1 + \frac{\text{Cost of Capital}}{1.15/1.03}\right) - 1 \]

= (1.1232) (1.15/1.03) - 1 = 25.41% or 25.41%
Disney Theme Park: The Baht NPV

NPV is equal to NPV in dollar terms

NPV = 28,626 Bt = $ 818 Million
Dealing with Inflation

In our analysis, we used nominal dollars and cash flows. Would the NPV have been different if we had used real cash flows instead of nominal cash flows? Since real cash flows are lower than nominal cash flows, it would be much lower. It should be unaffected.
The nominal cash flows in Disney Theme Park are deflated first at the inflation rate:

\[ \text{Real Cash Flow}_t = \frac{\text{Nominal Cash Flow}_t}{(1 + \text{Inflation Rate})^t} \]

The real cost of capital is obtained by deflating the nominal discount rate at the inflation rate:

\[ \text{Real Cost of Capital} = \frac{1 + \text{Nominal Cost of Capital}}{(1 + \text{Inflation Rate})} - 1 \]

For the theme park, this would be:

\[ \text{Real Cost of Capital} = \frac{1.25411}{1.15} - 1 = 9.05\% \]
<table>
<thead>
<tr>
<th>Year</th>
<th>Nominal CF (Bt)</th>
<th>Real CF (Bt)</th>
<th>PV at 6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>70,000 Bt</td>
<td>70,000 Bt</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>31,161 Bt</td>
<td>23,017 Bt</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>46,922 Bt</td>
<td>21,548 Bt</td>
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</tr>
<tr>
<td>3</td>
<td>69,779 Bt</td>
<td>33,396 Bt</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>90,282 Bt</td>
<td>42,118 Bt</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>111,759 Bt</td>
<td>51,880 Bt</td>
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</tr>
<tr>
<td>6</td>
<td>134,138 Bt</td>
<td>60,953 Bt</td>
<td></td>
</tr>
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<td>7</td>
<td>157,527 Bt</td>
<td>69,472 Bt</td>
<td></td>
</tr>
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<td>8</td>
<td>181,916 Bt</td>
<td>78,015 Bt</td>
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</tr>
<tr>
<td>9</td>
<td>206,305 Bt</td>
<td>86,558 Bt</td>
<td></td>
</tr>
</tbody>
</table>

NPV of Project = 28,626 Bt
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 discounted cashflow models,

- Cashflows will be cashflows after debt payments to equity investors.
- Return will be Return on Equity (ROE) = Net Income/BV of Equity.

If using accounting returns,

- ROE has to be greater than cost of equity.
- Return will be Return on Equity (ROE) = Net Income/BV of Equity.

Equity Analysis: The Parallels
A Brief Example: A Paper Plant for Aracruz

The plant will have a life of 10 years. During that period, the plant will be depreciated using double declining balance depreciation, with a life of 10 years.

The plant will require an initial investment of 250 Million BR at the end of the fifth year. An additional investment of 50 Million BR will be needed to update the plant.

Aracruz plans to borrow 100 Million BR, at a real interest rate of 5.5% using a 10-year term loan. Where the loan will be paid off in equal annual increments.

The plant is expected to have a capacity of 750,000 tons and will have the following characteristics:

Investment Assumptions
Aswath Damodaran

Operating Assumptions

The plant will be partly in commission in a couple of months, but will have a capacity of only 650,000 tons in the first year, 700,000 tons in the second year before getting to its full capacity of 750,000 tons in the third year. The capacity utilization rate will be 90% for the first 3 years, and rise to 95% after that. The investment will be salvaged at book value at the end of year 10, and rise to 95% after that. The investment will be salvaged at the end of the tenth year, and is expected to be 15% of total revenue, and the investments have to be made at the beginning of each year. At the end of the tenth year, it is anticipated that the entire revenue will be made at the beginning of each year. The working capital requirements are estimated to be 15% of total revenue.

The working capital will be salvaged.

The price per ton of linerboard is currently $400, and is expected to keep pace with inflation for the life of the plant.

