Real Options: Fact and Fantasy
Aswath Damodaran

Underlying Theme: Searching for an Elusive Premium

Traditional discounted cashflow models under estimate the value of investments, where there are options embedded in the investments to

- Delay or deter making the investment (delay)
- Adjust or alter production schedules as price changes (flexibility)
- Expand into new markets or products at later stages in the process, based upon observing favorable outcomes at the early stages (expansion)
- Stop production or abandon investments if the outcomes are unfavorable at early stages (abandonment)

Put another way, real option advocates believe that you should be paying a premium on discounted cashflow value estimates.
Three Basic Questions

1. When is there a real option embedded in a decision or an asset?
2. When does that real option have significant economic value?
3. Can that value be estimated using an option pricing model?
When is there an option embedded in an action?

An option provides the holder with the right to buy or sell a specified quantity of an underlying asset at a fixed price (called a strike price or exercise price) at or before the expiration date of the option. The payoffs on this asset (real option) have to be contingent on an event occurring within a finite period.

There has to be a clearly defined underlying asset whose value changes over time in unpredictable ways.

The payoffs on this asset (real option) have to be contingent on an event occurring within a finite period.
Payoff Diagram on a Call

Price of underlying asset

Strike Price

Net Payoff on Call

Price of underlying asset
Payoff Diagram on Put Option

Price of underlying asset

Strike Price

Net Payoff

On Put
When does the option have significant economic value?

For an option to have significant economic value, there has to be a restriction on competition in the event of the contingency. In a perfectly competitive product market, no contingency, no matter how positive, will generate positive net present value. At the limit, real options are most valuable when you have exclusivity - you and only you can take advantage of the contingency. They become less valuable as the barriers to competition become less steep.

For an option to have significant economic value, there has to be a restriction on competition in the event of the contingency. In a perfectly competitive product market, no contingency, no matter how positive, will generate positive net present value. At the limit, real options are most valuable when you have exclusivity - you and only you can take advantage of the contingency. They become less valuable as the barriers to competition become less steep.
Determinants of option value

Variables Relating to Underlying Asset

- Value of Underlying Asset: as this value increases, the right to buy (sell) at a fixed price becomes more (less) valuable.

- Variance in that value: as the variance increases, both calls and puts will become more valuable because all options have limited downside and depend upon price volatility for upside.

- Expected dividends on the asset, which are likely to reduce the price appreciation component of the asset, reducing the value of calls and increasing the value of puts.

Variables Relating to Option

- Strike Price of Options: the right to buy (sell) at a fixed price becomes more (less) valuable at a lower price.

- Life of the Option: both calls and puts benefit from a longer life.

- Level of Interest Rates: as rates increase, the right to buy (sell) at a fixed price in the future becomes more (less) valuable.
When can you use option pricing models to value real options?

The notion of a replicating portfolio that drives option pricing models makes them most suited for valuing real options where:

- The underlying asset is traded and observable prices and volatility are available.
- An active marketplace exists for the option itself.
- The cost of exercising the option is known with some degree of certainty.
- The value estimates that emerge will be far more imprecise.
- The value can deviate much more dramatically from market price because of the difficulty of arbitrage.

When option pricing models are used to value real assets, we have to accept the fact that:

- The value estimates that emerge will be far more imprecise.
- The value can deviate much more dramatically from market price because of the difficulty of arbitrage.
Creating a replicating portfolio

The objective in creating a replicating portfolio is to use a combination of risk-free borrowing/lending and the underlying asset to create the same cashflows as the option being valued.

- Call = Borrowing + Buying \( \Delta \) of the Underlying Stock
- Put = Selling Short \( \Delta \) on Underlying Asset + Lending

The number of shares bought or sold is called the option delta. The principles of arbitrage then apply, and the value of the option has to be equal to the value of the replicating portfolio.
The Binomial Option Pricing Model

Option Details

$K = 40$
$r = 11\%$
$t = 2$

Stock Price Calculation:

- $D = 0.4, B = 9.01$
- $D = 1.11 B = 10$
- $D = 1.11 B = 10$
- $D = 1.11 B = 10$

- $Call = 0.4 \times 35 - 9.01 = 10$
- $Call = 1 \times 70 - 36.04 = 33.96$
- $Call = 0.8278 \times 50 - 21.61 = 19.42$

- $Call = 4.99$
- $Call = 33.96$
- $Call = 19.42$
The limiting distributions...
The version of the model presented by Black and Scholes was designed to value European options, which were dividend-protected.

The value of a call option in the Black-Scholes model can be written as a function of the following variables:

\[ C = S_0 e^{-rT} N(d_1) - Ke^{-rT} N(d_2) \]

where:
- \( C \) = Value of the call option
- \( S_0 \) = Current value of the underlying asset
- \( K \) = Strike price of the option
- \( r \) = Riskless interest rate corresponding to the life of the option
- \( T \) = Time to expiration of the option
- \( \sigma \) = Variance in the ln(value) of the underlying asset

The Black-Scholes model was designed to value European options, which were dividend-protected.
The Black Scholes Model

Value of call = $N(d_1)$ - $Ke^{-rt}N(d_2)$

where,

\[d_2 = d_1 - \frac{\sigma \sqrt{t}}{Q} \]

- $N(d_2)$: Risk neutral probability that $S > K$
- Borrow $K e^{-rt}N(d_2)$
- Buy $N(d_1)$ shares of stock; $N(d_1)$ is called the option delta

The replicating portfolio is embedded in the Black-Scholes model. To replicate this call, you would need to

\[d_1 = \frac{\ln S - \ln K + (r + \frac{\sigma^2}{2})t}{\sigma \sqrt{t}} \]

\[d_1 = \frac{1}{\sqrt{O}} \left( \frac{7}{\sigma^2} + 1 \right) + \left( \frac{K}{S} \right) \ln \frac{1}{p} \]

where,

- $d_1$: Option delta
- $S$: Stock price
- $P$: Stock price
- $r$: Risk-free rate
- $\sigma$: Volatility
- $t$: Time to expiration
- $N(d_1)$: Cumulative standard normal distribution
- $N(d_2)$: Standard normal distribution
- $K$: Strike price
- $Q$: Risk neutral probability
### The Normal Distribution

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Adjusting for Dividends

If the dividend yield \(\frac{\text{dividends}}{\text{Current value of the asset}}\) of the underlying asset is expected to remain unchanged during the life of the option, the Black-Scholes model can be modified to take dividends into account:

\[
C = S e^{-yt} N(d_1) - K e^{-rt} N(d_2)
\]

where,

\[
d_2 = d_1 - \sigma \sqrt{t}
\]

The value of a put can also be derived:

\[
d_2 = d_1 - \sigma \sqrt{t}
\]

\[
C = K e^{-rt} (1 - N(d_2)) - S e^{-yt} (1 - N(d_1))
\]

\[
d_1 = \frac{\ln S}{\sigma^2 t} + (r - \frac{\text{dividends}}{\text{Current value of the asset}} + \frac{\sigma^2}{2}) t
\]

If the dividend yield \(\text{dividends} = \text{dividend yield} \times \text{Current value of the asset of the asset (of the asset)}\)
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Choice of Option Pricing Models

Most practitioners who use option pricing models to value real options argue for the binomial model over the Black-Scholes model. This is due to the following reasons:

- Early exercise is the rule rather than the exception with real options.
- Underlying asset values are generally discontinuous.

The question then becomes when and why the two approaches yield different estimates of value. If you can develop a binomial tree with outcomes at each node, it looks a great deal like a decision tree from capital budgeting. The question then becomes when and why the two approaches yield different estimates of value.
Traditional decision tree analysis tends to use

- One cost of capital to discount cashflows in each branch to the present
- Probabilities to compute an expected value

These values will generally be different from option pricing models

Decision Trees could yield the same values as option pricing models if you modified decision tree analysis to:

- Use different discount rates at each node to reflect where you are in the decision tree (This is the Copeland solution)
- Use the risk-free rate to discount cashflows in each branch, estimate the probabilities to estimate an expected value and adjust the expected value for the market risk in the investment
Key Tests for Real Options

1. Is there an option embedded in this asset/decision?
   - Can you identify the underlying asset?
   - Can you specify the contingency under which you will get payoffs?
   - Can you identify the underlying asset?
   - Is there an option embedded in this asset/decision?

2. Is there exclusivity?
   - If yes, there is option value.
   - If no, there is none.
   - If in between, you have to scale value.

3. Can you use an option pricing model to value the real option?
   - Is the underlying asset traded?
   - Can the option be bought and sold?
   - Is the cost of exercising the option known and clear?
Option Pricing Applications in Investment/Strategic Analysis
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 a project. If the cash flows do not measure up, the last option that is embedded in projects is the option to abandon an investment. The first of these options is the option to delay taking an investment, when a firm has exclusive rights to it, until a later date. The second of these options is taking advantage of other opportunities (investments) in the future. These options all add value to projects and may make a "bad" investment 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

- Present Value of Expected Cash Flows on Product
- Present Value of Cash Flows from Project
- Initial Investment in Project
- Project's NPV turns positive in this section
- Project's NPV in this section has negative

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Insights for Investment Analyses

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

Q The value of these rights increases with the volatility of the underlying business.

Q The cost of acquiring these rights (by buying them or spending money on development, for instance) has to be weighed against these benefits.
Example 1: Valuing product patents as options

A product patent provides the firm with the right to develop the product and market it. The firm will do so only if the present value of the expected cash flows from developing the product exceeds the cost of development. If this does not occur, the firm can shelve the patent and not incur any further costs. If $I$ is the present value of the expected cash flows from the product, and $V$ is the present value of the costs of developing the product, the payoffs from owning a product patent can be written as:

Payoff from owning a product patent = $V - I$ if $V > I$

= 0 if $V \leq I$
Payoff on Product Option

Present Value of cashflows on product

Cost of product introduction

Net Payoff to introduction
### Obtaining Inputs for Patent Valuation

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<tr>
<th>Estimation Process</th>
<th>Input</th>
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<tr>
<td>1. Present Value of Cash Inflows from Taking Project</td>
<td>5. Dividend Yield</td>
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<td>Cost of delay</td>
<td>Value of the Underlying Asset</td>
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<td>Each year of delay translates into one less year of value-creating cashflows</td>
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<td>Variance in cash flows of similar assets or firms</td>
<td>Variance in present value from capital budgeting simulation</td>
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<td>Cost of making investment on the project is assumed; option is exercised when investment is made.</td>
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<td>Life of the Patent</td>
<td>Exercise Price on Option</td>
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<td>Annual cost of delay = (\frac{u}{1-\frac{1}{1+\text{Cost of delay}}})</td>
<td>4. Expiration of the Option</td>
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<td>Each year of delay translates into one less year of value-creating cashflows</td>
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<td>Variance in present value of underlying asset</td>
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<td>Time will be noisy, but that adds value.</td>
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- \(u\): Annual cost of delay
- \(\frac{1}{1+\text{Cost of delay}}\): Value of the Underlying Asset
Biogen, a bio-technology firm, has a patent on Avonex, a drug to treat multiple sclerosis, for the next 17 years, and it plans to produce and sell the drug by itself. The key inputs on the drug are as follows:

- Present Value of Cash Flows from Introducing the Drug Now = $3.422 billion
- Present Value of Cost of Developing Drug for Commercial Use = $2.875 billion
- PV of Cost of delaying Drug to Commercial Use = $2.875 billion
- Riskless Rate = 1% (17-year T-Bond rate)
- PV of Cash Flows from Introducing the Drug Now = $3.422 billion

Valuing a Product Patent: Avonex
Valuing a firm with patents

The value of a firm with a substantial number of patents can be derived using the option pricing model. If we use this approach, we should be careful not to double count and allow for a high growth rate in cash flows (in the DCF valuation).

\[
\text{Value of Firm} = \text{Value of commercial products (using DCF valuation)} + \text{Value of existing patents (using option pricing)} + (\text{Value of New patents that will be obtained in the future} - \text{Cost of obtaining these patents})
\]

The last input measures the efficiency of the firm in converting its R&D into commercial products. If we assume that a firm earns its cost of capital from research, this term will become zero.

If we use this approach, we should be careful not to double count and allow for a high growth rate in cash flows (in the DCF valuation).
Biogen had two commercial products (a drug to treat Hepatitis B and

\[ \text{Present Value of License Fees} = \frac{\$ \ 50 \text{ million}}{0.07} \times (1 - (1.07)^{-12}) = \$ \ 397.13 \text{ million} \]

Value of Biogen’s existing products

At the time of this valuation, that it had licensed to other pharmaceutical firms.

Value of Biogen’s existing products

Biogen had two commercial products (a drug to treat Hepatitis B and

Biogen continued to fund research into new products, spending about $100 million on R&D in the most recent year. These R&D expenses were expected to grow 20% a year for the next 10 years. Therefore, the cost of capital was estimated to be 15%.

There was a significant amount of risk associated with this component described above (for the next 10 years, and break even after that, i.e., $25 in value in patents (valued using the option pricing model) thereafter. It was assumed that every dollar invested in research would create $1.25 in patent value for every $1 invested in R&D.

The value of Biogen’s Future R&D
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</table>

Note: The table represents the calculation of the present value of future R&D costs and the excess value, adjusted for an interest rate of 15%.
The value of Biogen as a firm is the sum of all three components – the present value of cash flows from existing products, the value of Avonex (as an option) and the value created by new research:

\[
\text{Value} = \text{Existing Products + Existing Patents + Value: Future R&D}
\]

Since Biogen had no debt outstanding, this value was divided by the number of shares outstanding (35.5 million) to arrive at a value per share:

\[
\text{Value per share} = \frac{\$1,622.43\text{ million}}{35.5} = \$45.70
\]

The value of Biogen as a firm is the sum of all three components – the present value of cash flows from existing products, the value of Avonex (as an option) and the value created by new research:
The Real Options Test: Patents and Technology

Q

The Option Test:

• Underlying Asset: Product that would be generated by the patent.
• Contingency: If PV of CFs from development > Cost of development: PV - Cost
  If PV of CFs from development < Cost of development: 0

Q

The Exclusivity Test:

• Patents restrict competitors from developing similar products.
• Patents do not restrict competitors from developing other products to treat the same disease.

Q

The Pricing Test:

• Underlying Asset: Patents are not traded. Not only do you therefore have to estimate the present values and volatilities yourself, you cannot construct replicating positions or do arbitrage.

Q

Conclusion: You can estimate the value of the real option but the quality of your estimate will be a direct function of the quality of your capital budgeting. It works best if you are valuing a publicly traded firm and the variance of your estimate will be a direct function of the variance in the underlying stock prices.

Aswath Damodaran
Example 2: Valuing Natural Resource Options

In a natural resource investment, the underlying asset is the resource and the value of the asset is based upon two variables - the quantity of the resource that is available in the investment and the price of the resource.

In most such investments, there is a cost associated with developing the resource. Defining the cost of development as $X$, and the estimated value of the resource as $V$, the potential payoffs on a natural resource option can be written as follows:

Payoff on natural resource investment = $\begin{cases} V - X & \text{if } V > X \\ 0 & \text{if } V \leq X \end{cases}$
### Estimating Inputs for Natural Resource Options

<table>
<thead>
<tr>
<th>1. Estimation Process</th>
<th>2. Cost of Developing Reserve (Strike Price)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Time to Expiration</td>
<td>4. Variance in Value of Underlying Asset</td>
</tr>
<tr>
<td>5. Net Production Revenue (Dividend Yield)</td>
<td>6. Development Lag</td>
</tr>
</tbody>
</table>

#### Input Estimation Process

1. **Value of Available Reserves of the Resource**
   - Expert estimates (Geologists for oil...)
     - The present value of the after-tax cash flows from the resource are then estimated.

2. **Cost of Developing Reserve (Strike Price)**
   - Past costs and the specifics of the investment
     - The resource can then be estimated
     - Expert estimates (Geologists for oil...)
     - The present value of the after-tax cash flows from the resource

3. **Time to Expiration**
   - Relinquishment Period: if asset has to be relinquished in a point in time
   - Relinquishment Period: if asset has to be relinquished

4. **Variance in Value of Underlying Asset**
   - Based upon variability of the price of the resources and variability of available reserves.

5. **Net Production Revenue (Dividend Yield)**
   - Net production revenue every year as percent of market value.

6. **Development Lag**
   - Calculate present value of reserve based upon the lag.
Consider an offshore oil property with an estimated oil reserve of 50 million barrels of oil, where the present value of the development cost is $12 per barrel currently.

Once developed, the net production revenue each year will be 5% of the marginal value per barrel currently is $12 per barrel of oil.

The firm has the rights to exploit this reserve for the next twenty years. The riskless rate is 8% and the variance in oil prices is 0.03.

The value of the reserves is the present value of the expected future revenues. The present value of the expected future revenues is the expected future revenues discounted at the riskless rate.
Inputs to Option Pricing Model

- Dividend Yield = Net Production Revenue / Value of Reserve = 5%
- Riskless Rate = 8%
- Variance in the value of the underlying asset = 0.03
- Time to expiration on the option = 20 years
- Exercise Price = Present Value of development cost = $12 * 50 = $600 million
- Riskless rate = 8%

Exercise Price = Present Value of development cost = $12 * 50 = $600 million

Discounting the reserve back at the dividend yield over the delay period. Hence, the lost production revenue over the delay period. The estimated opportunity cost of this delay until two years from now. The oil will not be available for sale if development is started today, the oil will not be available for sale.

\[ \text{Yield} = \frac{1.05}{1/05} = \frac{1.05}{0.05} \approx 21 \]

Discounted back the length of the development lag at the dividend.

Current Value of the asset = \( S = \text{Value of the developed reserve} \)
Based upon these inputs, the Black-Scholes model provides the following value for the call:

\[
\text{Call Value} = 544.22 \times e^{-0.05(20)} \times 0.8498 - 600 \times e^{-0.08(20)} \times 0.6030 = 97.08 \text{ million}
\]

This oil reserve, though not viable at current prices, still is a valuable property because of its potential to create value if oil prices go up.

\[
\begin{align*}
\text{d}_1 &= 1.0359 \\
\text{d}_2 &= 0.2613 \\
\text{N}(\text{d}_2) &= 0.6030 \\
\text{N}(\text{d}_1) &= 0.8498
\end{align*}
\]

Valuing the Option
Extending the option pricing approach to value natural resource firms.

The value of natural resource firms can be viewed primarily as options, the firm itself can be valued using option pricing models. Since the assets owned by a natural resource firm can be viewed as a portfolio of assets, valuing the entire portfolio of assets as in the approach will provide a lower value than valuing a portfolio of options (as in this approach) will provide. Nevertheless, the value obtained from the model still provides an interesting perspective on the determinants of resource firm value (which is what the natural resource firm really owns). Nevertheless, the value obtained from the model still provides an interesting perspective on the determinants of resource firm value (which is what the natural resource firm really owns).