The variable cost of production, primarily labor and material, is expected to be 55% of total revenue; there is a fixed cost of 50 million BR, which will grow at the inflation rate.

The price per ton of linerboard is currently $400, and is expected to keep pace with inflation for the life of the plant.
The analysis is done in real, equity terms. Thus, the hurdle rate has to be a real cost of equity. The real cost of equity for Aracruz, based upon the beta estimate of 0.71, the real riskless rate of 5% (using the real growth rate in Brazil as proxy), the risk premium for Brazil of 7.5% (based on country rating spread over U.S. premium of 5.5%), and the risk premium for Brazil of 7.5% (based on country rating), is:

\[ \text{Real Cost of Equity} = 5\% + 0.71 \times 7.5\% = 10.33\% \]

The hurdle rate in real, equity terms, thus, the hurdle rate has to
### ROE Analysis

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Income</th>
<th>Depreciation</th>
<th>Cap Exp</th>
<th>Ending BV: Assets</th>
<th>Debt</th>
<th>BV: Equity</th>
<th>Avg Equity</th>
<th>ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(1,289 BR)</td>
<td>50,000 BR</td>
<td>200,000 BR</td>
<td>92,233 BR</td>
<td>107,767 BR</td>
<td>0 BR</td>
<td>92,233 BR</td>
<td>-1.00%</td>
</tr>
<tr>
<td>2</td>
<td>27,371 BR</td>
<td>40,000 BR</td>
<td>160,000 BR</td>
<td>84,429 BR</td>
<td>75,961 BR</td>
<td>0 BR</td>
<td>84,429 BR</td>
<td>8.02%</td>
</tr>
<tr>
<td>3</td>
<td>155,122 BR</td>
<td>32,000 BR</td>
<td>128,000 BR</td>
<td>75,395 BR</td>
<td>52,605 BR</td>
<td>0 BR</td>
<td>75,395 BR</td>
<td>23.52%</td>
</tr>
<tr>
<td>4</td>
<td>215,526 BR</td>
<td>25,600 BR</td>
<td>102,400 BR</td>
<td>68,045 BR</td>
<td>36,125 BR</td>
<td>0 BR</td>
<td>68,045 BR</td>
<td>48.52%</td>
</tr>
<tr>
<td>5</td>
<td>242,234 BR</td>
<td>20,480 BR</td>
<td>131,920 BR</td>
<td>58,653 BR</td>
<td>75,267 BR</td>
<td>0 BR</td>
<td>58,653 BR</td>
<td>43.51%</td>
</tr>
<tr>
<td>6</td>
<td>218,664 BR</td>
<td>26,384 BR</td>
<td>105,536 BR</td>
<td>49,636 BR</td>
<td>59,034 BR</td>
<td>0 BR</td>
<td>49,636 BR</td>
<td>32.56%</td>
</tr>
<tr>
<td>7</td>
<td>246,844 BR</td>
<td>21,107 BR</td>
<td>84,429 BR</td>
<td>40,348 BR</td>
<td>64,283 BR</td>
<td>0 BR</td>
<td>40,348 BR</td>
<td>45.85%</td>
</tr>
<tr>
<td>8</td>
<td>270,036 BR</td>
<td>16,886 BR</td>
<td>67,543 BR</td>
<td>24,495 BR</td>
<td>44,365 BR</td>
<td>0 BR</td>
<td>24,495 BR</td>
<td>58.98%</td>
</tr>
<tr>
<td>9</td>
<td>290,215 BR</td>
<td>13,509 BR</td>
<td>54,034 BR</td>
<td>12,575 BR</td>
<td>41,459 BR</td>
<td>0 BR</td>
<td>12,575 BR</td>
<td>68.68%</td>
</tr>
</tbody>
</table>

### Real ROE of 40.12% is greater than Real Cost of Equity of 10.33%
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 at Disney, we can compute return on equity and cost of equity at Aracruz to pass judgment on whether Aracruz is creating value to its equity investors.