The preferred approach would be to value the entire firm as one option. A purist would probably disagree, arguing that valuing an option on a portfolio of assets (as in this approach) will provide a lower value than valuing a portfolio of options (which the natural resource firm really owns). Nevertheless, the value obtained from the model still provides an interesting perspective on the determinants of the value of natural resource firms.

Since this information is likely to be difficult to obtain for large natural resource firms, such as oil companies, which own hundreds of such assets, a variant is to value the entire firm as one option. Since this information is likely to be difficult to obtain for large natural resource firms, such as oil companies, which own hundreds of such assets, a variant is to value the entire firm as one option.
<table>
<thead>
<tr>
<th>Input to model</th>
<th>Corresponding input for valuing firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of underlying asset</td>
<td>Value of cumulated estimated reserves of the firm</td>
</tr>
<tr>
<td>Exercise Price</td>
<td>Value of underlying asset</td>
</tr>
<tr>
<td>Time to expiration on option</td>
<td>Value of underlying asset</td>
</tr>
<tr>
<td>Variance in the price of the natural resource</td>
<td>Variance in value of asset</td>
</tr>
<tr>
<td>Riskless Rate</td>
<td>Riskless rate corresponding to life of the option</td>
</tr>
<tr>
<td>Dividend Yield</td>
<td>Dividend yield</td>
</tr>
<tr>
<td>Riskless Rate</td>
<td>Riskless rate</td>
</tr>
<tr>
<td>Average relinquishment period across all reserves owned by the firm (if known) or estimate of when reserves will be exhausted</td>
<td>Average relinquishment period across all reserves owned by the firm (if known) or estimate of when reserves will be exhausted</td>
</tr>
<tr>
<td>Estimated cumulative cost of developing estimated reserves</td>
<td>Estimated cumulative cost of developing estimated reserves</td>
</tr>
<tr>
<td>Estimated annual net production revenue as a percentage of value of the reserve</td>
<td>Estimated annual net production revenue as a percentage of value of the reserve</td>
</tr>
</tbody>
</table>
Gulf Oil was the target of a takeover in early 1984 at $70 per share. Gulf Oil had 165.3 million shares outstanding, and total debt of $9.9 billion. The average relinquishment life of the reserves is 12 years.

The bond rate at the time of the analysis was 9.00%.

The price of oil was $22.38 per barrel, and the production cost, taxes, and royalties were estimated at $7 per barrel.

The variance in oil prices is 0.03.

The average development life is approximately two years.

Gulf Oil was expected to have net production revenues each year of approximately 5% of the value of the developed reserves. The variance in present value dollars was 0.00%.

It had estimated reserves of 3038 million barrels of oil and the average cost of developing these reserves was estimated to be $9.10 per barrel in 1984 at $70 per share (1). Gulf Oil was the target of a takeover in early 1984 at $70 per share.
Valuing Undeveloped Reserves

Inputs for valuing undeveloped reserves:
- Value of underlying asset = Value of estimated reserves discounted back for period of development lag = 3038 * ($22.38 - $7) / 1.052 = $42,380.44
- Exercise price = Estimated development cost of reserves = 3038 * $10 = $30,380 million
- Time to expiration = Average length of relinquishment option = 12 years
- Variance in value of asset = Variance in oil prices = 0.03
- Riskless interest rate = 9%
- Dividend yield = Net production revenue / Value of developed reserves = 5%

Based upon these inputs, the Black-Scholes model provides the following:

\[
\begin{align*}
\text{Call Value} &= 42,380.44 \exp(-0.05 \times 12) \times 0.9510 - 30,380 \\
&= 13,306 million
\end{align*}
\]
In addition, Gulf Oil had free cashflows to the firm from its oil and gas production of $915 million from already developed reserves and these cashflows are likely to continue for ten years (the remaining lifetime of developed reserves), yields.

The present value of these developed reserves, discounted at the weighted average cost of capital of 12.5%, yields:

\[
\text{Value of already developed reserves} = 915 \times \frac{1}{1.125^{10}} = 915 \times 0.5065 = 5065.83
\]

Valuing Oil

\[
\text{Total value of firm} = 5065.83 + 13,906 = 18,372.83
\]

Less Outstanding Debt

\[
\text{Value of Equity} = 18,372.83 - 9,900 = 8,472.83
\]

\[
\text{Value per share} = \frac{8,472.83}{165.3} = 51.25
\]
Putting Natural Resource Options to the Test

Real option pricing models work well with natural resource options.

- With a fair degree of precision, experience that commodity companies have with this, they can estimate this cost.
- Oil companies buy and sell reserves from each other regularly.
- If we assume that we know the quantity with a fair degree of certainty, you can:
  - Trade the underlying asset.
  - If the reserve or mine may not be traded, the commodity is.

The Option Pricing Test:

- Underlying Asset: While the reserve or mine may not be traded, the commodity is.
- If the reserve or mine may not be traded, the commodity is.

The Exclusivity Test:

- Natural resource reserves are limited (at least for the short term)
- If value > Cost of development: 0
- Contingency: If value > Cost of development: Value - Dev Cost
- Underlying Asset: Oil or gold in reserve

The Option Test:
Taking a project today may allow a firm to consider and take other valuable projects in the future (provides a more-than-compensating value).

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/Take Other Projects
The Option to Expand

- Present Value of Expected Cash Flows
- 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

Ambev is considering introducing a soft drink to the U.S. market. The drink will initially be introduced only in the metropolitan areas of the U.S. and the cost of this "limited introduction" is $500 million. While the current expectation is that the cash flows from having this investment will be only $750 million, there is considerable uncertainty about both the potential for the drink, leading to significant variance in this estimate.

If the initial introduction works out well, Ambev could go ahead with a full-scale introduction to the entire market with an additional investment of $1 billion at any time over the next 5 years. While the financial analysis of the cash flows from this investment suggests a negative NPV of $100 million, this is only $400 million. Thus, by itself, the new investment has a positive NPV of $500 million. The potential for the drink is uncertain, and the cash flows from this investment suggest that the present value of the cash flows from this investment is $500 million. Ambev is considering introducing a soft drink to the U.S. market. The current expectation is that the cash flows from having this investment will be only $750 million, but there is considerable uncertainty about both the potential for the drink and the variance in this estimate.
Valuing the Expansion Option

Value of the Underlying Asset (S) = PV of Cash Flows from Expansion to entire U.S. market, if done now = $750 Million

Strike Price (K) = Cost of Expansion into entire U.S. market = $1000 Million

Standard Deviation in Underlying Asset’s Value = 34.25%

Time to expiration = Period for which expansion option applies = 5 years

We estimate the standard deviation in firm value of publicly traded firms in the beverage markets, which is approximately 34.25%.

By using the annualized standard deviation in firm value of publicly traded firms, we estimate the standard deviation in the estimate of the project value.

Call Value = $234 Million

$1000 Million - $750 Million = $250 Million

Valuing the Expansion Option
Considering the Project with Expansion Option

NPV of Limited Introduction = $400 Million - $500 Million

= - $100 Million

Value of Option to Expand to Full Market = $234 Million

NPV of Project with option to expand

= - $100 Million + $234 Million

= $134 Million

Invest in the project
Aswath Damodaran

The Real Options Test for Expansion Options

Using option pricing models to value expansion options will not only yield extremely noisy estimates, but may attach inappropriate premiums to over time as the market evolves.

Option: Licenses are sometimes bought and sold, but more diffuse expansion options may not be.

Underlying Asset: As with patents, there is no trading in the underlying asset and cost of exercising the option is not known with any precision and may itself evolve. Not clear if exercising the option always yields a positive NPV of expansion

The Exclusivity Test

Barriers may range from strong (exclusive licenses granted by the government) to weaker (brand name, knowledge of the market) to weakest (first mover).

The Pricing Test

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Opportunities and not Options…

An Exclusive Right to Second Investment

A Zero competitive advantage on Second Investment

100% of option value No option value

Increasing competitive advantage/bars to entry

Pharmaceutical patents

Telecom Licenses

Brand Name

Technological Edge

First-Mover

Pre-Requisite

Is the first investment necessary for the second investment?

Second Investment has zero excess returns

Second investment has large sustainable excess return

Option has no value Option has high value

Not necessary Necessary

A Zero competitive advantage on Second Investment

No option value
Some analysts have justified the valuation of internet firms on the basis that you are buying the option to expand into a very large market. What do you think of this argument?

Is there an option to expand embedded in these firms?

Is it a valuable option?
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 the project more valuable.

The diagram illustrates the Present Value of Expected Cash Flows on Project, the Cost of Abandonment, and the Present Value of Cash Flows from Project.
Airbus is considering a joint venture with Lear Aircraft to produce a small commercial airplane capable of carrying 40-50 passengers on short haul flights. The project has a life of 30 years.

Airbus will have to invest $500 million for a 50% share of the venture.

Airbus’s 50% share of the expected cash flows is $480 million, which is eager to enter into the deal, offers to buy Lear Aircraft, which is keen on getting out of the venture. Airbus decides to abandon the project.

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 of 0.16.

Valuing the Option to Abandon
Project with Option to Abandon

Assume that the five-year riskless rate is 6%. The value of the put option can be estimated as follows:

- Time to expiration = Life of the Project = 5 years
- Dividend Yield = 1/Life of the Project = 1/5 = 0.20 = 0.033 (We are assuming that the project's present value will drop by roughly 1/n in each year into the project)
- Strike Price ($K) = Salvage Value from Abandonment = $400 million
- Variance in Underlying Asset's Value = 0.16
- $480 million = Value of the Underlying Asset ($S) = PV of Cash Flows from Project

The value of the put option is then estimated using the Black-Scholes model with the following parameters:

- Strike Price ($K) = $400 million
- Underlying Asset's Value ($S) = $480 million
- Time to expiration = 5 years
- Dividend Yield = 0.033
- Riskless Rate = 6%
- Variance in Underlying Asset's Value = 0.16
Should Airbus enter into the joint venture?

The value of this abandonment option has to be added on to the net present value of the project of $-20 million, yielding a total net present value of $53.23 million.
Having a option to abandon a project can make otherwise unacceptable projects acceptable. Actions that increase the value of the abandonment option include:

- More cost flexibility, that is, making more of the costs of the projects into variable costs
- Fewer long-term contracts/obligations with employees and customers
- Finding partners in the investment, who are willing to acquire your investment in the future
- Lower long-term contracts/obligations with employees and customers
- More cost flexibility, that is, making more of the costs of the projects into variable costs

These actions will undoubtedly cost the firm some value, but this has to be weighed off against the increase in the value of the abandonment option.
Option Pricing Applications in the Capital Structure Decision
The most direct applications of option pricing in capital structure decisions is in the design of securities. In fact, most complex financial instruments can be broken down into some combination of a simple bond/common stock and a variety of options.

The other application of option pricing is in valuing flexibility. Often, firms preserve debt capacity or hold back on issuing debt because they want to maintain flexibility. If these securities are to be issued to the public, and traded, the options have to be priced. If these are non-traded instruments (bank loans, for instance), they still have to be priced. If these securities are to be issued to the public, and traded, the options bond/common stock and a variety of options. The most direct applications of option pricing in capital structure
Firms maintain excess debt capacity and larger cash balances than are warranted by current needs, to meet unexpected future requirements. While maintaining this financing flexibility has value to firms, it also has a cost; the excess debt capacity implies that the firm is giving up some value and has a higher cost of capital. The value of flexibility can be analyzed using the option pricing framework; a firm maintains larger cash balances and excess debt capacity in order to have the option to take projects that might arise in the future.
Quality of the Firm's Projects: It is the excess return that the firm
earns on its projects that provides the value to flexibility. Other things
equal, firms operating in businesses where projects earn substantially
higher returns than their hurdle rates should value flexibility more than those that operate in stable businesses where
future projects, thus, firms with predictable capital expenditures and
low excess returns should value flexibility less than those with high
excess returns. Thus, firms with predictable capital expenditures and
low uncertainty about future projects will increase when there is greater uncertainty about
Excess returns are small, whereas excess returns should value flexibility
in both of those variables.\n\n\nDeterminants of Value of Flexibility Option

Quality of the Firm's Projects: It is the excess return that the firm
earns on its projects that provides the value to flexibility. Other things
are equal, firms operating in businesses where projects earn substantially
higher returns than their hurdle rates should value flexibility more than those that operate in stable businesses where
future projects, thus, firms with predictable capital expenditures and
low excess returns should value flexibility less than those with high
excess returns.
Consider a firm that has expected reinvestment needs (with an associated cost) $X$ each year, with a standard deviation in that value of $\sigma_X$. These external reinvestment needs can be used to cover the difference and exceed the firm’s internal funds. If $X > L$, excess debt capacity remains unused. If $X < L$, excess debt capacity becomes useful if external reinvestment needs exceed the firm’s internal funds.

If $X > L$: Excess debt capacity can be used to cover the difference and invest in projects.

If $X < L$: Excess debt capacity remains unused (with an associated cost). Normal access refers to the external financing that is used by a firm each year. (Normal access refers to the external normal access to capital markets.) Assume that the firm can raise $L$ from internal cash flows and is able to invest in both internal projects and acquisitions.

Reinvestments include both internal projects and acquisitions. Consider a firm that has expected reinvestment needs of $X$ each year, $\sigma_X$. The value of flexibility as an option.
What happens when you make the investment?

If the investment earns excess returns, the firm’s value will increase by the present value of these excess returns over time. If we assume that the excess return each year is constant and perpetual, the present value of the excess returns that would be earned can be written as:

\[
\text{Value of investment} = \frac{ROC - \text{Cost of capital}}{\text{Cost of capital}}
\]

The value of the investments that you can take because you have excess debt capacity becomes the payoff to maintaining excess debt capacity.

If \( X > L \):

\[
\text{New investments} \times \frac{(ROC - \text{Cost of capital})}{\text{Cost of capital}}
\]

If \( X < L \):

0

What happens when you make the investment?
The Value of Flexibility

Actual Reinvestment Needs

Expected (Normal) Reinvestment Needs that can be financed without flexibility

Cost of Maintaining Financing Flexibility

Payoff: \((S-K) \times \text{Excess Return}\) / WACC

Excess Return / WACC = PV of excess returns in perpetuity

Use financing flexibility to take unanticipated investments (acquisitions) to take unanticipated

Use financing flexibility

Expected Reinvestment (Normal)

Without be financed

Needs that can be financed

The Value of Flexibility
<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>Cost of Equity</th>
<th>Cost of Debt</th>
<th>Cost of Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>7.97%</td>
<td>4.61%</td>
<td>12.55%</td>
</tr>
<tr>
<td>20%</td>
<td>18.77%</td>
<td>4.61%</td>
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<td>40%</td>
<td>25.65%</td>
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<td>28.95%</td>
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<tr>
<td>90%</td>
<td>39.85%</td>
<td>9.42%</td>
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</tr>
</tbody>
</table>

**Current Debt Ratio:** 18%
Inputs to Option Valuation Model

Aswath Damodaran

One way to think about firms that preserve debt capacity because they want flexibility is that they are forgoing use this debt to invest in existing projects at existing excess returns because they think that they might have an increase in either investment needs or excess returns.

To value the flexibility as a percent of firm value (as an annual cost), these inputs would be the inputs to the model:

- Expected Reinvestment needs as a percent of Firm Value
- \( \sigma^2 \) = Variance in ln(Net Capital Expenditures)
- \( t = 1 \) year
- \( S = \frac{E(ROC - WACC)}{WACC} \)

Once this option has been valued, the present value of the excess returns that will be gained by taking the additional investments would be the present value of the excess returns.

\( \Delta V = \frac{\Delta \text{Value}}{\text{Firm Value}} \times 100 \%

One way to think about firms that preserve debt capacity because they think that they have the flexibility to invest in more projects.
Expected reinvestment needs as a percent of firm value:

- Over the last 5 years, reinvestment (net cap ex, acquisitions and changes in working capital) has been approximately 5.3% of firm value. Over the last 5 years, reinvestment needs as a percent of firm value:

\[ \text{Expected Reinvestment needs} = \frac{\text{Net Income} + \text{Depreciation} + \text{Net Debt Issued}}{\text{Market Value of Firm}} \]

Reinvestment needs that can be financed without flexibility:

\[ \frac{\text{Net Income} + \text{Depreciation} + \text{Net Debt Issued}}{\text{Market Value of Firm}} - \frac{\text{New Debt - Debt Repaid}}{\text{Market Value of Firm}} \]

This number has averaged 4.8% over the last 5 years. We looked at net debt financing each period, as a percent of firm value (as a measure of access to external financing each year). We looked at net debt financing each period, as a percent of firm value: (New Debt - Debt Repaid)/Market Value of Firm.

I am assuming that this is the expected reinvestment need; the variance in reinvestment needs, as a percent of firm value over the last 5 years, has been approximately 0.375. This variance is approximately 5.3% of firm value. The variance in reinvestment needs that can be financed without flexibility:

\[ \text{Reinvestment needs} = \frac{\text{Net Income} + \text{Depreciation}}{\text{Market Value of Firm}} \]
Valuing Flexibility at Disney

Disney’s cost of capital at its optimal debt ratio is 11.64%. The cost of maintaining flexibility is therefore 0.78% annually (12.22%) -
Disney earns 18.69% on its projects has a cost of capital of 12.22%.

The value of flexibility (annually) = 1.6092% (0.6% / 12.22%) = 0.85% of value

Disney’s cost of capital at its optimal debt ratio is 11.64%. The cost it incurs to maintain flexibility is therefore 0.78% annually (12.22%). The excess return (annually) is 6.47%

The value of an option with these characteristics is 1.6092%

\[
\text{Value of Flexibility (annual)} = 1.6092\% \cdot \frac{0.692\%}{0.0647}\% = 0.85\% \text{ of value}
\]

\[
\sigma^2 = 0.0375 \text{ (variance in ln(Reinvestment Needs/Firm Value))}
\]

\[
t = 1 \text{ year}
\]

\[
K = 4.8\%
\]

\[
S = 5.33\%
\]

The value of flexibility as a percentage of firm value can be estimated as:

\[
\text{Value of Flexibility} = 1.6092\% \cdot \frac{0.692\%}{0.1222}\% = 0.85\% \text{ of value}
\]
Determinants of the Value of Flexibility

1.1: Firms with significant internal operating cash flows should value flexibility less than firms with small or negative operating cash flows.

1.2: Firms with easy access to financial markets should have a lower value of flexibility than firms with difficult or non-existent access.

1.3: Firms that do not have the capacity to earn or sustain excess returns get no value from flexibility.

2: For flexibility, the greater the value of flexibility, the greater the capacity to earn excess returns. The greater the value of flexibility, the more unpredictable the reinvestment needs of a firm, the greater the value of flexibility. The more unpredictable the reinvestment needs of a firm, the greater the value of flexibility.
Option Pricing Applications in Valuation

Value of Patents/Licenses

Value of Undeveloped Reserves for Natural Resource Firms

Equity Value in Deeply Troubled Firms

Aswath Damodaran
Aswath Damodaran

Option Pricing Applications in Equity Valuation

...value from the rights to a product or a service (e.g., a patent).

Start-up firms or high-growth firms which derive the bulk of their

Natural resource companies, where the undeveloped reserves can be

called option, which is the option to liquidate the firm.

Earnings and a significant chance of bankruptcy (e.g., a firm with high leverage, negative...

Equity in a troubled firm (i.e., a firm with high leverage, negative...
The equity in a firm is a residual claim, i.e., equity holders lay claim to all cashflows left over after all outstanding debts (debts, preferred stock etc.) have been satisfied. The principle of limited liability, however, protects equity investors in publicly traded firms if the value of the firm is less than the value of the outstanding debt, and other financial claims are paid off.

If a firm is liquidated, the same principle applies, with equity investors receiving whatever is left over in the firm after all outstanding debts are paid off. The equity in a firm is a residual claim, i.e., equity holders lay claim to all cashflows left over after all outstanding debts (debts, preferred stock etc.) have been satisfied.

The equity investors in publicly traded firms are protected if the value of the firm is less than the value of the outstanding debt and other financial claims are paid off.

In the firm, the outstanding debt, and they cannot lose more than their investment in the firm. If the value of the firm is less than the value of the equity investors, however, the principle of limited liability protects equity investors in publicly traded firms if the value of the firm is less than the value of the outstanding debt, and other financial claims are paid off. The principle of limited liability, however, protects equity investors in publicly traded firms if the value of the firm is less than the value of the outstanding debt, and other financial claims are paid off.
Equity as a call option

The payoff to equity investors, on liquidation, can therefore be written as:

\[
\text{Payoff to equity on liquidation} = \begin{cases} 
V - D & \text{if } V > D \\
0 & \text{if } V \leq D
\end{cases}
\]

where,

\[V = \text{Value of the firm}, \quad D = \text{Face Value of the outstanding debt and other external claims}, \quad \Lambda = \text{Value of the firm at liquidation}\]

A call option, with a strike price of \(K\), on an asset with a current value \(S\), has the following payoffs:

\[
\text{Payoff on exercise} = \begin{cases} 
S - K & \text{if } S > K \\
0 & \text{if } S \leq K
\end{cases}
\]
Payoff Diagram for Liquidation Option

Value of firm

Net Payoff on Equity

Face Value of Debt

Payoff Diagram for Liquidation Option
Application to valuation: A simple example

Assume that you have a firm whose assets are currently valued at $100 million and that the standard deviation in this asset value is 40%.

Further, assume that the face value of debt is $80 million (it is zero coupon debt with 10 years left to maturity).

If the ten-year treasury bond rate is 10%,

• what should the interest rate on debt be?
• how much is the equity worth?

Assume that you have a firm whose assets are currently valued at $100 million and that the standard deviation in this asset value is 40%.
Model Parameters

- Riskless rate \( r = T \) Treasury bond rate corresponding to option life = 10%.
- Value of the underlying asset \( S = \) Value of the firm = $100 million.
- Exercise price \( K = \) Face Value of outstanding zero-coupon debt = $80 million.
- Life of the option \( t = \) Life of zero-coupon debt = 10 years.
- Variance in the value of the underlying asset \( \sigma^2 = \) Variance in firm value = 0.16.
- Variance in the value of the underlying asset = \( \sigma^2 \) = Variance in firm value = 0.16.

\[ \text{Value of the underlying asset} = S = \text{Value of the firm} = \$100 \text{ million} \]

\[ \text{Exercise price} = K = \text{Face Value of outstanding zero-coupon debt} = \$80 \text{ million} \]

\[ \text{Life of the option} = t = \text{Life of zero-coupon debt} = 10 \text{ years} \]

\[ \text{Riskless rate} = r = T = \text{Treasury bond rate corresponding to option life} = 10\% \]
Valuing Equity as a Call Option

Based upon these inputs, the Black-Scholes model provides the following value for the call:

\[
\text{Value of the call} = 100 \cdot N(d_1) - 80 \cdot \text{exp}(-0.10) \cdot 10 \cdot N(d_2) = 75.94 \text{ million}
\]

Value of the outstanding debt = $100 - $75.94 = $24.06 million

Interest rate on debt = \( \frac{80}{24.06 \cdot 10} \) = 12.77%

\begin{align*}
\text{Value of the call} &= 100 \cdot N(0.9451) - 80 \cdot \text{exp}(-0.10) \cdot 10 \cdot N(0.6310) \\
&= 75.94 \\
N(d_2) &= 0.3345 \\
N(d_1) &= 0.9451 \\
d_2 &= 0.3345 \\
d_1 &= 1.5994
\end{align*}

Based upon these inputs, the Black-Scholes model provides the following value for the call:
Aswath Damodaran

The Effect of Catastrophic Drops in Value

Assume now that a catastrophe wipes out half the value of this firm (the value drops to $50 million), while the face value of the debt remains at $80 million. What will happen to the equity value of this firm?

If it will be worth more than $25.94 million
It will be worth nothing since debt outstanding > Firm Value
It will drop in value to $25.94 million
[From previous page]
Firm Value - market value of debt

$50 million - $80 million = $25.94 million
Illustration: Value of a troubled firm

- Assume now that, in the previous example, the value of the firm were reduced to $50 million while keeping the face value of the debt at $80 million.
- This firm could be viewed as troubled, since it owes (at least in face value terms) more than it owns.
- The equity in the firm will still have value, however.
Aswath Damodaran

Valuing Equity in the Troubled Firm

- Value of the underlying asset = $50 million
- Exercise price = K = Face Value of outstanding debt = $80 million
- Life of the option = t = Life of zero-coupon debt = 10 years
- Riskless rate = r = Treasury bond rate corresponding to option life = 10%
- Variance in the value of the underlying asset = $\sigma^2 = \text{Variance in firm value} = 0.16$

Valuing Equity in the Troubled Firm
The Value of Equity as an Option

Based upon these inputs, the Black-Scholes model provides the following value for the call:

\[ d_1 = 1.0515 \quad N(d_1) = 0.8534 \]
\[ d_2 = -0.2135 \quad N(d_2) = 0.4155 \]

Value of the call = $50 \times 0.8534 - 80 \times 0.4155 = $39.44 - $30.44 = $9.00 million

Value of the bond = $50 - $30.44 = $19.56 million

This might explain why stock in firms, which are in Chapter I and essentially bankrupt, still has value.

The equity in this firm drops by, because of the option characteristics of equity.

This might explain why stock in firms, which are in Chapter I and essentially bankrupt, still has value.
Equity value persists as firm value changes.
The first implication is that equity will have value, even if the value of the firm falls well below the face value of the outstanding debt. Such a firm will be viewed as troubled by investors, accountants, and analysts, but that does not mean that its equity is worthless. Just as deep out-of-the-money traded options command value because the time until the option expires is long and because the possibility that the value of the underlying asset may increase above the strike price is non-zero, equity will command value because of the time premium on the option (the time until the bonds mature and come due) and the possibility that the value of the assets may increase above the face value of the bonds before they come due. The first implication is that equity will have value, even if the value of the firm falls well below the face value of the outstanding debt.
Implication 1: The Conflict between Bondholders and Stockholders

Consider again the firm described in the earlier example, with a value of assets of $100 million, a face value of zero-coupon ten-year debt of $80 million, a standard deviation in the value of the firm of 40%, the value of equity of $27.94 million, a value of debt of $24.06 million, and a value of equity of $75.94 million. The equity and debt in this firm were valued as follows:

- Value of Equity = $75.94 million
- Value of Debt = $24.06 million
- Value of Firm = $100 million

Would taking a risky project with a negative net present value of -$2 million make sense to you as an equity investor in this firm? Would this project be risky enough to push up the standard deviation in the value of the firm to 50%? Would you ever take a very risky project that will push up the standard deviation in firm value to 50%? Would taking a risky, bad project ever make sense to you as an equity investor in this firm?

Yes ☐ No ☐
Valuing Equity after the Project

The value of equity rises from $75.94 million to $77.71 million, even though the

- Value of Equity = $77.71
- Value of Debt = $20.29
- Value of Firm = $98.00
- Value of Bond = $98.00

The value of equity rises by $1.77 million, and the value of the firm declines by $2 million. The increase in equity comes at the

- Exercise price = K = Face Value of outstanding debt = $80 million
- Life of the option = T = Life of zero-coupon debt = 10 years
- Variance in the value of the underlying asset = \sigma^2 = Variance in Firm Value = 0.25
- Riskless rate = r = Treasury bond rate corresponding to option life = 10%

Impulse to the valuation of the underlying asset is lowered because of the negative net present.

\begin{align*}
\text{Value of the underlying asset} = S &= \text{Value of the firm} = $100 million - $2 million \\
\text{Value of the firm} &= $98 million - $2 million \\
\end{align*}
II. The Effects of an Acquisition

Assume that you are the manager of a firm and that you buy another firm, with a fair market value of $150 million, for exactly $150 million. In an efficient market, the stock price of your firm will remain unchanged. If you are the manager of a firm and that you buy another firm, with a fair market value of $150 million, for exactly $150 million, in an efficient market, the stock price of your firm will remain unchanged.
You are provided information on two firms, which operate in unrelated businesses and hope to merge.

Firm A
- Value of the firm: $100 million
- Face Value of Debt: $80 million
- Maturity of debt: 10 years
- Std. Dev. in value: 40%
- Correlation between cashflows: 0.4

Firm B
- Value of the firm: $150 million
- Face Value of Debt: $50 million
- Maturity of debt: 10 years
- Std. Dev. in value: 50%

The variance in the value of the firm after the acquisition can be calculated as follows:

\[
\text{Variance in combined firm value} = \sigma_1^2 w_1^2 + \sigma_2^2 w_2^2 + 2 \rho_{12} \sigma_1 \sigma_2 w_1 w_2
\]

\[
= (0.4)^2 (0.16) + (0.6)^2 (0.25) + 2 (0.4) (0.6) (0.4) (0.4) (0.5)
= 0.154
\]

The ten-year bond rate is 10%.
Correlation between cashflows: 0.4
Std. Dev. in value: 40%
Maturity of debt: 10 years
Face Value of Debt
Value of the firm

Effects on equity of a conglomerate merger
The values of equity and debt in the individual firms and the combined firm can then be estimated using the option pricing model:

<table>
<thead>
<tr>
<th>Firm</th>
<th>Value of Equity in the Firm</th>
<th>Value of Debt in the Firm</th>
<th>Value of the Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm A</td>
<td>$24.06</td>
<td>$134.47</td>
<td>$90.00</td>
</tr>
<tr>
<td>Firm B</td>
<td>$75.94</td>
<td>$20.74</td>
<td>$100.00</td>
</tr>
<tr>
<td>Combined Firm</td>
<td>$134.47</td>
<td>$20.74</td>
<td>$207.43</td>
</tr>
</tbody>
</table>

The combined value of the equity prior to the merger is $210.41 million and it declines to $207.43 million after the merger.

The wealth of the bondholders increases by an equal amount. There is a transfer of wealth from stockholders to bondholders, as a consequence of the merger. Thus, conglomerate mergers that are not followed by increases in leverage are likely to see this redistribution of wealth occur across claim holders in the firm.
The examples that have been used to illustrate the use of option pricing theory to value equity have made some simplifying assumptions. Among them are the following:

1. There were only two claim holders in the firm – debt and equity.
2. There is only one issue of debt outstanding and it can be retired at face value.
3. The debt has a zero coupon and no special features (convertibility, put clauses, etc.).
4. The value of the firm and the variance in that value can be estimated.

Obtaining option pricing inputs - Some real world problems
## Real World Approaches to Getting Inputs

<table>
<thead>
<tr>
<th>Value of the Firm</th>
<th>Value of the Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cumulate market values of equity and debt (or)</td>
<td>• Value of the Debt</td>
</tr>
<tr>
<td>• Value the assets in place using FCFF and WACC (or)</td>
<td>• If the debt is long term and coupon bearing, add the cumulated value of the debt.</td>
</tr>
<tr>
<td>• Use cumulated market values of equity and debt (or)</td>
<td>• If the debt is short term, you can use only the face or book value.</td>
</tr>
</tbody>
</table>

### Variance in Firm Value

Where:
- $\sigma^2_{firm}$ is the variance in firm value.
- $\sigma^2_e$ is the variance in the stock price.
- $\sigma^2_d$ is the variance in the bond price.
- $w_e$ is the weight of equity.
- $w_d$ is the weight of debt.

If stocks and bonds are traded:
- Use average firm value variance from the industry in which the company operates.
- If not traded, use variances of similarly rated bonds.

If not available, use weighted duration of bonds outstanding (or) weighted maturity.

### Value of the Debt

- If the debt is short term, you can use only the face or book value.
- If the debt is long term and coupon bearing, add the cumulated nominal value of these coupons to the face value of the debt.

### Maturity of the Debt

- Face value weighted duration of bonds outstanding (or) weighted maturity.
- If not available, use weighted duration of bonds outstanding (or) weighted maturity.

### Estimation Process

- Use the FCFF and WACC (or) cumulative market values of equity and debt (or)
Valuing Equity as an option - Eurotunnel in early 1998

- Eurotunnel has been a financial disaster since its opening
  - In 1997, Eurotunnel had earnings before interest and taxes of -£56 million and net income of -£685 million
  - At the end of 1997, its book value of equity was -£117 million
- It had £8,865 million in face value of debt outstanding
  - The weighted average duration of this debt was 10.93 years

<table>
<thead>
<tr>
<th>Debt Type</th>
<th>Face Value</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short term</td>
<td>935</td>
<td>0.50</td>
</tr>
<tr>
<td>10 year</td>
<td>2435</td>
<td>6.7</td>
</tr>
<tr>
<td>20 year</td>
<td>3555</td>
<td>12.6</td>
</tr>
<tr>
<td>Longer</td>
<td>1940</td>
<td>18.2</td>
</tr>
<tr>
<td>Total</td>
<td>£8,865 mil</td>
<td>10.93 years</td>
</tr>
</tbody>
</table>
The Basic DCF Valuation

The value of the firm estimated using projected cashflows to the firm, discounted at the weighted average cost of capital was £2,312 million. This was based upon the following assumptions:

- Revenues will grow 5% a year in perpetuity.
- Capital spending and depreciation will grow 5% a year in perpetuity.
- The COGS, which is currently 85% of revenues will drop to 65% of revenues in Yr 5 and stay at that level.
- The COGS which is currently 95.35% will drop to 70% after year 5.
- The debt ratio, which is currently 95.35%, will drop to 70% after year 5.
- The debt for the stock will be 1.10 for the next five years, and drop to 0.8 after that.
- The beta for the stock will drop to 1.0 for the next five years, and drop to 0.8 after that.
- The cost of debt is 10% in high growth period and 8% after that.
- The long term bond rate is 6%.
- The beta for the stock will drop to 1.0 for the next five years, and drop to 0.8 after that.
- The cost of debt is 10% in high growth period and 8% after that.
- The debt ratio, which is currently 95.35%, will drop to 70% after year 5.
- The debt for the stock will be 1.10 for the next five years, and drop to 0.8 after that.
- The beta for the stock will drop to 1.0 for the next five years, and drop to 0.8 after that.
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- The debt for the stock will be 1.10 for the next five years, and drop to 0.8 after that.
- The beta for the stock will drop to 1.0 for the next five years, and drop to 0.8 after that.
- The cost of debt is 10% in high growth period and 8% after that.
- The debt ratio, which is currently 95.35%, will drop to 70% after year 5.
The 15-year bond rate is 6%. I used a bond with a duration of roughly 11 years to match the life of my option.

The proportion of debt in the capital structure during the period (1992-1996) was 85%.

The correlation between stock price and bond price changes has been 0.5.

Annualized variance in firm value =

\[
(0.15)^2 (0.41)^2 + (0.17)^2 (0.85)^2 + 2 (0.15) (0.85) (0.17) (0.41) = 0.0335
\]

Annualized variance in firm value was 85%.

The 15-year bond rate is 6%. (I used a bond with a duration of roughly 11 years to match the life of my option.)
Valuing Eurotunnel Equity and Debt

Inputs to Model

- Value of the underlying asset = $S = Value of the firm = £2,312 million
- Exercise price = $K = Face Value of outstanding debt = £8,865 million
- Life of the option = $t = Weighted average duration of debt = 10.93 years
- Variance in the value of the underlying asset = $\sigma^2 = Variance in firm value = 0.0335
- Riskless rate = $r = Treasury bond rate corresponding to option life = 6%

Based upon these inputs, the Black-Scholes model provides the following:

\[
\begin{align*}
V_{\text{call}} &= S \cdot N(d_1) - K \cdot e^{-r \cdot t} \cdot N(d_2) \\
N(d_1) &= \frac{\ln(S/K) + (r + \frac{\sigma^2}{2}) \cdot t}{\sigma \cdot \sqrt{t}} \\
N(d_2) &= \frac{\ln(S/K) + (r - \frac{\sigma^2}{2}) \cdot t}{\sigma \cdot \sqrt{t}}
\end{align*}
\]

\[
\begin{align*}
d_1 &= \frac{\ln(2,312/8,865) + (0.06 + 0.0335/2) \cdot 10.93}{0.0335 \cdot \sqrt{10.93}} = -0.337 \\
d_2 &= \frac{\ln(2,312/8,865) + (0.06 - 0.0335/2) \cdot 10.93}{0.0335 \cdot \sqrt{10.93}} = -1.439
\end{align*}
\]

Value of the call = $2,312 (0.2023) - 8,865 exp(-0.06)(10.93) (0.0751) = £122 million

Appropriate interest rate on debt = (8865/2190)(1/10.93)-1 = 13.65%
In Closing…

There are real options everywhere.