In 1996, Aracruz had net income of 47 million BR on book value of equity of 2,115 million BR, yielding a return on equity of:

\[
\text{ROE} = \frac{47}{2,115} = 2.22\% 
\]

This can be converted into a dollar value by multiplying by the book value of equity, to yield a equity economic value added:

\[
\text{Equity EVA} = (2.22\% - 10.33\%) \times 2,115 \text{ Million} = -171 \text{ Million BR}
\]

\[
\text{Excess Return} = 2.22\% - 10.33\% = -8.11\%
\]

Cost of Equity = 10.33% (Real because book value is inflation adjusted)

This reflects the real rate of return on equity of equity capital of 2.15 million BR, yielding a return on equity of:

\[
\text{ROE} = \frac{2.22\%}{10.33\%} = 2.22\% 
\]

In 1996, Aracruz had net income of 47 million BR on book value of equity of 2,115 million BR, yielding a return on equity of:

\[
\text{Excess Return} = 2.22\% - 10.33\% = -8.11\%
\]

Cost of Equity = 10.33% (Real because book value is inflation adjusted)
An Incremental CF Analysis

<table>
<thead>
<tr>
<th>Year</th>
<th>FCFE</th>
<th>PV of FCFE (at 10.33%)</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(185,100 BR)</td>
<td>(185,100 BR)</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>38,244 BR</td>
<td>34,663 BR</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>76,477 BR</td>
<td>29,966 BR</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>114,925 BR</td>
<td>26,974 BR</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>153,006 BR</td>
<td>25,649 BR</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>192,082 BR</td>
<td>21,122 BR</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>231,122 BR</td>
<td>17,629 BR</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>270,137 BR</td>
<td>14,859 BR</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>309,867 BR</td>
<td>12,636 BR</td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td>349,633 BR</td>
<td>43,001 BR</td>
<td>14</td>
</tr>
</tbody>
</table>

PV of FCFE (at 10.33%)
Our conclusions on a project are clearly conditioned on a large number of assumptions. 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 variables, revenues, costs, and other variables over very long time periods.

The Role of Sensitivity Analysis
Viability of Paper Plant: Sensitivity to Price per Ton

Aracruz: NPV versus Price per Ton

Price per Ton

NPV

Ton

Viability of Paper Plant: Sensitivity to Price per Ton

Aswath Damodaran
What does sensitivity analysis tell us?

Aswath Damodaran

Assume that the manager at Aracruz who has to decide 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 price drops below $360 per ton. (Though the expected price per ton is $400, there is a significant probability of the price dropping below $360.) Is this the right thing to do?

Yes  □  No  □  

Explain.
Most projects considered by any business create side costs and benefits.

The returns on a project should incorporate these costs and benefits.

The benefits that may not be captured in the traditional capital budgeting analysis include project synergies (where cash flows from one project may accrue to other projects) and options embedded in projects (including the option to delay, expand or abandon a project).

The side costs include the costs created by the use of resources that the firm may have. Projects already own (opportunity costs) and lost revenues for other business may create side costs and benefits.
An opportunity cost arises when a project uses a resource that may have been paid for by the firm, or a resource that is already owned by a firm is being considered for use elsewhere in the business, in which case the opportunity cost is the cost of replacing it.

- When a resource that is already owned by a firm is being considered for use elsewhere in the business, in which case the opportunity cost is the expected present value of the after-tax rental or lease revenues.
- When a resource that is already owned by a firm is being considered for use elsewhere in the business, in which case the opportunity cost is the expected proceeds from the sale, net of any capital gains taxes.
- When a resource that is already owned by a firm is being considered for use elsewhere in the business, in which case the opportunity cost is the expected 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.
Case 1: Opportunity Costs

Assume that Disney owns land in Bangkok already. This land is undeveloped and was acquired several years ago for $5 million. The land currently can be sold for $40 million, though that would create a capital gain (which will be taxed at 20%). In assessing the theme park, which of the following would you do:

- Ignore the cost of the land, since Disney owns it already.
- Use the book value of the land, which is $5 million.
- Use the market value of the land, which is $40 million.
- Other:
  Use the market value of the land, which is $40 million.
In the Aracruz example, assume that the firm will use its existing distribution system to service the production out of the new paper plant. The new plant manager argues that there is no cost associated with using this system, since it has 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
Current Usage = 50,000 (50% of Capacity); 50% Excess Capacity;

Cost of a building new capacity = $1,500,000; Cost of Capital = 12%

Book Value = $1,000,000
unit = $5/unit

Basic Framework

When I run out of capacity, what will I do?
If I take this project, when will I run out of capacity?
If I do not take this project, when will I run out of capacity?