- Insights we get on understanding how and why companies behave the way decisions have value.
- Recognizing that building in flexibility and escape hatches into large

The real value from real options lies in

- Approaches (decision trees) to yield equivalent value.
- When options have significant economic value, the inputs needed to exclusively associated with using them.
- Most of them have no significant economic value because there is no

There are real options everywhere.
<table>
<thead>
<tr>
<th>Industry Name</th>
<th>Std Dev (Equity)</th>
<th>Std Dev (Firm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertising</td>
<td>35.48%</td>
<td>27.11%</td>
</tr>
<tr>
<td>Aerospace/Defense</td>
<td>37.40%</td>
<td>33.13%</td>
</tr>
<tr>
<td>Air Transport</td>
<td>44.52%</td>
<td>33.80%</td>
</tr>
<tr>
<td>Aluminum</td>
<td>29.20%</td>
<td>22.05%</td>
</tr>
<tr>
<td>Apparel</td>
<td>45.25%</td>
<td>37.34%</td>
</tr>
<tr>
<td>Auto &amp; Truck</td>
<td>31.01%</td>
<td>23.90%</td>
</tr>
<tr>
<td>Auto Parts (OEM)</td>
<td>31.21%</td>
<td>26.63%</td>
</tr>
<tr>
<td>Auto Parts (Replacement)</td>
<td>33.28%</td>
<td>25.71%</td>
</tr>
<tr>
<td>Bank</td>
<td>24.44%</td>
<td>22.44%</td>
</tr>
<tr>
<td>Bank (Canadian)</td>
<td>21.18%</td>
<td>19.12%</td>
</tr>
<tr>
<td>Bank (Foreign)</td>
<td>23.12%</td>
<td>22.39%</td>
</tr>
<tr>
<td>Bank (Midwest)</td>
<td>20.13%</td>
<td>19.15%</td>
</tr>
<tr>
<td>Beverage (Alcoholic)</td>
<td>22.21%</td>
<td>20.24%</td>
</tr>
<tr>
<td>Beverage (Soft Drink)</td>
<td>37.59%</td>
<td>32.50%</td>
</tr>
<tr>
<td>Building Materials</td>
<td>30.86%</td>
<td>23.87%</td>
</tr>
<tr>
<td>Canadian Energy</td>
<td>25.24%</td>
<td>21.41%</td>
</tr>
<tr>
<td>Cement &amp; Aggregates</td>
<td>32.83%</td>
<td>29.86%</td>
</tr>
<tr>
<td>Chemical (Basic)</td>
<td>29.43%</td>
<td>25.16%</td>
</tr>
<tr>
<td>Chemical (Diversified)</td>
<td>30.87%</td>
<td>27.01%</td>
</tr>
<tr>
<td>Chemical (Specialty)</td>
<td>33.74%</td>
<td>29.34%</td>
</tr>
<tr>
<td>Coal/Alternate Energy</td>
<td>40.48%</td>
<td>34.85%</td>
</tr>
<tr>
<td>Computer &amp; Peripherals</td>
<td>64.64%</td>
<td>59.54%</td>
</tr>
<tr>
<td>Computer Software &amp; SW</td>
<td>57.80%</td>
<td>54.69%</td>
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<tr>
<td>Construction &amp; Engineering</td>
<td>25.95%</td>
<td>22.62%</td>
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<tr>
<td>Consumer Discretionary</td>
<td>20.96%</td>
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<td>Consumer Discretionary (Foreign)</td>
<td>27.71%</td>
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<tr>
<td>Energ. Prot. (Balance)</td>
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<td>Electric Utility (Central)</td>
<td>14.93%</td>
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<td>16.56%</td>
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<td>Forest Products</td>
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<td>46.04%</td>
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<td>47.73%</td>
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<td>49.42%</td>
</tr>
<tr>
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<td>93.79%</td>
<td>93.40%</td>
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<td>95.10%</td>
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<td>96.97%</td>
<td>96.80%</td>
</tr>
<tr>
<td>Aerospace/Defense (Technical) (Foreign)</td>
<td>98.56%</td>
<td>98.50%</td>
</tr>
</tbody>
</table>
Acquisition Valuation
Acquisition valuations are complex, because the valuation often involved issues like synergy and control, which go beyond just valuing a target firm. It is important on the right sequence, including when you should consider synergy, how synergy be valued, and if so, how? What is the value of control? How can you estimate the value?
Steps involved in an Acquisition Valuation

Step 1: Establish a motive for the merger/acquisition.

Step 2: Choose a target.

Step 3: Value the target with the acquisition motive built in.

Step 4: Decide on the mode of payment - cash or stock, and if cash, arrange for financing - debt or equity.

Step 5: Choose the accounting method for the merger/acquisition - purchase or pooling.
Step 1: Motives behind acquisitions

1. Simpler rational is undervaluation, i.e., that firms that are undervalued by financial markets,

2. A more controversial reason is diversification, with the intent of stabilizing earnings and reducing risk.

3. Synergy refers to the potential additional value from combining two firms, either from operational or financial sources.

4. Poorly managed firms are taken over and restructured, by the new owners, who lay claim to the financial value. Synergy can come from tax savings, increased debt capacity, or cash slack.

5. Managerial self-interest and hubris are the primary, though unstated, reasons for many takeovers.

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Step 1: Motives behind acquisitions

1. Simpler rationale is undervaluation, i.e., that firms that are undervalued by financial markets,
Step 2: Choose a target firm for the acquisition

- **Control**
  - Manager's Interests
  - Badly managed firm whose stock has underperformed the market
  - Cash slack: has great projects/ no funds
  - Debt capacity: is unable to borrow money or pay high rates
  - Tax savings: provides a tax benefit to acquirer
- **Financial Synergy**
  - Higher growth: should have potential for higher growth
  - Cost savings: in same business to create economies of scale
  - Cash slack: has great projects/ no funds
  - Unable to borrow money or pay high rates
- **Operating Synergy**
  - Diversification: in a business which is different from the acquiring firm's
  - Trades at a price below the estimated value

**Target firm** needs:
- Characteristics that best meet CEO's ego and power
Step 3: Value Target Firm with motive built in

Target Firm Value = Independent Value + Synergy

Synergy is the difference between the latter and former

Value the combined firm with the operating synergy

Value the firms independently.

Value the Target Firm as stand-alone entity: No extra premium

Value of Target Firm in optimally run firm: No additional premium

Value of Target Firm as stand-alone entity: No extra premium

Manager’s Interest

Control

Debt Capacity: Value of Target Firm + Increase in Value from Debt

Cash Slack: Value of Target Firm + NPV of Projects/Target

Tax Benefits: Value of Target Firm + PV of Tax Benefits

Synergy: Tax Benefits + Independent Value + Synergy

Value the combined firm with the operating synergy

Target Firm Value = Independent Value + Synergy
**The Valuation Process**

---

**Valuation Process**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Value the company as is, with existing inputs.</td>
</tr>
<tr>
<td>2.</td>
<td>Value the company as if optimally managed. This will usually mean that investment, financing, and dividend policies will be altered.</td>
</tr>
<tr>
<td>3.</td>
<td>Value the combined firm with synergy built in. This may include:</td>
</tr>
<tr>
<td></td>
<td>a. A higher growth rate in revenues and earnings.</td>
</tr>
<tr>
<td></td>
<td>b. Greater margins because of economies of scale.</td>
</tr>
<tr>
<td></td>
<td>c. Lower taxes because of synergies.</td>
</tr>
<tr>
<td></td>
<td>d. Lower cost of debt.</td>
</tr>
</tbody>
</table>

---

**Synergy**

- Value of the bidding firm (pre-acquisition). This is the value of the bidding firm with control premium.
- Subtract the value of the target firm (with control premium) + value of the bidding firm (pre-acquisition). This is the value of the synergy.

**Comparison**

<table>
<thead>
<tr>
<th>Should You Pay?</th>
<th>Valuation Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>If motive is undervaluation, this is the maximum you should pay.</td>
<td>This is the value of the bidding firm (pre-acquisition). This is the value of the bidding firm with control premium.</td>
</tr>
<tr>
<td>If motive is control or in a stand-alone valuation, this is the maximum you should pay.</td>
<td>Subtract the value of the target firm (with control premium) + value of the bidding firm (pre-acquisition). This is the value of the synergy.</td>
</tr>
</tbody>
</table>

---

**Control Premium**

- Higher returns on capital and lower risk. |
- Return unused cash.
### Valuing NCR for AT & T

<table>
<thead>
<tr>
<th>Component</th>
<th>Valuation Guidelines</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Quo</td>
<td>Value the company as is, with existing inputs.</td>
<td>$5.495 million</td>
</tr>
<tr>
<td>Control Premium</td>
<td>Value the company as if optimally managed. This will usually mean real investment, financing and dividend policy will be altered:</td>
<td>$774 million</td>
</tr>
<tr>
<td>Synergy</td>
<td>Value the combined firm with synergy built in. This may include</td>
<td>$4.552 million</td>
</tr>
</tbody>
</table>

#### Valuation

- **Valuation Guidelines**
  - 1. Look at industry averages for optimal (if lazy)
  - 2. Do a full-fledged corporate financial analysis
  - 3. Higher returns on projects and divesting unproductive projects
  - 4. Optimal capital structure
  - 5. Higher returns on projects and divesting unproductive projects
  - 6. Higher dividends
  - 7. Growth synergy
  - 8. Economies of scale
  - 9. Tax benefits
  - 10. Lower cost of debt

#### Components

- **Value**
  - $6.723 million
  - $1.178 million
  - $6.723 million
  - $11.278 million

#### Value Components

- $5,949 million
- $6,723 million
- $774 million
- $4,552 million
Step 4: Decide on payment mechanism: Cash versus Stock

1. Generally speaking, firms which believe that their stock is undervalued will not use stock to do acquisitions. Conversely, firms which believe that their stock is over or correctly valued will use stock to do acquisitions.

2. Not surprisingly, the premium paid is larger when an acquisition is financed with stock rather than cash. There might also be a tax rationale for using stock instead of cash, and an accounting rationale for using stock as opposed to cash. You are allowed to use pooling instead of purchase.

3. There might be an accounting rationale for using stock as opposed to cash. You are allowed to use pooling instead of purchase.

4. Generally speaking, firms which believe that their stock is undervalued will not use stock to do acquisitions.
The Exchange Ratio in a Stock for Stock Exchange

Correct Exchange Ratio to use in a Valuation = Value per Share of Target Firm (with control premium and target-controlled synergies) / Value per Share of Bidding Firm

- If the exchange ratio is set too low, there will be a transfer of wealth from the bidding firm's stockholders to the target firm's stockholders.
- If the exchange ratio is set too high, there will be a transfer of wealth from the target firm's stockholders to the bidding firm's stockholders.

Exchange Ratio
Step 5: Choose an accounting method for the merger

**Purchase Method:**
- The acquiring firm records the assets and liabilities of the acquired firm at market value, without goodwill.
- This approach is allowed only if the acquiring firm exchanges its common stock for common stock of the acquired firm.
- Since earnings are not affected by the amortization of goodwill, the reported earnings per share under this approach will be greater than the reported earnings per share in the purchase approach.

**Pooling of Interests:**
- The book values of the assets and liabilities of the merging firms are added to arrive at values for the combined firm. Since the market value of the transaction is not recognized, no goodwill is created or amortized.
- This approach is allowed only if the acquiring firm exchanges its common stock for common stock of the acquired firm.
- The reported earnings per share under this approach will be greater than the reported earnings per share in the purchase approach.
The value of control should be inversely proportional to the perceived quality of that management and its capacity to maximize firm value.NEGligible or firms which are operating at or close to their optimal value without restructuring, Value of Control = Value of firm, with restructuring - Value of firm, which operates at or below optimum capacity than it is for a well-managed firm. Value of control will be much greater for a poorly managed firm than for a well-managed firm.
After the hostile takeover, many of the hostile takeovers were followed by a significant management change in 17 of the 19 hostile takeovers, with the entire corporate management team replaced.

Leverage was quickly reduced, however, with proceeds from sale of assets, which resulted in a downgrading of the debt. The overwhelming majority of the divestitures were of units which were in business areas unrelated to the company's core business, i.e., they constituted reversal of earlier corporate diversification.

Almost 60% of the takeovers were followed by significant divestitures, where half or more of the firm was divested. The divestitures, where half or more of the firm was divested, were more focused on core business in these firms, but investment was more focused on capital investment in the amount of capital.

There was no significant change in the amount of capital investment in these firms, but investment was more focused on core business. The divestitures were more focused on core business.

There were significant management changes in 17 of the 19 hostile takeovers, with the entire corporate management team replaced in 7 of the 19 hostile takeovers, with the entire corporate management team replaced.

There was no significant change in the amount of capital investment in these firms, but investment was more focused on core business. The divestitures were more focused on core business.
Digital had earnings before interest and taxes of $391.38 million in 1997, which translated into:

- A pre-tax operating margin of 3% on revenues of $13,046 million, depreciation of $461 million and working capital expenditures of $475 million.

Based on its beta of 1.15, an after-tax cost of borrowing of 5% and a debt ratio of approximately 10%, the cost of capital for Digital in 1997 was:

\[
\text{Cost of Capital} = 0.9 \times (6\% + 5\% 	imes 1.15) + 0.15 \times 5\% = 12.33\% 
\]

Digital had capital expenditures of $475 million, depreciation of $461 million and working capital was 15% of revenues.

Operating income, net cap ex and revenues are expected to grow 6% a year for the next 5 years, and 5% thereafter.

Operating income, net cap ex and revenues are expected to grow 6% a year for the next 5 years, and 5% thereafter.
Digital: Status Quo Valuation

<table>
<thead>
<tr>
<th>Year</th>
<th>FCFF</th>
<th>Terminal Value</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$133.26</td>
<td>$119.42</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$141.25</td>
<td>$113.43</td>
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</tr>
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<td>3</td>
<td>$149.73</td>
<td>$107.75</td>
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</tr>
<tr>
<td>4</td>
<td>$158.71</td>
<td>$102.35</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$168.24</td>
<td>$2,717.35</td>
<td>$1,667.47</td>
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</table>

Terminal Year $156.25 Firm Value = $2,110.41

Debt ratio remains at 10%, but after-tax cost of debt drops to 4%. Beta declines to 1.

Working capital remains 15%.

The capital expenditures are assumed to be 10% of depreciation in stable growth.

Firm Value = $2,110.41

Terminal Value $156.25

PV $1,667.47

$2,717.35

$168.24

$158.71

$157.25

$149.73

$141.25

$133.26

Year 5

Terminal Value

PV $1,667.47
Digital: Change in Control

After year 5, the beta will drop to 1, and the after-tax cost of debt will decline to 4%.
After years to 10%, the return on capital will increase the expected growth rate in the next 5 years to 10%.
The reinvestment rate remains unchanged, but the increase in the capital (pre-tax Operating margin will go up to 4%)
Digital will raise its return on capital to 11.35%, which is its cost of capital = 12.88% (0.8) + 5.25% (0.2) = 11.35%
New After-tax Cost of Debt = 5.25%
Cost of Equity = 6% + 1.25 (5.5%) = 12.88%
New Beta = 1.25 (Unlevered Beta = 1.07; Debt/Equity Ratio = 25%)
Digital will raise its debt ratio to 20%. The beta will increase, but the cost of capital will decrease.

Digital: Change in Control
Aswath Damodaran

Digital Valuation: Change in Control

Value of the Firm: Status Quo

$3,980.29

Value of the Firm: With Control Change

$6,584.62

Value of Control

$2,421 million

Terminal Year

5

$228.82

4

$228.02

3

$189.11

2

$174.91

1

$156.29

PV

Terminal Value

FCFF

Year

1

$140.36

2

$138.65

3

$136.97

4

$135.31

5

$6,584.62

Terminal Year

$3,980.29

2

$156.29
The key to the existence of synergy is that the target firm controls a specialized resource that becomes more valuable if combined with the bidding firm's resources in a different functional area. The specialized resource will vary depending upon the merger:

- In horizontal mergers: Economies of scale, which reduce costs, or from increased market power, which increases profit margins and sales. (Examples: Bank of America and Security Pacific, Chase and Chemical)

- In vertical integration: Primary source of synergy here comes from controlling the chain of production much more completely.

- In functional integration: When a firm with strengths in one functional area acquires another firm with strengths in a different functional area, the potential synergy gains arise from exploiting the strengths in these areas.

The key to valuing synergy is that the target firm controls a specialized resource.
Valuing Operating Synergy

(a) What form is the synergy expected to take? Will it reduce costs as a percentage of sales and increase profit margins (as is the case when there are economies of scale)? Will it increase future growth (as is the case when there is increased market power)? When can the gains from synergy show up instantaneously after the takeover? When can the synergy be expected to start affecting cash flows?

(b) When can the synergy be reasonably expected to start showing up?
A procedure for valuing synergy

1. The firms involved in the merger are valued independently, by discounting expected cash flows to each firm at the weighted average cost of capital for that firm.

2. The value of the combined firm, with no synergy, is obtained by adding the values obtained for each firm in the first step.

3. The effects of synergy are built into expected growth rates and cashflows, and the combined firm is re-valued with synergy.

Value of Synergy = Value of the combined firm, with synergy - Value of the combined firm, without synergy
Synergy Effects in Valuation Inputs

Economies of Scale

Longer Growth Period

Better Projects: Higher Return on Capital (ROE)

More Projects: Higher Reinvestment Rate (Retention)

Higher Operating Margin of combined firm will be greater than the revenue-weighted operating margin of individual firms.

If synergy is

Valuation Inputs that will be affected are

Economies of Scale

Longer Growth Period

Better Projects: Higher Return on Capital (ROE)

More Projects: Higher Reinvestment Rate (Retention)

Higher Operating Margin of combined firm will be greater than the revenue-weighted operating margin of individual firms.
Valuing Synergy: Compaq and Digital

In 1997, Compaq acquired Digital for $30 per share + 0.945 Compaq share for every Digital share ($33-60 per share). The acquisition was motivated by the belief that the combined firm would be able to find investment opportunities and compete better than the firms individually could.
<table>
<thead>
<tr>
<th>Company</th>
<th>Background Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compaq Digital</td>
<td>Opt Mgd</td>
</tr>
<tr>
<td><strong>Current EBIT</strong></td>
<td>$2,987 million</td>
</tr>
<tr>
<td><strong>Current Revenues</strong></td>
<td>$25,484 million</td>
</tr>
<tr>
<td><strong>Capital Expenditures - Depreciation</strong></td>
<td>$184 million</td>
</tr>
<tr>
<td><strong>Expected growth rate - next 5 years</strong></td>
<td>10%</td>
</tr>
<tr>
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<td>5%</td>
</tr>
<tr>
<td><strong>Debt /(Debt + Equity)</strong></td>
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<td>1.25</td>
</tr>
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</tr>
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<tr>
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<td>20</td>
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</tr>
<tr>
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<td>$2,987 million</td>
</tr>
<tr>
<td><strong>Digital: Ops Mgd</strong></td>
<td>2,987</td>
</tr>
<tr>
<td><strong>EBIT</strong></td>
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<td>20</td>
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<tr>
<td><strong>%</strong></td>
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<td><strong>Expected growth rate after year 5</strong></td>
<td>5</td>
</tr>
</tbody>
</table>
Valuing Compaq

<table>
<thead>
<tr>
<th>Year</th>
<th>FCFF</th>
<th>Terminal Value</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1,518.19</td>
<td>$1,354.47</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$1,670.01</td>
<td>$1,329.24</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$1,837.01</td>
<td>$1,304.49</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$2,020.71</td>
<td>$1,280.19</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$2,222.78</td>
<td>$33,278.53</td>
<td>$2,832.74</td>
</tr>
<tr>
<td></td>
<td>$2,222.78</td>
<td>$38,546.91</td>
<td></td>
</tr>
</tbody>
</table>

After year 5, capital expenditures will be 110% of depreciation.

Value of Compaq = $38,547 million
The Combined firm will have some economies of scale, allowing it to increase its current after-tax operating margin slightly. The dollar savings will be approximately $100 million.

The Combined firm will also have a slightly higher growth rate of 10.50% over the next 5 years, because of operating synergies.

Combined Firm’s Debt/Equity Ratio = 1.36%

Combined Firm’s Unlevered Beta = 1.07

Unlevered Beta = 1.07 * (4.5/43.4) + 1.17 * (38.6/43.4) = 1.16

Digital’s Unlevered Beta = 1.07; Compaq’s Unlevered Beta = 1.17

The beta of the combined firm is computed in two steps:

Cost of Capital = 12.93% (88) + 5% (1.0) = 11.98%

New Levered Beta = 1.16 (1/(1-0.36)(1.364)) = 1.26

Digital’s Firm’s Value = 4.5; Compaq’s Firm’s Value = 38.6

Levered Beta = 1.07; Combined’s Unlevered Beta = 1.17

The Combined Firm’s Valuation

Q

The Combined firm will have some economies of scale, allowing it to increase its
Combined Firm Valuation

<table>
<thead>
<tr>
<th>Year</th>
<th>FCFF</th>
<th>Terminal Value</th>
<th>PV</th>
<th>Value of Combined Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1,726.65</td>
<td>$1,541.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$1,907.95</td>
<td>$1,521.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$2,108.28</td>
<td>$1,501.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$2,329.65</td>
<td>$1,481.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$2,574.26</td>
<td>$66,907.52</td>
<td>$39,463.87</td>
<td></td>
</tr>
<tr>
<td>Terminal Year</td>
<td>$3,345.38</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Value of Combined Firm = $45,911
The Value of Synergy

Total Value of Synergy = $38,547 + 4,532
Value of Compaq + Value of Digital
Value of Combined Firm with Synergy

Value of Combined Firm with Synergy = $43,079 million

The Value of Synergy = $2,432 million
Value of Firm - Status Quo = $2,110 million

+ Value of Control = $2,521 million

Value of Firm - Change of Control = $4,531 million

+ Value of Synergy = $2,432 million

Total Value of Digital with Synergy = $6,963 million
There are 146.789 million Digital shares outstanding, and Digital had $1,006 million in debt outstanding. Estimate that maximum price you would be willing to offer on this deal.

Assume that Compaq wanted to do an exchange offer, where it would exchange its shares for Digital shares. Assuming that Compaq stock is valued at $27 per share, what would be the exchange ratio?
Evaluating Compaq’s Offer

Value of Digital with Synergy = $6,963 mil

- Value of Cash paid in deal = $ 30 * 146.789 mil shrs = $4,403 mil
- Remaining Debt (assumed by Compaq) = 1,500 mil
- Value of Digital with Synergy = $6,963 mil

Compaq’s Value per Share at time of Exchange Offer = $39.27

Appropriate Exchange Ratio = 0.39 Compaq shares for every Digital share

Actual Exchange Ratio = 0.945 Compaq shares per Digital share

146.789 mil shrs * $10.59 = Value of Digital per share

$27
<table>
<thead>
<tr>
<th></th>
<th>Citigroup</th>
<th>Travelers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Income</td>
<td>$3,591</td>
<td>$3,104</td>
</tr>
<tr>
<td>BV of Equity</td>
<td>$20,722</td>
<td>$20,736</td>
</tr>
<tr>
<td>ROE</td>
<td>17.33%</td>
<td>14.97%</td>
</tr>
<tr>
<td>Dividends</td>
<td>$1,104</td>
<td>$587</td>
</tr>
<tr>
<td>Payout Ratio</td>
<td>30.74%</td>
<td>18.91%</td>
</tr>
<tr>
<td>Retention Ratio</td>
<td>69.26%</td>
<td>81.09%</td>
</tr>
<tr>
<td>Expected Growth</td>
<td>12.00%</td>
<td>12.14%</td>
</tr>
<tr>
<td>Growth Period</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Beta</td>
<td>1.25</td>
<td>1.40</td>
</tr>
<tr>
<td>Risk Premium</td>
<td>4.00%</td>
<td>4.00%</td>
</tr>
<tr>
<td>MV of Equity (bil)</td>
<td>8,416</td>
<td>5,000</td>
</tr>
<tr>
<td>Cost of Equity</td>
<td>11.00%</td>
<td>11.60%</td>
</tr>
<tr>
<td>Beta - stable</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Growth-stable</td>
<td>6.00%</td>
<td>6.00%</td>
</tr>
<tr>
<td>Payout-stable</td>
<td>65.38%</td>
<td>69.26%</td>
</tr>
<tr>
<td>Retention Ratio</td>
<td>30.74%</td>
<td>30.74%</td>
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<tr>
<td>Beta - stable</td>
<td>1.00</td>
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<td>Growth-stable</td>
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</tr>
<tr>
<td>Payout-stable</td>
<td>65.38%</td>
<td>69.26%</td>
</tr>
<tr>
<td>DDM</td>
<td>$70,743</td>
<td>$53,464</td>
</tr>
<tr>
<td>DDM/share</td>
<td>155.84</td>
<td>46.38</td>
</tr>
</tbody>
</table>

Citigroup + Travelers = ?
Based upon these numbers, what exchange ratio would you agree to as a Citicorp stockholder? The actual exchange ratio was 2.5 shares of Travelers for every share of Citicorp. As a Citicorp stockholder, do you think that this is a reasonable exchange ratio?
The Value of Synergy

Increase in ROE as ROE

Increase by 1%

Increase by 2%

Increase by 3%

Increase in Equity Value

0

5000

10000

15000

20000

25000

30000

Change in ROE of combined firm

Increase in Equity Value as ROE
Sources of Financial Synergy

- Diversification: Acquiring another firm as a way of reducing risk cannot create value.
- Cash Slack: When a firm with significant excess cash acquires a firm, the combination can create value.
- Debt Capacity: By combining two firms, each of which has little or no capacity to borrow money and create value, it is possible to create a firm that may have the capacity to carry debt.
- Tax Benefits: The tax paid by two firms combined together may be lower than the taxes paid by them as individual firms.
I. Diversification: No Value Creation?

A takeover, motivated only by diversification considerations, has no

In the case of private firms or closely held firms, where the owners

may not be diversified personally, there might be a potential value gain

from diversification.

The value of the combined firms will always be the sum of the values

effect on the combined value of the two firms involved in the takeover.

of the independent firms.

Q

Q

The value of the combined firms will always be the sum of the values

effect on the combined value of the two firms involved in the takeover.

A takeover, motivated only by diversification considerations, has no

from diversification.
Managers may reject profitable investment opportunities if they have to raise new capital to finance them.

It may therefore make sense for a company with excess cash and no investment opportunities to take over a cash-poor firm with good investment opportunities. The additional value of combining these two firms lies in the present value of the projects that would not have been taken if they had stayed apart, but can now be taken because of the availability of cash.
Assume that Netscape has a severe capital rationing problem, resulting in approximately $500 million of investments, with a cumulative net present value of $100 million, being rejected.

IBM has far more cash than promising projects, and has accumulated $4 billion in cash that it is trying to invest. It is under pressure to return the cash to the owners.

If IBM takes over Netscape Inc., it can be argued that the value of the combined firm will increase by the synergy benefit of $100 million, which is the net present value of the projects possessed by the latter.
III. Tax Benefits

(1) If one of the firms has tax deductions that it cannot use because it is losing money, while the other firm has income on which it pays significant taxes, the combining of the two firms can lead to higher tax savings from depreciation in future years. Lossing money, while the other firm has income on which it pays significant taxes, the combining of the two firms can lead to tax savings that can be shared by the two firms. The value of this synergy is the present value of the tax savings that accrue because of this merger. The assets of the firm being taken over can be written up to reflect new market value, in some forms of mergers, leading to higher tax savings that can be shared by the two firms. The value of this synergy can be calculated as the present value of the tax savings that accrue because of this merger.

(2) The assets of the firm being taken over can be written up to reflect new market value, in some forms of mergers, leading to higher tax savings that can be shared by the two firms. The value of this synergy is the present value of the tax savings that accrue because of this merger.
Assume that you are Best Buys, the electronics retailer, and that you would like to enter the hardware component of the market. You have been approached by investment bankers for Zenith, which has net operating losses of $2 billion. If your tax rate is 36%, estimate the tax benefits from this acquisition.

If the market value of Zenith is $800 million, would you pay this tax benefit as a premium on the market value? If Best Buys had only $500 million in taxable income, how would you compute the tax benefits from this acquisition? Assume that you are Best Buys, the electronics retailer, and that you have a recognized brand name, is on its last legs financially. The firm has not been approached by investment bankers for Zenith, which while still a hardware component of the market, you have been approached with a tax benefit of $2 billion. If your tax rate is 36%, estimate the tax benefits from this acquisition.
One of the earliest leveraged buyouts was done on Congoleum Inc., a diversified firm in ship building, flooring and automotive accessories.

After the takeover, estimated to cost $400 million, the firm would be allowed to write up its assets to reflect their new market values, and claim depreciation on the new values. The estimated change in depreciation and the present value effect of this depreciation, discounted at the firm’s cost of capital of 14.5% is shown below:
<table>
<thead>
<tr>
<th>Year</th>
<th>Deprec'n</th>
<th>Deprec'n</th>
<th>Change in Tax Savings</th>
<th>PV Year 1980-89</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>$8.00</td>
<td>$35.51</td>
<td>$27.51</td>
<td>$13.20</td>
</tr>
<tr>
<td>1981</td>
<td>$8.80</td>
<td>$36.26</td>
<td>$27.46</td>
<td>$13.18</td>
</tr>
<tr>
<td>1982</td>
<td>$9.68</td>
<td>$37.07</td>
<td>$27.39</td>
<td>$13.15</td>
</tr>
<tr>
<td>1983</td>
<td>$10.65</td>
<td>$37.95</td>
<td>$27.30</td>
<td>$13.10</td>
</tr>
<tr>
<td>1984</td>
<td>$11.71</td>
<td>$21.23</td>
<td>$9.52</td>
<td>$4.57</td>
</tr>
<tr>
<td>1985</td>
<td>$12.65</td>
<td>$17.50</td>
<td>$4.85</td>
<td>$2.33</td>
</tr>
<tr>
<td>1986</td>
<td>$13.66</td>
<td>$16.00</td>
<td>$2.34</td>
<td>$1.12</td>
</tr>
<tr>
<td>1987</td>
<td>$14.75</td>
<td>$14.75</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>1988</td>
<td>$15.94</td>
<td>$15.94</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>1989</td>
<td>$17.21</td>
<td>$17.21</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
</tbody>
</table>
IV. Debt Capacity

Diversification will lead to an increase in debt capacity and an increase in the value of the firm. Has to be weighed against the immediate transfer of wealth that occurs to existing bondholders from the stockholders.
When two firms in different businesses merge, the combined firm will have less variable earnings, and may be able to borrow more (have a higher debt ratio) than the individual firms.

In the following example, we will combine two firms, with optimal debt ratios of 30% each, and end up with a firm with an optimal debt ratio of 40%.
<table>
<thead>
<tr>
<th>Debt (%)</th>
<th>Firm A - No Debt</th>
<th>Firm A - Added Debt</th>
<th>Firm B - No Debt</th>
<th>Firm B - Added Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>10.37%</td>
<td>10.45%</td>
<td>10.37%</td>
<td>10.45%</td>
</tr>
<tr>
<td>35%</td>
<td>10.77%</td>
<td>10.77%</td>
<td>10.77%</td>
<td>10.77%</td>
</tr>
<tr>
<td>45%</td>
<td>10.95%</td>
<td>10.95%</td>
<td>10.95%</td>
<td>10.95%</td>
</tr>
<tr>
<td>65%</td>
<td>12.95%</td>
<td>12.95%</td>
<td>12.95%</td>
<td>12.95%</td>
</tr>
</tbody>
</table>

**WACC**

- Year 1: 11.32%
- Year 2: 11.32%
- Year 3: 11.32%
- Year 4: 11.32%
- Year 5: 11.32%
- After year 5: 10.55%

**Effect on Costs of Capital of Added Debt**
## Effect on Value of Added Debt

<table>
<thead>
<tr>
<th></th>
<th>Firm A</th>
<th>Firm B</th>
<th>AB - No new</th>
<th>AB - Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCFF in year 1</td>
<td>$120.00</td>
<td>$220.00</td>
<td>$340.00</td>
<td>$340.00</td>
</tr>
<tr>
<td>FCFF in year 2</td>
<td>$144.00</td>
<td>$242.00</td>
<td>$386.00</td>
<td>$386.00</td>
</tr>
<tr>
<td>FCFF in year 3</td>
<td>$172.80</td>
<td>$242.82</td>
<td>$386.83</td>
<td>$386.83</td>
</tr>
<tr>
<td>FCFF in year 4</td>
<td>$207.36</td>
<td>$297.82</td>
<td>$437.83</td>
<td>$437.83</td>
</tr>
<tr>
<td>FCFF in year 5</td>
<td>$242.00</td>
<td>$322.10</td>
<td>$462.10</td>
<td>$462.10</td>
</tr>
<tr>
<td>Terminal Value</td>
<td>$5,796.97</td>
<td>$7,813.00</td>
<td>$13,609.97</td>
<td>$16,101.22</td>
</tr>
<tr>
<td>Present Value</td>
<td>$4,020.91</td>
<td>$5,760.47</td>
<td>$9,781.38</td>
<td>$11,429.35</td>
</tr>
</tbody>
</table>
Empirical Evidence on Synergy

Operating synergy was the primary motive in one-third of hostile takeovers. (Bhide)

If synergy is perceived to exist in a takeover, the value of the combined firm should be greater than the sum of the values of the bidding and target firms, operating independently.

$V(AB) > V(A) + V(B)$

Operating synergy increases 7.48% ($117 million in 1984 dollars) on average, on the announcement of the merger. Bradley, Desai and Kim (1988) use a sample of 236 inter-firm tender offers between 1963 and 1984 and report that the combined value of the target and bidder firms increases 7.48% ($117 million in 1984 dollars) on average, on the announcement of the merger.
Operational Evidence on Synergy

A stronger test of synergy is to evaluate whether merged firms improve their performance (profitability and growth), relative to their competitors, after takeovers.

McKinsey & Co.

KPMG in a more recent study of global acquisitions concludes that most mergers fail - the merged companies do worse than their peer group. They concluded that 28 of the 58 programs failed both tests, and 6 failed at least one test.

Largest number of acquisitions that are reversed within fairly short time periods.

Based on studies that have tracked acquisitions for longer time periods, the failure rate of acquisitions made between 1972 and 1986 was 20.2%. In 1988, 28 of the 58 acquisition programs were reversed, and 6 failed at least one test.

58% of the acquisitions made between 1982 and 1986 were divested by 1988. In studies that have tracked acquisitions for longer time periods (ten years or more), the divestiture rate of acquisitions rises to almost 50%.

Did the acquisitions help the parent companies outperform the competition?

Did the return on the amount invested in the acquisitions exceed the cost of capital?

Performance (profitability and growth), relative to their competitors, after takeovers.

Did the return on the amount invested in the acquisitions exceed the cost of capital?

Both questions -...
Who gets the benefits of synergy?

The sharing of the benefits of synergy among the two players will depend in large part on whether the bidding firm's contribution to the creation of the synergy is unique or easily replaced. If it can be easily replaced, the bulk of the synergy benefits will accrue to the target firm. If it is unique, the sharing of benefits will be much more equitable.

Bradley, Desai and Kim (1988) conclude that the benefits of synergy accrue primarily to the target firms when there are multiple bidders involved in the takeover. They estimate that the market-adjusted stock returns around the announcement of the takeover for successful single bidder takovers to be 2%, in single bidder takovers, and -1.33%, in contested takovers. In multiple bidder takovers, when there are multiple bidders, the benefits of synergy accrue primarily to the target firms, and the successful bidder's stock returns around the announcement of the takeover are 2%. In contested takovers, the successful bidder's stock returns are -1.33%.
Enhancement of Value

Price Enhancement versus Value

March 26, 1999

Data from January 1995 through January 1999

The study looked at stocks of companies that changed their
names. The study also looked at stocks of companies that changed their
names to include web-related

Stock price performance of

Enhancement

Price Enhancement versus Value
Cashflow to Firm:

\[
\text{EBIT}(1-t) \quad 2196 \\
- \text{Nt CpX} \quad 1549 \\
- \text{Chg WC} \quad 253 \\
= \text{FCFF} \quad 394
\]

Expected Growth in EBIT (1-t):

\[
0.8206 \times 0.0996 = 0.0817 \\
8.17\%
\]

Per Share: 7.73

Discount at Cost of Capital (WACC): 9.05\% (0.8416) + 2.26\% (0.1584) = 7.98\%

Terminal Value 5 = \(\frac{2196}{0.0686 - 0.04} = 70,898\)

\(\text{Reinvestment Rate} = 0.8206\times 0.0996 = 0.0817\) \\
\(\text{Return on Capital} = 8.20\%\) \\
\(\text{Return on Capital} = 9.96\%\)

\(\text{Firm's D/E Ratio} = 18.8\%\)

\(\text{Mature Market Premium} = 4\%\)

\(\text{Country Risk Premium} = 1.53\%\)

\(\text{Risk Premium} = 4\% + 1.53\% = 5.53\%\)

\(\text{Unlevered Beta for Sector} = 0.79\%

\(\text{Country Risk Beta} = 0.87\%\)

\(\text{Government Bond Rate} = 4.24\%\)

\(\text{Beta} \times \text{Risk Premium} = 0.87 \times 4.0\% = 3.48\%\)

\(\text{Expected Growth} = 2.66\% = 0.20\% (1 - 2.66\%) (1 - 4.0\%) = 0.20\%

\(\frac{465}{0.0686 - 0.04} = 2024\)

\(\text{Expected Growth} = 8.20\%\)

\(\text{Return on Capital} = 9.96\%\)

\(\text{WC} = 13\%\)

\(\text{Return on Capital} = 9.96\%\)
Using the DCF framework, there are four basic ways in which the value of a firm can be enhanced:

- Changing the financial mix
- Changing the financial composition
- Changing the opportunity cost of capital
- Reducing the operating risk in investments/assets

The cash flows from existing assets to the firm can be increased by either:

- Increasing after-tax earnings from operations (after capital expenditures or working capital)
- Decreasing reinvestment needs (net capital expenditures or working capital)
- Increasing the rate of reinvestment in the firm
- Improving the return on capital on those reinvestments

The expected growth rate in these cash flows can be increased by either:

- Increasing the rate of reinvestment in the firm
- Improving the return on capital on those reinvestments

The length of the high growth period can be extended to allow for more years of high growth by either:

- Reducing the operating risk in investments/assets
- Changing the financing composition
- Changing the financial mix

The cost of capital can be reduced by:

- Reducing the operating risk in investments/assets
- Changing the financial mix
- Changing the financing composition
A Basic Proposition

Proposition 1: Actions that do not affect current cash flows, future growth, the length of the high growth period or the discount rate cannot affect value.
Value Neutral Actions

Stock splits and stock dividends change the number of units of equity in a firm, but cannot affect firm value since they do not affect cash flows, growth or risk.