Cut back on production: cost is PV of after-tax cash flows from lost sales

Buy new capacity: cost is difference in PV between earlier & later investment

Explain why is it better to buy?
### Opportunity Cost of Excess Capacity

\[ \text{PV(lost sales)} = 336,734 \]

\[ \text{PV (building capacity in Year 3 instead of Year 8)} = 461,846 \]

<table>
<thead>
<tr>
<th>Year</th>
<th>Old</th>
<th>New</th>
<th>Old + New</th>
<th>Lost ATCF</th>
<th>PV (ATCF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150.00%</td>
<td>30.00%</td>
<td>80.00%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>255.00%</td>
<td>31.50%</td>
<td>86.50%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>360.50%</td>
<td>33.08%</td>
<td>93.58%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>466.55%</td>
<td>34.73%</td>
<td>101.28%</td>
<td>5,115</td>
<td>3,251</td>
</tr>
<tr>
<td>5</td>
<td>573.21%</td>
<td>36.47%</td>
<td>109.67%</td>
<td>38,681</td>
<td>21,949</td>
</tr>
<tr>
<td>6</td>
<td>680.53%</td>
<td>38.29%</td>
<td>118.81%</td>
<td>75,256</td>
<td>38,127</td>
</tr>
<tr>
<td>7</td>
<td>788.58%</td>
<td>40.20%</td>
<td>128.78%</td>
<td>115,124</td>
<td>52,076</td>
</tr>
<tr>
<td>8</td>
<td>897.44%</td>
<td>42.21%</td>
<td>139.65%</td>
<td>158,595</td>
<td>64,054</td>
</tr>
<tr>
<td>9</td>
<td>9107.18%</td>
<td>44.32%</td>
<td>151.50%</td>
<td>206,000</td>
<td>74,286</td>
</tr>
</tbody>
</table>

\[ \text{PV (lost sales)} = 336,734 \]

Opportunity Cost of Excess Capacity = $336,734
Assume that in the Disney theme park example, 20% of the revenues at the Bangkok Disney park are expected to come from people who would have gone to Disneyland in Anaheim, California. In doing the analysis of the park, 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 to introduce a new show on the Disney cable channel on Saturday mornings that is expected to attract 20% of its viewers from ABC?

- Yes
- No

Assume that in the Disney theme park example, 20% of the revenues at the Bangkok Disney park are expected to come from people who would have gone to Disneyland in Anaheim, California. In doing the analysis of the park, would you

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

Cost
Product and Project Cannibalization: A Real
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. Consider, for instance, a typical Disney animated movie. Assume that it costs $50 million to produce and promote. This movie, in addition to theatrical revenues, also produces revenues from the sale of merchandise (stuffed toys, plastic figures, clothes...) and stage shows (see "Beauty and the Beast" and the "Lion King"). Increased attendance at the theme parks (e.g., increased attendance at Disneyland) also provides additional revenues.

Project Synergies
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. These options all add value to projects and may make a "bad" project a good one. The last option that is embedded in projects is the option to abandon a project, if the cash flows do not measure up. The first option of these options is taking one project may allow us 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 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 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

Present Value of Expected Cash Flows on Product

Initial Investment in Project

Project's NPV turns positive in this section

NPV in this section has negative

Valuing the Option to Delay a Project
Aswath Damodaran

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. Having the exclusive rights to a product or project is valuable, even if the product or project is not viable today.
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.