Accounting decisions that affect reported earnings but not cash flows should have no effect on value.

- Changing inventory valuation methods from FIFO to LIFO or vice versa in financial reports but not for tax purposes.
- Choosing the depreciation method used in financial reports (but not the tax books) from accelerated to straight line depreciation.
- Major non-cash restructuring charges that reduce reported earnings but are not tax deductible.
- Using pooling instead of purchase in acquisitions cannot change the value of a target firm.

Value Neutral Actions: such as tracking stock.

Decisions that create new securities on the existing assets of the firm (without altering the financial mix) such as tracking stock.

- Listing pooling instead of purchase in acquisitions cannot change the value of a target firm.
Value Creation 1: Increase Cash Flows from Assets in Place

Aswath Damodaran

The assets in place for a firm reflect investments that have been made historically by the firm. To the extent that these investments were poorly made and/or poorly managed, it is possible that value can be increased by increasing the after-tax cash flows generated by these assets.

EBIT (1-t) - (Capital Expenditures - Depreciation) - Change in Non-cash Working Capital = Free Cash Flow to Firm

The cash flows discounted in valuation are after taxes and reinvestment needs have been met:

The assets in place for a firm reflect investments that have been made historically by the firm. To the extent that these investments were poorly made and/or poorly managed, it is possible that value can be increased by increasing the after-tax cash flows generated by these assets.

Proposition 2: A firm that can increase its current cash flows, without significantly impacting future growth or risk, will increase its value.
Ways of Increasing Cash Flows from Assets in Place

Revenues

\[ \text{Revenues} = \text{EBIT} \times \text{Operating Margin} \]

\[ \text{FCFF} = \text{EBIT} (1-t) + \text{Depreciation} - \text{Capital Expenditures} - \text{Sales} \]

\[ \text{Sales} = \text{EBIT} \times (1-t) + \text{Depreciation} - \text{Capital Expenditures} - \text{Sales} \]

Divest assets that have negative EBIT

More efficient operations and cost cutting: Higher Margins

Reduce tax rate

- Transfer pricing
- Moving income to lower tax locales

Investment

- Live off past over-

Better Inventory management and

tighter credit policies
1.1: Poor Investments: Should you divest?

For this investment:

- **Divestiture Value**: This is the price that will be paid by the highest bidder.
- **Salvage or Liquidation Value**: This is the net cash flow that the firm will receive if it terminates the project today.
- **Continuing Value**: This is the present value of the expected cash flows from continuing the investment through the end of its life.

In reality, there are three values that we need to consider:

- In reality, when you terminate a project, you get at least your capital back when you terminate a project.
- However, because that implicitly assumes that you get at least your investment would increase value. That is not necessarily true.
- At first sight, it may seem that terminating or divesting these investments would increase value. That is not necessarily true.
- Every firm has at least a few investments in place that are poor investments, earning less than the cost of capital or even losing money.

The question is: is it worth terminating these investments?
Assume that you have been called to run Compaq and that its returns on its different businesses are as follows:

<table>
<thead>
<tr>
<th>Business</th>
<th>Capital Invested</th>
<th>ROC</th>
<th>Cost of Capital</th>
<th>Inv. Cost</th>
<th>Capital Invested</th>
<th>ROC</th>
<th>Inv. Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainframe</td>
<td>$ 3 billion</td>
<td>11%</td>
<td>10%</td>
<td>$ 1 billion</td>
<td>$ 1.5 billion</td>
<td>14%</td>
<td>9.5%</td>
</tr>
<tr>
<td>PCs</td>
<td>$ 2 billion</td>
<td>14%</td>
<td>11%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>$ 1.5 billion</td>
<td>14%</td>
<td>9.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet</td>
<td>$ 1 billion</td>
<td>22%*</td>
<td>14%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Which of these businesses should be divested?

* Expected returns; current returns are negative

**Issue:** To liquidate or not to liquidate
A Divestiture Decision Matrix

- Whether to continue, terminate or divest an investment will depend upon which of the three values - continuing, liquidation or divestiture - is the greatest.
- If the continuing value is the greatest, there can be no value created by terminating or liquidating this investment.
- If the liquidation or divestiture value is greater than the continuing value, the firm value will increase by the difference between the two values:
  - If liquidation is optimal: Liquidation Value - Continuing Value
  - If divestiture is optimal: Divestiture Value - Continuing Value
The operating income for a firm can be written as:

\[ \text{Operating Income} = \text{Revenues} \times \text{Operating Margin} \]

The operating margin for a firm is a function of how efficiently it operates to produce the products and services that it sells. If a firm can reduce its costs, while generating similar revenues, it will increase its operating income and value.

\[ \text{EBIT} = \frac{\text{Operating Income}}{\text{Operating Margin} \times \text{Revenues}} \]

Not all cost cutting is value enhancing. If firms cut expenditures which are designed to create future growth (research and training expenses, for instance), they might report higher operating income but value might drop.

Cost cutting and layoffs comprise the first leg of value enhancement for most firms. Since they occur quickly and are tangible, the effect on earnings (and value) is immediate.
Operating Margin for Compaq: A Comparison to the Industry

Operating Margin

Industry

dell

Compaq
1.3: The Tax Burden

The value of a firm is the present value of its after-tax cash flows. Thus, any action that can reduce the tax burden on a firm over time, for a given operating income, will increase value.

The tax rate of a firm can be reduced over time by doing any of the following:

1. Moving income from high-tax locales to low-tax or no-tax locales
2. Acquiring or originating net operating loss carry forwards that can be used to shield future income
3. Using risk management to smooth income over time, to reduce the average tax rate paid over time on income
4. Using risk management to reduce the marginal tax rate on income, as income increases
   - The marginal tax rate on income tends to increase as income increases.
   - By using risk management to make income more stable, firms can make their income more stable and reduce their exposure to the highest marginal tax rates.

Thus, any action that can reduce the tax burden on a firm over time, for a given operating income, will increase value.
The Tax Effect: Telecom Italia
1.4: Reduce Net Capital Expenditures

The net capital expenditures refer to the difference between capital expenditures and depreciation. The net capital expenditures is a cash outflow that reduces the free cash flow to the firm.

During short periods, the capital expenditures can even be lower than depreciation for assets in place, creating a cash inflow from net capital expenditures. If a firm can reduce its net capital expenditures on assets in place, it will increase value. Part of the net capital expenditures on assets in place is designed to generate future growth, but part of it may be to maintain assets in place.

The net capital expenditures refers to the difference between capital expenditures and depreciation. The net capital expenditures can even be lower than depreciation for assets in place, creating a cash inflow from net capital expenditures.
1.5: Reduce Working Capital Needs

Growth and risk constant, will increase its value.

Reducing the non-cash working capital needs of a firm, while keeping decreases represent cash inflows.

Increases in non-cash working capital represent cash outflows, while

\[
\text{Non-cash Working Capital} = \text{Accounts Payable} - \text{Accounts Receivable} + \text{Inventory}
\]

The non-cash working capital in a firm can be measured as follows:

The non-cash working capital in a firm can be measured as follows:
The Cash Flow Effects of Working Capital:

Telecom Italia

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Sales</td>
<td>6.75%</td>
<td>12.99%</td>
<td>11.50%</td>
<td>11.50%</td>
</tr>
<tr>
<td></td>
<td>1007</td>
<td>1097</td>
<td>1007</td>
<td>1007</td>
</tr>
</tbody>
</table>
Value Creation 2: Increase Expected Growth

The expected growth in earnings of any firm is a function of two variables:

- The amount that the firm reinvests in assets and projects (reinvestment rate)
- The quality of these investments (return on capital)

Keeping all else constant, increasing the reinvestment rate will increase the expected growth rate in earnings but will not always increase firm value.
Value Enhancement through Growth

Value = Expected Growth Rate = Return on Capital \times Reinvestment Rate

- Do acquisitions
- Increase operating margins
- Increase capital turnover ratio
- Reinvest more in projects
2.1: Increase the Reinvestment Rate

As a general rule, raising the reinvestment rate when the Return on Capital (ROC) is less than the cost of capital will increase the value of the firm. Increasing the reinvestment rate when the ROC is greater than the cost of capital will reduce the value of the firm. The net effect will determine whether value increases or decreases.

Holding all else constant, increasing the reinvestment rate will increase the expected growth in earnings of a firm, as long as the ROC is greater than the cost of capital. Increasing the reinvestment rate will, however, reduce the cash flows of the firm.
Compaq, in 1998, had a return on capital of 11.6% and a cost of capital of 11.62%. It was reinvesting 93.28% of its earnings back into the firm. Was this reinvestment creating significant value?
The Return Effect: Reinvestment Rate

Compaq: Value/Share and Reinvestment Rate
2.2: Improve Quality of Investments

If a firm can increase its return on capital on new projects, while holding the reinvestment rate constant, it will increase its firm value.

This proposition might not hold, however, if the investments are in riskier projects, because the cost of capital will then increase.

- The firm would be better off under those circumstances returning cash flows caused by reinvesting capital with a lower return on capital than the cost of capital.
- The firm would also be better off returning cash flows generated by the higher growth, which will more than offset the increase in cash flows caused by reinvesting capital with a lower return on capital than the cost of capital.
- It is only when the return on capital exceeds the cost of capital, that the increase in value generated by the higher growth will more than offset the decrease in cash flows caused by reinvesting capital with a lower return on capital than the cost of capital.

The firm’s cost of capital still acts as a floor on the return on capital, holding the reinvestment rate constant, it will increase its firm value.

If a firm can increase its return on capital on new projects, while improving the quality of its investments, it will increase its firm value.
Telecom Italia: Quality of Investments

Value of Equity

10.96% 9.96% 8.96% 7.96% 6.96% 5.96% 4.96% 3.96% 2.96% 1.96% 0.96% 0.96%

0 0.0005 0.001 0.0015 0.002 0.0025 0.003 0.0035 0.004 0.0045 0.005 0.0055 0.006

Aswath Damodaran
The return on capital on a project or firm can be written as:

\[ \text{ROC} = \frac{\text{EBIT} (1-t)}{\text{Sales}} \times \frac{\text{Sales}}{\text{Capital}} \]

When firms increase prices for their products, they improve operating margins but reduce sales (and turnover ratios). The effects of the price/quantity decision can be captured in the return on capital. It provides a simple way of allowing firms to:

- Choose between price leader and volume leader strategies.
- Decide whether to change price policy in response to competitive pressure
- Environoment where competitors react to the firm's pricing decisions.

In analyzing these strategies, we should allow for a dynamic competitive

The strategy that maximizes value should be the better strategy.

The return on capital on a project or firm can be written as:

\[ \text{ROC} = \frac{\text{EBIT} (1-t)}{\text{Sales} - \text{Sales} \times \text{Capital}} \]

Growth

2.3: Pricing Decisions, ROC and Expected
A fair-price acquisition or divestiture is value neutral. A fair-price acquisition will increase value. A divestiture is the reverse of an acquisition, with a cash inflow now. If the present value of the future cash outflows is less than the cash inflow today, the divestiture will increase value. If the present value of the future cash outflows (i.e., cash flows from divesting the assets) followed by cash outflows (i.e., cash flows foregone on the divested asset) in the future, the acquisition will create value only if the present value benefits exceed the cost of the acquisitions. Put another way, an acquisition will create value only if the present value factors, than the cost of capital, generate a higher return on capital, after allowing for synergy and control. An acquisition is just a large-scale project. All of the rules that apply to individual investments apply to acquisitions, as well. For an acquisition to create value, it has to...
Aswath Damodaran

Value Creation 3: Increase Length of High Growth Period

Every firm, at some point in the future, will become a stable growth firm. If a firm is able to sustain a growth rate greater than its “stable” growth rate, it will become a stable growth firm, growing at a rate equal to or less than the economy in which it operates. The high growth period refers to the period over which a firm is able to increase the length of its high growth period, other things remaining equal.

If a firm is able to increase the length of its high growth period, other things remaining equal, it will increase value.
For firms to maintain high growth over a period, they have to earn excess returns. In a competitive market place, these excess returns should attract competitors who will erode these excess returns over time.

Thus, for a firm to maintain high growth and excess returns over time, it has to create barriers to entry that allow it to maintain these excess returns.
Some firms are able to sustain above-normal returns and growth because they have well-recognized brand names that allow them to charge higher prices than their competitors and/or sell more than their competitors.

Firms that are able to improve their brand name value over time can increase both their growth rate and the period over which they can expect to grow at rates above the stable growth rate, thus increasing value.
The most complete protection that a firm can have from competitive pressure is to own a patent, copyright or some other kind of legal protection allowing it to be the sole producer for an extended period.

Note that patents only provide partial protection, since they cannot protect a firm against a competitive product that meets the same need. Licenses and government-sanctioned monopolies also provide protection against competition, but they may, however, come with restrictions on excess returns, unlike in the United States, for instance, where returns on excess profits are regulated.

Increases and returns, in this instance, are monopolies but are regulated when it comes to price increases.
As another potential barrier to entry, the cost associated with switching from one firm's products to another is significant. This cost, known as switching costs, can make it difficult for competitors to come in and compete away excess returns.

Firms that are able to increase the cost of switching from their products to competitors' products, while reducing the costs of switching from competitors' products to their own, will be able to increase their expected length of growth. The greater the switching costs, the more difficult it is for competitors to switch from one firm's products to another.

3.3: Switching Costs
There are a number of ways in which firms can establish a cost advantage over their competitors and have a much higher capital turnover ratio. 

These cost advantages will show up in valuation in one of two ways: 

- The firm may charge lower prices than its competitors, but have a much higher operating margin. 
- The firm may charge the same price as its competitors, but have a much higher capital turnover ratio.

In businesses where scale can be used to reduce costs, economies of scale can give bigger firms advantages over smaller firms.
Gauging Barriers to Entry

Which of the following barriers to entry are most likely to work for Telecom Italia?

- Brand Name
- Patents and Legal Protection
- Switching Costs
- Cost Advantages

What about for Compaq?

- Brand Name
- Patents and Legal Protection
- Switching Costs
- Cost Advantages

Which of the following barriers to entry are most likely to work for Telecom Italia?
The cost of capital for a firm can be written as:

\[
\text{Cost of Capital} = k_e \left( \frac{E}{D+E} \right) + k_d \left( \frac{D}{D+E} \right)
\]

Where,

- \( k_e \) = Cost of Equity for the firm
- \( k_d \) = Borrowing rate (1 - tax rate)

The cash flows generated over time are discounted back to the present at the cost of capital. Holding the cash flows constant, reducing the cost of capital will increase the value of the firm. The cash flows generated over time are discounted back to the present at the cost of capital. Given current interest rates and its own default risk, the demand to compensate for risk, while the borrowing rate reflects the current long-term cost of equity, reflects the rate of return that equity investors in the firm would demand for their equity investments in the firm.
Estimating Cost of Capital: Telecom Italia

**Equity**
- Cost of Equity = 4.24% + 0.87(5.53%) = 9.05%
- Market Value of Equity = 9.92 $/share * 5255.13 = 52,110 Mil (84.16%)

**Debt**
- Cost of Debt = 4.24% + 0.2% (default spread) = 4.44%
- Market Value of Debt = 9,809 Mil (15.84%)

Cost of Capital
\[
\text{Cost of Capital} = 0.8416 \times 9.05\% + 0.1584 \times 4.44\% = 10.36\% (15.84\%)
\]

\[
9.05\% (15.84\%) = 7.98\%
\]
Cost of Capital = 11.16% (1.00) + 7% (1 - 0.35) (0.00) + 7% (6%) = 11.16%

Debt
- Market Value of Debt = 0
- Cost of Debt = 6% + 1% (default spread) = 7%

Equity
- Market Value of Equity = 23.38*1691 = $ 39.5 Billion
- Cost of Equity = 6% + 1.29 (4%) = 11.16%

Estimating Cost of Capital: Compaq
Reducing Cost of Capital

- Match debt to default risk
- Derivatives
- Swaps
- Cost of Equity \( \frac{E}{D+E} + \text{Pre-tax Cost of Debt} \) = Cost of Capital
- Change financing mix
- Leverage
- Reduce operating cost
- Financial wage contracts
- Outsourcing
- Changing product characteristics
- More effective advertising
- Changing customers
- Make product or service less discretionary to customers
- Changing product characteristics
- Derivatives
- Swaps
- Hybrids
- Default risk, reducing assets, reducing debt to debt
- Cost of Equity
- Leverage
- Reduce operating cost
- Financial wage contracts
- Outsourcing
## Telecom Italia: Optimal Debt Ratio

<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>Beta</th>
<th>Cost of Equity</th>
<th>Bond Rating</th>
<th>Interest rate on debt</th>
<th>Tax Rate</th>
<th>Cost of Debt (after-tax)</th>
<th>WACC</th>
<th>Firm Value (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0.79</td>
<td>8.63%</td>
<td>AAA</td>
<td>4.54%</td>
<td>49.08%</td>
<td>2.31%</td>
<td>8.63%</td>
<td>$45,598</td>
</tr>
<tr>
<td>10%</td>
<td>0.84</td>
<td>8.88%</td>
<td>AAA</td>
<td>4.54%</td>
<td>49.08%</td>
<td>2.31%</td>
<td>8.22%</td>
<td>$54,659</td>
</tr>
<tr>
<td>20%</td>
<td>0.89</td>
<td>9.19%</td>
<td>A+</td>
<td>5.24%</td>
<td>49.08%</td>
<td>2.67%</td>
<td>7.89%</td>
<td>$65,095</td>
</tr>
<tr>
<td>30%</td>
<td>0.97</td>
<td>9.59%</td>
<td>A-</td>
<td>5.74%</td>
<td>49.08%</td>
<td>2.92%</td>
<td>7.59%</td>
<td>$77,927</td>
</tr>
<tr>
<td>40%</td>
<td>1.06</td>
<td>10.12%</td>
<td>B</td>
<td>6.74%</td>
<td>49.08%</td>
<td>3.43%</td>
<td>7.45%</td>
<td>$86,035</td>
</tr>
<tr>
<td>50%</td>
<td>1.20</td>
<td>10.87%</td>
<td>B-</td>
<td>9.24%</td>
<td>49.08%</td>
<td>4.71%</td>
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<tr>
<td>60%</td>
<td>1.40</td>
<td>11.98%</td>
<td>CCC</td>
<td>10.24%</td>
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<td>1.87</td>
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<td>41.76%</td>
<td>6.84%</td>
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<tr>
<td>80%</td>
<td>2.94</td>
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<td>32.40%</td>
<td>8.95%</td>
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<td>$20,942</td>
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<tr>
<td>90%</td>
<td>5.88</td>
<td>36.76%</td>
<td>C</td>
<td>13.24%</td>
<td>28.80%</td>
<td>9.43%</td>
<td>12.16%</td>
<td>$17,040</td>
</tr>
</tbody>
</table>

### Notes
- **WACC**: Weighted Average Cost of Capital
- **Firm Value (G)**: Firm Value at each debt ratio

### Debt Ratio Calculations
- **Beta**: MarketBeta
- **Cost of Equity**: Cost of equity after tax
- **Bond Rating**: Bond rating
- **Interest rate on debt**: Interest rate on debt before tax
- **Tax Rate**: Corporate tax rate
- **Cost of Debt (after-tax)**: Cost of debt after tax
- **Firm Value (G)**: Firm Value at each debt ratio

### Additional Information
- **Beta**: MarketBeta
- **Cost of Equity**: Cost of equity after tax
- **Bond Rating**: Bond rating
- **Interest rate on debt**: Interest rate on debt before tax
- **Tax Rate**: Corporate tax rate
- **Cost of Debt (after-tax)**: Cost of debt after tax
- **Firm Value (G)**: Firm Value at each debt ratio
<table>
<thead>
<tr>
<th>Debt Ratio</th>
<th>Beta</th>
<th>Cost of Equity</th>
<th>Rating</th>
<th>Cost of Debt (after-tax)</th>
<th>Tax Rate</th>
<th>Cost of Equity (after-tax)</th>
<th>Bond Rating</th>
<th>Firm Value (G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>1.29%</td>
<td>1.16%</td>
<td>AAA</td>
<td>6.30%</td>
<td>35.00%</td>
<td>4.10%</td>
<td>C</td>
<td>$38,893</td>
</tr>
<tr>
<td>10%</td>
<td>1.38%</td>
<td>1.53%</td>
<td>AA</td>
<td>6.70%</td>
<td>35.00%</td>
<td>4.36%</td>
<td>C</td>
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Compaq: Optimal Capital Structure
Financing Details

What would the cash flows on a project for Telecom Italia look like in terms of project life?

If I told you that Telecom Italia has only short to medium term Lira debt on its books, what action could you take to enhance value?

Now what kind of debt would be best to finance such a project?

Currency?

Growth?

Cash Flow Patterns?

Project Life?

Terms of

What would the kind of debt be best to finance such a project?
<table>
<thead>
<tr>
<th>The Value Enhancement Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leverage.</strong></td>
</tr>
<tr>
<td>1. Reduce cost of switching to</td>
</tr>
<tr>
<td>2. Increase the cost of</td>
</tr>
<tr>
<td>3. Increase the profit margin and turnover</td>
</tr>
<tr>
<td><strong>Continuing Value.</strong></td>
</tr>
<tr>
<td>1. Reduce net working capital</td>
</tr>
<tr>
<td>2. Reduce capital requirements</td>
</tr>
<tr>
<td>3. Reduce capital maintenance</td>
</tr>
<tr>
<td><strong>Expected Growth.</strong></td>
</tr>
<tr>
<td>1. Increase reinvestment rate or marginal return on capital or both in new businesses.</td>
</tr>
<tr>
<td>2. Reduce capital expenditures that are expected to earn less than the cost of capital on new capital.</td>
</tr>
<tr>
<td>3. Eliminate new capital.</td>
</tr>
<tr>
<td><strong>Expected Length of High Growth Period.</strong></td>
</tr>
<tr>
<td>1. Change pricing strategy to maximize the product of profit margins and turnover.</td>
</tr>
<tr>
<td>2. Reduce capital expenditures on assets in place.</td>
</tr>
<tr>
<td><strong>Liquidity Value.</strong></td>
</tr>
<tr>
<td>1. Reduce receivables or by increasing inventory and accounts receivable or by reducing receivables and accounts payable.</td>
</tr>
<tr>
<td>2. Eliminate projects with expected revenues and no expenses that generate no continuing value.</td>
</tr>
<tr>
<td><strong>Diversified Value.</strong></td>
</tr>
<tr>
<td>1. Invest assets/projects with expected growth.</td>
</tr>
<tr>
<td>2. Invest in projects with expected growth.</td>
</tr>
<tr>
<td><strong>Degeneracy Value.</strong></td>
</tr>
<tr>
<td>1. Diversified projects.</td>
</tr>
<tr>
<td>2. Diversified assets in place.</td>
</tr>
<tr>
<td>3. Diversified receivables or by increasing inventory and accounts receivable or by reducing receivables and accounts payable.</td>
</tr>
<tr>
<td><strong>Degeneracy Value.</strong></td>
</tr>
<tr>
<td>1. Diversified projects.</td>
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<tr>
<td><strong>Cost of Financing.</strong></td>
</tr>
<tr>
<td>1. Use swaps and derivatives to match debt more closely.</td>
</tr>
<tr>
<td>2. Recapitalize to move the firm's assets closer to its optimal debt ratio.</td>
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</tr>
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</tr>
</tbody>
</table>
Cashflow to Firm

EBIT(1-t) : 2196 - Nt CpX - Chg WC = FCFF 39

Expected Growth in EBIT (1-t)

0.8206 * 0.1196 = 0.0981
9.81%

Terminal Value

\[ \frac{564}{0.0646 - 0.04} = 98,649 \]

Cost of Equity

10.1%

Cost of Debt

(4.24% + 2.50%) (1 - 0.4908) = 3.43%

Weights

E = 60%  D = 40%

Reinvestment Rate

82.06%

Terminal Value

5 = 2428 / (0.0646 - 0.04) = 96.49

Discount rate

Cost of Capital (WACC) = 10.1% (0.60) + 3.43% (0.40) = 7.43%

Revenue

MC: 6.75% of Revenues

Terminal Value

\[ 620 \times \frac{5}{0.96} = 649.09 \]

Per Share:

71,671 - 9809 = 61,862

Risk-free Rate

Government Bond Rate = 4.24%

Beta 1.06

Risk Premium

4.0% + 1.53%

Unlevered Beta for

Sector: 0.79

Firm's D/E Ratio:

66.7%

Mature Market Premium

4%

Country Risk Premium

1.53%

Return on Capital

11.96%

Expected Growth

1.96% of Revenues

Cashflow to Firm (in Euros)

European risk:

4.24%
Aswath Damodaran

Current Cashflow to Firm

EBIT(1-t): 1,395 - Nt CpX: 1012 - Chg WC: 290 = FCFF: 94

Reinvestment Rate: 93.28%

Expected Growth in EBIT (1-t): .9328 * 1976 = .1843

18.43%

Stable Growth: 5%; Beta: 1.00; ROC: 19.76%; Reinvestment Rate: 25.30%

Terminal Value: 5942 / (.0904 - .05) = 147,070

Cost of Equity: 12.00%

Cost of Debt: (6% + 2%)(1-.35) = 5.20%

Weights: E = 80%; D = 20%

Discount at Cost of Capital (WACC): (.80 * 12.00%) + (.20 * 5.20%) = 10.64%

Firm Value: 54895 + Cash: 4091 - Debt: 0 = Equity 58448 - Options: 538

Value/Share: $34.56

Riskfree Rate: Government Bond Rate = 6%

Beta: 1.50

Risk Premium: 4.00%

Unlevered Beta for Sectors: 1.29

Mature risk premium: 4%

Country Risk Premium: 0.00%

Compaq: Restructured

Reinvestment Rate: 93.28% (1998)

Return on Capital: 19.76%

Market To Book: 10.76%

EBIT(1-t): 1,395 - Nt CpX: 538 - Chg WC: 290 = FCFF: 94

Expected Growth in EBIT (1-t): .9328 - .1976 = .1483

18.43%

Stable Growth: 5%; Beta: 1.50; ROC: 4.00%; Reinvestment Rate: 10.64%

Terminal Value: 5942 / (.0904 - .05) = 147,070

Cost of Equity: 12.00%

Cost of Debt: (6% + 2%)(1-.35) = 5.20%

Weights: E = 80%; D = 20%

Discount at Cost of Capital (WACC): (.80 * 12.00%) + (.20 * 5.20%) = 10.64%

Firm Value: 54895 + Cash: 4091 - Debt: 0 = Equity 58448 - Options: 538

Value/Share: $34.56
Alternative Approaches to Value Enhancement

Maximize a variable that is correlated with the value of the firm. There are several choices for such a variable. It could be

- A risk-adjusted cash flow variable, such as Economic Value Added (EVA)
- A cash flow variable, such as Cash Flow Return on Investment (CFROI)
- A marketing variable, such as market share
- An accounting variable, such as earnings or return on investment

Simplicity comes at a cost; these variables are not perfectly correlated with DCF value. The advantages of using these variables are that they are often simpler and easier to use than DCF value. The disadvantage is that the simplicity comes at a cost; these variables are not perfectly correlated with DCF value.
The Economic Value Added (EVA) is a measure of surplus value created on an investment.

EVA = (Adjusted EBIT (1-t) + Depreciation & Other Non-cash Charges) / Capital Invested

CFROI = \frac{\text{Return on Capital} - \text{Cost of Capital}}{\text{Capital Invested in Project}}

The CFROI is a measure of the cash flow return made on capital earned on an investment.

Define the cost of capital as the weighted average of the costs of the different financing instruments used to finance the investment.

Define the return on capital as the weighted average of the returns on the capital earned on an investment.

The Economic Value Added (EVA) is a measure of surplus value added (EVA) and CFROI.
EVA.

In Practice: Measuring EVA

Correctly in DCF valuation, you can use those numbers to compute EVA.

Bottom line: If you estimate return on capital and cost of capital computed based on market values, the cost of capital for EVA purposes should be the cost of capital. The cost of capital represents the return that shareholders could expect to earn on their investments.

Operating Income: Operating income has to be cleansed of any expenses which are really capital expenses or financing expenses. Such as research and development.

Capital Invested: Many firms use the book value of capital invested as their measure of capital invested. To the degree that book value reflects accounting choices made over time, this may not be true. In addition, the book capital may not reflect the value of intangible assets.
Estimating Nestle’s EVA in 1995

Return on Capital

- After-tax Operating Income
  - Return on Capital = \( \frac{5665}{29,500} = 12.77\% \)

Capital in Assets in Place 1994

- Capital in Assets in Place 1994 = BV of Equity + BV of Debt
  - Capital in Assets in Place 1994 = 17774 + (4180 + 7546) = 29,500 Million Sfr

Cost of Capital

- Cost of Equity = 4.5\% + 0.99 (5.5\%) = 10\%
- Cost of Debt = 4.75\% (1 - .3351) = 3.16\%
- Cost of Capital = 10\% \left( \frac{5665}{68376} \right) + 3.16\% \left( \frac{11726}{68376} \right) = 8.85\%

Economic Value Added in 1995

- Economic Value Added in 1995 = \( \frac{3767}{29,500} \) 12.77\% = 1154.50 Million Sfr
Assume now that the Book Value at Nestle had been understated at 14,750 Million. Assuming the Operating Income remains the same,
estimate the EVA.
For companies, divisions or projects which make significant infrastructure investments, with long gestation periods, the current EVA may not be a good indicator of the quality of investments.
Tsingtao Brewery, a Chinese beer manufacturer, has made significant capital investments in the last two years, and plans to increase its exports over time. Using 1996 numbers, Tsingtao had the following capital investments in the last two years, and plans to increase its capital investments in the future. Tsingtao Brewery, a Chinese beer manufacturer, has made significant investments in the last two years, and plans to increase its exports over time. Using 1996 numbers, Tsingtao had the following capital investments in the last two years, and plans to increase its exports over time. Using 1996 numbers, Tsingtao had the following:

- Return on Capital = 1.28%
- Cost of Capital = 15.51%
- Capital Invested = 3.015 billion CC

Using these numbers, the Economic Value Added (EVA) in 1996 for Tsingtao Brewery was calculated as follows:

\[ \text{Economic Value Added} = \text{Return on Capital} \times \text{Capital Invested} - \text{Cost of Capital} \times \text{Capital Invested} \]

\[ = 1.28\% \times 3.015 \text{ billion CC} - 15.51\% \times 3.015 \text{ billion CC} \]

\[ = -429 \text{ million CC} \]

Estimating Tsingtao's EVA in 1996

Note: The calculation is based on the provided return on capital, cost of capital, and capital invested figures for Tsingtao Brewery in 1996.
Discussion Issue: Reading the EVA

Tsingtao had a negative EVA of –429 million in 1996. Assuming that the book value of capital, operating income and cost of capital are correctly measured, which of the following are implied by this EVA?

- The firm has invested in poor projects
- The firm has inferior management
- The firm is currently earning less on its projects than it should be earning, given its cost of capital

What does this tell you about the current EVA of young, start-up firms early in the life cycle?

- The measured EVA will generally be very negative
- The measured EVA will generally be very positive

The firm has invested in poor projects correctly measured, which of the following are implied by this EVA?

- The book value of capital, operating income and cost of capital are the same in 1996 and 2016
- The firm has invested in poor projects
- The EVA has a negative EVA of –429 million in 1996. Assuming that
Aswath Damodaran

An Equity EVA

When capital is difficult to measure, and leverage is not a choice variable (because of regulations or standard practice), the economic value added can be stated in equity terms. The economic value added can be stated in equity terms, because of regulations or standard practice, the economic variable (because of regulations or standard practice), the economic value added can be stated in equity terms.

Equity EVA = (ROE - Cost of Equity) (Equity Invested)

Equity Invested: This is supposed to measure the equity invested in projects in place. It is usually measured by dividing the equity invested in projects in place. It is usually measured by dividing the book value of equity.

Return on Equity: This is supposed to measure the return made on the equity invested.

Cost of Equity: This is supposed to measure the cost of equity for the project, division, or firm, for which the EVA is being measured.
Equity EVA for J.P. Morgan = $1,574 Million - ($10,451 Million) \times 0.1217 = $303 Million

Net Income Earned in 1996 = $1,574 Million

Equity Invested at the end of 1995 = $10,451 Million

Cost of Equity for 1996 = 7\% + 0.94 \times (5.5\%) = 12.17\%
Assume now that you are the CEO of J.P. Morgan and that your compensation next year will depend upon whether you increase the Equity EVA or not. What are the three ways in which you can increase your Equity EVA?
Divisional EVA

When EVA is computed at the division level, the computation requires
• book value be estimated at the divisional level. Since firms do not
• income be estimated at the divisional level. Again, allocation of fixed
• cost of equity and capital be estimated at the divisional level

The initial estimates of EVA are likely to reflect the allocation mechanisms used and the mistakes made in those allocations. Changes in EVA over time are more useful measures than the initial EVA estimates themselves.

Changes in EVA over time are more useful measures than the initial EVA estimates themselves.

The initial estimates of EVA are likely to reflect the allocation mechanisms used and the mistakes made in those allocations.
Things to Note about EVA

- EVA is a measure of dollar surplus value, not the percentage difference in returns.
- It is closest in both theory and construct to the net present value of a project in capital budgeting, as opposed to the IRR.
- The value of a firm, in DCF terms, can be written in terms of the EVA of projects in place and the present value of the EVA of future projects.

Aswath Damodaran
Aswath Damodaran

DCF Value and NPV

Value of Firm = Value of Assets in Place + Value of Future Growth = (Investment in Existing Assets + NPV of Assets in Place) + NPV of all future projects = \( \sum_{N=1}^{\infty} \text{NPV} \)

where there are expected to be \( N \) projects yielding surplus value (or excess returns) in the future and \( I \) is the capital invested in assets in place (which might or might not be equal to the book value of these assets).
Aswath Damodaran

DCF Valuation, NPV and EVA

Firm Value = Capital Invested in Assets in Place + PV of EVA from Assets in Place + Sum of PV of EVA from new projects

\[
\text{Firm Value} = \text{Capital Invested in Assets in Place} + \text{PV of EVA from Assets in Place} + \text{Sum of PV of EVA from new projects}
\]
A Simple Illustration

Assume that you have a firm with

- A 100

In each year 1-5, assume that

- \( R_{OC} \) on projects will be equal to the cost of capital (10%)
- Investments will grow at 5% a year forever

After year 5, assume that

Assume that all of these projects will have infinite lives.

- \( WACC_{New\,Projects} = 10\% \)
- \( R_{OC} = 15\% \)
- \( WACC_{New\,Projects} = 10\% \)
- \( R_{OC} = 15\% \)
- \( I_A = 100 \)

In each year 1-5, assume that

Assume that you have a firm with
Firm Value using EVA Approach

Value of Firm = $170.85

Capital Invested in Assets in Place = $100

EVA from Assets in Place = (.15 - .10) (100)/.10 = $50

PV of EVA from New Investments in Year 1 = [(.15 - .10)(10)/.10]/1.1 = $4.55

PV of EVA from New Investments in Year 2 = [(.15 - .10)(10)/.10]/1.13 = $4.13

PV of EVA from New Investments in Year 3 = [(.15 - .10)(10)/.10]/1.14 = $3.76

PV of EVA from New Investments in Year 4 = [(.15 - .10)(10)/.10]/1.15 = $3.42

PV of EVA from New Investments in Year 5 = [(.15 - .10)(10)/.10]/1.16 = $3.11

Total PV of EVA = $170.85

Firm Value = Value of Assets in Place + PV of EVA from New Investments

Value of Assets in Place = $100

EVA from Assets in Place = (.15 - .10) (100)/.10 = $50

PV of EVA from New Investments = $170.85 - $100 = $70.85

Firm Value = $170.85

$170.85
### Firm Value using DCF Valuation: Estimating FCFF

<table>
<thead>
<tr>
<th>Year</th>
<th>Term</th>
<th>EBIT (1-t) : Assets in Place</th>
<th>EBIT (1-t) : Investments - Yr 1</th>
<th>EBIT (1-t) : Investments - Yr 2</th>
<th>EBIT (1-t) : Investments - Yr 3</th>
<th>EBIT (1-t) : Investments - Yr 4</th>
<th>EBIT (1-t) : Investments - Yr 5</th>
<th>EBIT (1-t) : Investments - Yr 6</th>
<th>Total EBIT (1-t)</th>
<th>Net Capital Expenditures</th>
<th>FCFF</th>
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<td>Year</td>
<td>FCFF</td>
<td>PV of FCFF ($10)</td>
<td>Terminal Value</td>
<td>PV of Terminal Value</td>
<td>Value of Firm</td>
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</tr>
</tbody>
</table>

**Value of Firm:** $170.85
Growth, by itself, does not create value. It is growth, with investment in excess return projects, that creates value.