Aswath Damodaran
The Option to Expand

Present Value of Expected Cash Flows on Expansion

Additional Investment to Expand

Expansion becomes attractive in this section

Firm will not expand in this section

The Option to Expand
An Example of an Expansion Option

Disney is considering investing $100 million to create a Spanish version of the Disney channel to serve the growing Mexican market. A financial analysis of the cash flows from this investment suggests that the present value of the cash flows from this investment to Disney will be only $80 million. Thus, by itself, the new channel has a negative NPV of $20 million.

However, if the market in Mexico turns out to be more lucrative than currently anticipated, Disney could expand its reach to all of Latin America any time over the next 10 years. While the current expectation is that the cash flows from having a Disney channel in Latin America is only $100 million, there is considerable uncertainty about both the potential for such an channel and the shape of the market itself, leading to significant variance in the estimate. Disney could expand its reach to all of Latin America with an additional investment of $150 million any time over the next 10 years.

A financial analysis of the cash flows from this investment suggests that the potential for such a channel and the shape of the market itself, leading to significant variance in this estimate. If the market in Mexico turns out to be more lucrative than currently anticipated, Disney could expand its reach to all of Latin America any time over the next 10 years. While the current expectation is that the cash flows from having a Disney channel in Latin America is only $100 million, there is considerable uncertainty about both the potential for such an channel and the shape of the market itself, leading to significant variance in the estimate.
Valuing the Expansion Option

Call Value = $45.9 Million

Conditions:
- Time to expiration = Period for which expansion option applies = 10 years
- Variance in Underlying Asset's Value = 0.10
- Strike Price (K) = Cost of Expansion into Latin America = $150 Million
- Value of the Underlying Asset (S) = PV of Cash Flows from Expansion to Latin America, if done now = $100 Million

We estimate the variance in the estimate of the project value by using the annualized variance in firm value of publicly traded entertainment firms in the Latin American markets, which is approximately 10%.
Considering the Project with Expansion Option

\[
\text{NPV of Disney Channel in Mexico} = -20 \text{ Million} + 45.9 \text{ Million} = 25.9 \text{ Million}
\]

Take the Project

\[
\text{Value of Option to Expand} = 25.9 \text{ Million}
\]

\[
\text{NPV of Project with option to expand} = -20 \text{ Million} + 25.9 \text{ Million} = 5.9 \text{ Million}
\]

\[
\text{NPV of Disney Channel in Mexico} = 80 \text{ Million} - 100 \text{ Million} = -20 \text{ Million}
\]
Aswath Damodaran

The Option to Abandon

A firm may sometimes have the option to abandon a project. If the cash flows do not meet up to expectations, 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

Disney is considering taking a 25-year project which

• requires an initial investment of $250 million in an real estate partnership
• has the net present value of $4 million is small, assume that Disney

While the net present value of $4 million is small, assume that Disney has the option to abandon this project anytime by selling its share back to the developer in the next 5 years for $150 million.

A simulation of the cash flows on this time share investment yields a variance in the present value of the cash flows from being in the partnership is 0.09.
Project with Option to Abandon

Option can be estimated as follows:

Assume that the five-year riskless rate is 7%. The value of the put option can be estimated as follows:

\[ V = 254 \text{ million} \]

Strike Price (K) = Salvage Value from Abandonment = $150 million

Time to expiration = Life of the Project = 5 years

\[ \text{Time to expiration} = \frac{1}{\text{Life of the Project}} = \frac{1}{5} = 0.2 \]

\[ \text{Dividend Yield} = \frac{1}{\text{Life of the Project}} = \frac{1}{5} = 0.2 \]

\[ \text{Variance in Underlying Asset's Value} = 0.09 \]

\[ \text{Value of the Underlying Asset} = 254 \text{ million} \]

\[ \frac{\text{Value of the Underlying Asset}}{\text{PV}} = S \]

\[ \frac{254 \text{ million}}{25} = 23.04 \text{ million} \]
Should Disney take this project?

The value of this abandonment option has to be added on to the net present value of the project of $4 million, yielding a total net present value of $7.86 million.