• The growth of 5% a year after year 5 creates no additional value.

• In the example above, the market value of $170.85 million exceeds the book value of $100 million, because the return on capital is 5% higher than the cost of capital.

The "market value added" (MVA), which is defined to be the excess of market value over capital invested, is a function of the excess value created.

In the example above, the market value of $170.85 million exceeds the book value of $100 million, because the return on capital is 5% higher than the cost of capital.
EVA Valuation of Nestle

<table>
<thead>
<tr>
<th>Term, Year</th>
<th>Return on Capital</th>
<th>Cost of Capital</th>
<th>EBIT(1-t)</th>
<th>WACC (Capital)</th>
<th>EVA</th>
<th>PV of EVA</th>
<th>Value of Firm</th>
<th>Value of Equity</th>
<th>Value of Debt</th>
<th>Value of Assets in Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12.77%</td>
<td>8.85%</td>
<td>3,766.66F</td>
<td>2,612.06F</td>
<td>1,154.60F</td>
<td>1,145.10F</td>
<td>29,500.00F</td>
<td>29,121.24F</td>
<td>1,088.16F</td>
<td>22,911.84F</td>
</tr>
<tr>
<td>1</td>
<td>12.77%</td>
<td>8.85%</td>
<td>3,945.20F</td>
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<td>1,117.00F</td>
<td>1,107.76F</td>
<td>29,121.24F</td>
<td>29,182.45F</td>
<td>1,088.16F</td>
<td>22,033.28F</td>
</tr>
<tr>
<td>2</td>
<td>12.77%</td>
<td>8.85%</td>
<td>4,113.88F</td>
<td>3,044.38F</td>
<td>1,175.90F</td>
<td>1,165.81F</td>
<td>29,121.24F</td>
<td>29,243.66F</td>
<td>1,088.16F</td>
<td>22,155.08F</td>
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<tr>
<td>3</td>
<td>12.77%</td>
<td>8.85%</td>
<td>4,286.37F</td>
<td>3,286.61F</td>
<td>1,235.90F</td>
<td>1,226.07F</td>
<td>29,121.24F</td>
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<td>22,277.07F</td>
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<tr>
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<td>12.77%</td>
<td>8.85%</td>
<td>4,458.07F</td>
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<td>22,400.17F</td>
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<tr>
<td>5</td>
<td>12.77%</td>
<td>8.85%</td>
<td>4,621.24F</td>
<td>3,809.08F</td>
<td>1,376.90F</td>
<td>1,367.48F</td>
<td>29,121.24F</td>
<td>29,428.08F</td>
<td>1,088.16F</td>
<td>22,524.28F</td>
</tr>
</tbody>
</table>

PV of EVA (growing at 3%) = 25,121.24F
### DCF Valuation of Nestle

<table>
<thead>
<tr>
<th>Year</th>
<th>Terminal Value</th>
<th>EBIT (1-t)</th>
<th>Depreciation</th>
<th>Cap Ex</th>
<th>Change in WC</th>
<th>FCFF</th>
<th>WACC</th>
<th>PV of FCFF</th>
<th>Terminal Value 151,113.54 Fr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00 Fr</td>
<td>0.00 Fr</td>
<td>0.00 Fr</td>
<td>0.00 Fr</td>
<td>0.00 Fr</td>
<td>0.00 Fr</td>
<td>8.85%</td>
<td>0.00 Fr</td>
<td>151,113.54 Fr</td>
</tr>
<tr>
<td>1</td>
<td>1.088.16 Fr</td>
<td>4,066.46 Fr</td>
<td>2,305.00 Fr</td>
<td>4,898.02 Fr</td>
<td>755.00 Fr</td>
<td>-2,348.00 Fr</td>
<td>8.85%</td>
<td>1,407.00 Fr</td>
<td>140,706.74 Fr</td>
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<tr>
<td>2</td>
<td>4.289.25 Fr</td>
<td>4,390.06 Fr</td>
<td>2,488.02 Fr</td>
<td>5,265.38 Fr</td>
<td>2,683.71 Fr</td>
<td>-2,348.00 Fr</td>
<td>8.85%</td>
<td>1,385.02 Fr</td>
<td>138,321.74 Fr</td>
</tr>
<tr>
<td>3</td>
<td>11.726.00 Fr</td>
<td>4,739.37 Fr</td>
<td>2,685.58 Fr</td>
<td>5,523.38 Fr</td>
<td>2,283.71 Fr</td>
<td>-2,348.00 Fr</td>
<td>8.85%</td>
<td>1,363.02 Fr</td>
<td>135,978.74 Fr</td>
</tr>
<tr>
<td>4</td>
<td>54.621.24 Fr</td>
<td>5,116.40 Fr</td>
<td>2,898.83 Fr</td>
<td>2,154.45 Fr</td>
<td>442.33 Fr</td>
<td>-2,348.00 Fr</td>
<td>8.85%</td>
<td>1,341.02 Fr</td>
<td>133,635.74 Fr</td>
</tr>
<tr>
<td>5</td>
<td>131,113.54 Fr</td>
<td>5,689.08 Fr</td>
<td>3,129.00 Fr</td>
<td>2,154.45 Fr</td>
<td>442.33 Fr</td>
<td>-2,348.00 Fr</td>
<td>8.85%</td>
<td>1,318.02 Fr</td>
<td>131,282.74 Fr</td>
</tr>
</tbody>
</table>

**Value of Firm:** 42,895.24 Fr

**Value of Debt:** 11,726.00 Fr

**Value of Equity:** 31,169.24 Fr

**Value Per Share:** 1,088.16 Fr
In summary...

A policy of maximizing the present value of economic value added over time should be the equivalent of a policy of maximizing firm value.

Both EVA and Discounted Cash Flow Valuation should provide us with the same estimate for the value of a firm.

In their full forms, the information that is required for both approaches is exactly the same - expected cash flows over time and costs of capital.
Firms are often evaluated upon year-to-year changes in EVA rather than the present value of EVA over time.

The advantage of this comparison is that it is simple and does not require the making of forecasts about future earnings potential. While it is simpler than DCF valuation, using year-by-year EVA changes comes at a cost. In particular, it is entirely possible that a firm earning less valuable, which focuses on increasing EVA on a year-to-year basis may end up being less valuable.

Another advantage is that it can be broken down by any unit—person, division, etc., as long as one is willing to assign capital and allocate earnings across these same units. While it is simpler than DCF valuation, using year-by-year EVA changes can be broken down by any unit—person, division, etc., as long as one is willing to assign capital and allocate earnings across these same units.
<table>
<thead>
<tr>
<th>Year (Term, Year)</th>
<th>Return on Capital</th>
<th>WACC (Capital)</th>
<th>EBIT</th>
<th>EBIT(1-t)</th>
<th>WACC(Capital)</th>
<th>Value of Equity</th>
<th>Value of Debt</th>
<th>Value of Equity + Debt</th>
<th>Value of Assets in Place</th>
<th>Value of Firm</th>
<th>Value of Equity per Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12.77%</td>
<td>8.85%</td>
<td>3,766.66Fr</td>
<td>2,612.06Fr</td>
<td>3,766.66Fr</td>
<td>42,895.24Fr</td>
<td>11,726.00Fr</td>
<td>54,621.24Fr</td>
<td>29,500.00Fr</td>
<td>54,621.24Fr</td>
<td>4,298.85Fr</td>
</tr>
<tr>
<td>1</td>
<td>12.77%</td>
<td>8.85%</td>
<td>4,066.46Fr</td>
<td>2,819.97Fr</td>
<td>4,066.46Fr</td>
<td>42,895.24Fr</td>
<td>11,726.00Fr</td>
<td>54,621.24Fr</td>
<td>29,500.00Fr</td>
<td>54,621.24Fr</td>
<td>4,298.85Fr</td>
</tr>
<tr>
<td>2</td>
<td>12.77%</td>
<td>8.85%</td>
<td>4,390.06Fr</td>
<td>3,044.38Fr</td>
<td>4,390.06Fr</td>
<td>42,895.24Fr</td>
<td>11,726.00Fr</td>
<td>54,621.24Fr</td>
<td>29,500.00Fr</td>
<td>54,621.24Fr</td>
<td>4,298.85Fr</td>
</tr>
<tr>
<td>3</td>
<td>12.77%</td>
<td>8.85%</td>
<td>4,739.37Fr</td>
<td>3,286.61Fr</td>
<td>4,739.37Fr</td>
<td>42,895.24Fr</td>
<td>11,726.00Fr</td>
<td>54,621.24Fr</td>
<td>29,500.00Fr</td>
<td>54,621.24Fr</td>
<td>4,298.85Fr</td>
</tr>
<tr>
<td>4</td>
<td>12.77%</td>
<td>8.85%</td>
<td>5,116.40Fr</td>
<td>3,548.07Fr</td>
<td>5,116.40Fr</td>
<td>42,895.24Fr</td>
<td>11,726.00Fr</td>
<td>54,621.24Fr</td>
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<td>4,298.85Fr</td>
</tr>
<tr>
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<td>8.85%</td>
<td>5,523.38Fr</td>
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<td>4,298.85Fr</td>
</tr>
<tr>
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<td>11,726.00Fr</td>
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<td>29,500.00Fr</td>
<td>54,621.24Fr</td>
<td>4,298.85Fr</td>
</tr>
</tbody>
</table>

PV of EVA at 3% a year:

PV of EVA = 25,121.24Fr

PV of 29,787.18Fr growing at 3% a year:

PV of 590.67Fr growing at 3% a year:

Value of Assets in Place = 29,500.00Fr

Value of Firm = 54,621.24Fr

Value of Equity = 42,895.24Fr

Value of Debt = 11,726.00Fr

Value per Share = 4,298.85Fr
In the above example, Nestle is expected to increase its EVA from 1154.50 million Sfr in 1995 to 1246 million Sfr in 1996. However, do you think it is possible to deliver a higher EVA than expected while making the firm less valuable?

Assume that you are the CEO of Nestle and that you are offered a very substantial bonus. Can you think of ways in which you can deliver an EVA greater than 1246 million Sfr, you will receive a bonus. If you deliver an EVA greater than 1246 million Sfr in 1996, Nestle is expected to increase its EVA from 1154.50 million Sfr in 1995 to 1246 million Sfr in 1996.

Discussion Issues
When Increasing EVA on year-to-year basis may result in lower Firm Value

If the increase in EVA on a year-to-year basis has been accomplished at the expense of the EVA of future projects, the value of the firm will actually decrease. For example, if the return on capital on future projects increases to 13.27% (from the existing 12.77%), while the cost of capital on these projects stays at 8.85%, the EVA in Year 1 will increase. However, this increase in EVA in Year 1 is accomplished by reducing the return on capital on future projects to 12.77% (from the existing 13.27%).

If, however, the increase in EVA in Year 1 is accomplished by reducing the return on capital on future projects to 12.27%, the firm value will actually decrease. In this case, the gain from the EVA in Year 1 may be more than offset by the present value of the loss of EVA from the future periods.
Firm Value and EVA Tradeoffs over Time
When the increase in EVA is accompanied by an increase in the cost of capital, either because of higher operational risk or changes in financial leverage, the firm value may decrease even as EVA increases.

For instance, in the example above, assume that the spread stays at 3.91% on all future projects but the cost of capital increases to 9.85% for these projects (from 8.85%). The value of the firm will drop.
### Nestle's Value at a 9.95% Cost of Capital

| Term Year | Return on Capital | WACC (Capital) | EBIT (1-t) | EVA | PV of EVA | Value of Assets in Place | Value of Firm | Value of Debt | Value of Equity | Value Per Share |
|-----------|------------------|----------------|------------|------|---------|-------------------------|----------------|--------------|----------------|----------------|----------------|
| 0         | 12.77%           | 8.85%          | 3,766.66Fr | 1,154.60Fr | 2,612.06Fr | 29,500.00Fr              | 48,169.84Fr   | 11,726.00Fr  | 36,443.84Fr    | 924.50Fr       |
| 1         | 12.77%           | 9.85%          | 4,089.94Fr | 1,446.80Fr | 2,843.41Fr | 29,500.00Fr              | 48,169.84Fr   | 11,726.00Fr  | 36,443.84Fr    | 924.50Fr       |
| 2         | 12.77%           | 9.85%          | 4,438.89Fr | 1,733.86Fr | 3,093.20Fr | 29,500.00Fr              | 48,169.84Fr   | 11,726.00Fr  | 36,443.84Fr    | 924.50Fr       |
| 3         | 12.77%           | 9.85%          | 4,815.55Fr | 2,023.32Fr | 3,362.79Fr | 29,500.00Fr              | 48,169.84Fr   | 11,726.00Fr  | 36,443.84Fr    | 924.50Fr       |
| 4         | 12.77%           | 9.85%          | 5,222.11Fr | 2,313.36Fr | 3,653.78Fr | 29,500.00Fr              | 48,169.84Fr   | 11,726.00Fr  | 36,443.84Fr    | 924.50Fr       |
| 5         | 12.77%           | 9.85%          | 5,660.96Fr | 2,603.40Fr | 3,967.88Fr | 29,500.00Fr              | 48,169.84Fr   | 11,726.00Fr  | 36,443.84Fr    | 924.50Fr       |
| 6         | 12.77%           | 9.85%          | 5,830.79Fr | 2,893.44Fr | 4,389.94Fr | 29,500.00Fr              | 48,169.84Fr   | 11,726.00Fr  | 36,443.84Fr    | 924.50Fr       |

PV of EVA = 18,669.84Fr

PV of EVA growing at 3% a year = 21,101.04Fr

Value of Assets in Place = 29,500.00Fr

Value of Firm = 48,169.84Fr

Value of Debt = 11,726.00Fr

Value of Equity = 36,443.84Fr

Return on Capital at a 9.95% Cost of Capital = 12.77%
EVA: The Risk Effect

Nestlé: Value Per Share and Cost of Capital

<table>
<thead>
<tr>
<th>Value Per Share</th>
<th>Cost of Capital</th>
</tr>
</thead>
<tbody>
<tr>
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<td>7.85%</td>
</tr>
<tr>
<td>200.00Fr</td>
<td>8.85%</td>
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<td>12.85%</td>
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<tr>
<td>1,200.00Fr</td>
<td>13.85%</td>
</tr>
<tr>
<td>1,400.00Fr</td>
<td>14.85%</td>
</tr>
</tbody>
</table>
Advantages of EVA

1. EVA is closely related to NPV. It is closest in spirit to corporate finance theory that argues that the value of the firm will increase if you take positive NPV projects.

2. It avoids the problems associated with approaches that focus on percentage spreads - between ROE and Cost of Equity and ROC and Cost of Capital. These approaches may lead firms with high ROE to turn away good projects to avoid lowering their percentage spreads.

3. It makes top managers responsible for a measure that they have more control over - the return on capital and the cost of capital are affected by their decisions rather than one that they feel they cannot control as well - the market price per share.

4. It is influenced by all of the decisions that managers have to make within a firm - the investment decisions and dividend decisions affect the return on capital and the financing decision affects the WACC.
The relationship between EVA and Market Value Changes is more complicated than the one between EVA and Firm Value.

The market value of a firm reflects not only the Expected EVA of Assets in Place but also the Expected EVA from Future Projects. To the extent that the actual economic value added is smaller than the expected EVA, the market value can decrease even though the EVA is higher.
High EVA companies do not earn excess returns.
Increases in EVA do not create excess returns.
Implications of Findings

It does suggest also that "investment strategies" based upon EVA have grown with (and excess returns) than for firms with low or no anticipated EVA and market value will be weaker for firms with high anticipated growth.

It does suggest that the correlation between increasing year-to-year EVA and the "below-expectation EVA, "below-expectation EVA and no EVA at all, the firm should deliver.

This does not imply that increasing EVA is bad from a corporate finance standpoint. In fact, given a choice between delivering a surplus return and increasing EVA, the firm should deliver surplus returns. Nevertheless, the high surplus returns should be viewed more carefully than EVA gains from below-expectation EVA.
When focusing on year-to-year EVA changes, the most important conditions are:

1. Most or all of the assets of the firm are already in place, i.e., very little or none of the value of the firm is expected to come from future growth.
   - This minimizes the risk that the increase in EVA is less than what the market expects.

2. The leverage is stable and the cost of capital cannot be altered by the investment decisions made by the firm.
   - This minimizes the risk that the increase in EVA is accompanied by an increase in the cost of capital.

3. The firm is in a sector where investors anticipate little or no surplus returns, i.e., firms in this sector are expected to earn their cost of capital.
   - This minimizes the risk that the increase in EVA is less than what the market expected it to be, leading to a drop in the market price.

4. The leverage is stable and the cost of capital cannot be altered easily by the firm.
   - This minimizes the risk that the higher EVA is accompanied by an increase in the cost of capital.

5. The investment decisions made by the firm.
   - This minimizes the risk that increases in current EVA come at the expense of future EVA.

   - This minimizes the risk that increases in current EVA are expected to come from future or none of the value of the firm is expected to come from future growth.

Most or all of the assets of the firm are already in place, i.e., very little or none of the value of the firm is expected to come from future growth.
When focusing on year-to-year EVA changes can be dangerous

1. High growth firms, where the bulk of the value can be attributed to future growth.
2. Firms where neither the leverage nor the risk profile of the firm is stable, and can be changed by actions taken by the firm.
3. Firms where the current market value has imputed in it expectations of significant surplus value or excess return projects in the future.

Note that all of these problems can be avoided if we restate the objective as maximizing the present value of EVA over time. If we do so, however, some of the perceived advantages of EVA - its simplicity and observability - disappear.