Introduction to Valuation

Principles, Methods, and Quantitative Analysis

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October 2025

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A Philosophical Basis for Valuation

Based on Damodaran (2006)

The Core Principle

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Valuation is the process of converting a story into numbers. The value of any asset is the present value of its expected future cash flows.

Pricing

- You are pricing an asset.
- Based on what others in the market are paying for "similar" assets.
- Driven by market mood, momentum, and story.
- Example: Relative Valuation (Multiples).

Valuing

- You are valuing an asset.
- Based on its fundamental characteristics: cash flow, growth, and risk.
- Independent of market mood.
- Example: Discounted Cash Flow (DCF).

The Three Approaches to Valuation

1. **Discounted Cash Flow (DCF) Valuation**
   - Values an asset based on the present value of its expected future cash flows.
   - This is the core of *intrinsic valuation*.

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   - Values an asset based on how similar assets are priced in the market.
   - This is a *pricing* exercise.
3. **Contingent Claim (Option) Valuation**
   - Uses option pricing models for assets that have option-like characteristics.
   - Examples: Patents, undeveloped natural resource reserves, or a startup's option to scale.

Overview of DCF Models

The Goal: Estimate Intrinsic Value

The value of an asset is the present value of its future cash flows, discounted at a rate that reflects their riskiness.

1. Equity Valuation

- **Cash Flow:** Free Cash Flow to Equity (FCFE)
- **Discount Rate:** Cost of Equity (k_e)
- **Result:** Value of the Equity stake in the business.

$$\text{Value}_{\text{Equity}} = \sum_{t=1}^{\infty} \frac{E(FCFE_t)}{(1+k_e)^t}$$

2. Firm Valuation

- **Cash Flow:** Free Cash Flow to Firm (FCFF)
- **Discount Rate:** Weighted Average Cost of Capital (WACC)
- **Result:** Value of the entire Firm (Debt + Equity).

$$\text{Value}_{\text{Firm}} = \sum_{t=1}^{\infty} \frac{E(FCFF_t)}{(1+\text{WACC})^t}$$

Step 1: Estimating Cash Flows (FCFF)

The cash flow available to all claimholders (Debt & Equity)

The Formula (from EBIT)

$$\text{FCFF} = \text{EBIT}(1-t) - (\text{CapEx} - \text{Dep}) - (\Delta\text{Non-Cash WC})$$

- **EBIT(1-t):** Net Operating Profit After Tax (NOPAT). This is the unlevered, after-tax operating profit.

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- **(Δ Non-Cash WC):** Investment in Working Capital. Growth requires cash to be tied up in inventory and receivables.

Key Idea

FCFF is the cash flow *before* any debt payments (interest or principal). This is why we discount it at the WACC, which includes the cost of debt.

Step 1: Estimating Cash Flows (FCFE)

The cash flow available *only* to equity holders

The Formula (from Net Income)

$$\text{FCFE} = \text{NI} - (\text{CapEx} - \text{Dep}) - (\Delta \text{WC}) + (\text{New Debt} - \text{Debt Repaid})$$

- **Net Income (NI):** The starting point. This is the accounting profit *after* interest expense.

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- **+(Net Debt):** We add back any cash raised from debt (or subtract cash used to repay debt). This cash is available to equity holders.

Key Idea

FCFE is the cash flow *after* all debt payments. This is why we discount it at the Cost of Equity (k_e), as it represents the residual claim.

Step 2: Forecasting Growth (Fundamental Growth)

Growth must be financed by reinvestment

The Growth Equation

$$g = \text{Reinvestment Rate} \times \text{Return on Invested Capital}$$

For Equity (FCFE)

$$g = \text{Retention Ratio} \times \text{ROE}$$

- **Retention Ratio:** $1 - \text{Payout Ratio}$
- **ROE:** $\frac{\text{Net Income}}{\text{Book Value of Equity}}$

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$$g = \text{Reinvestment Rate} \times \text{ROIC}$$

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Key Takeaway

A firm cannot grow if it does not reinvest. A firm that reinvests at a low ROIC will destroy value.

Step 3: Estimating Terminal Value (TV)

The value of the firm at the start of its "stable growth" phase

Method 1: Perpetuity Growth (Gordon Growth)

$$TV_n = \frac{\text{Cash Flow}_{n+1}}{\text{Discount Rate} - g_n}$$

- TV_n: Terminal Value at the end of year n.
- g_n: The stable, perpetual growth rate.
- **Crucial Assumption:** g_n *must* be less than the growth rate of the economy (and less than the risk-free rate).

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Method 2: Exit Multiple

$$TV_n = \text{EBITDA}_n \times \text{Exit Multiple}$$

Step 4: Estimating the Discount Rate (WACC)

The blended cost of capital for the firm

The WACC Formula

$$\text{WACC} = \left(\frac{E}{V}\right) \times k_e + \left(\frac{D}{V}\right) \times k_d \times (1 - t)$$

- k_e: Cost of Equity $\rightarrow$ The most difficult component. We use CAPM or Factor Models.
- k_d: Cost of Debt $\rightarrow$ The Yield-to-Maturity (YTM) on the firm's long-term bonds.
- $E/V, D/V$: Market Value weights of Equity and Debt. (e.g., $V = \text{Market Cap} + \text{Market Value of Debt}$).
- $(1 - t)$: The Tax Shield $\rightarrow$ Interest payments are tax-deductible, so the effective cost of debt is lower.

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Key Questions

The WACC is where most of the valuation "battles" are fought.

- What is the right cost of equity (k_e)?
- What is the right cost of debt (k_d) for an unrated firm?

Quantitative Risk Analysis for DCF

Moving beyond single-point estimates

The Problem with Single-Point Estimates

A standard DCF gives a single value (e.g., \$120.50), but the inputs are all uncertain.

- What if revenue growth is 3% instead of 5%?
- What if WACC is 9% instead of 8%?
- **Scenario Analysis** is basic, but **Monte Carlo Simulation** is superior.

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Method: Monte Carlo Simulation

1. **Define Distributions:** Instead of single numbers, define key inputs as probability distributions.
   - *Revenue Growth:* Normal Distribution (Mean=5%, StdDev=2%)
   - *Operating Margin:* Uniform Distribution (Min=10%, Max=15%)
   - *WACC:* Normal Distribution (Mean=8%, StdDev=0.5%)
2. **Iterate:** Run the DCF analysis 10,000+ times, each time pulling a random value from each distribution.

Monte Carlo Simulation Output

Example: Probability Distribution of Firm Value

Key Insights from Simulation

- **Expected Value:** The mean of the distribution (e.g., $122.10).
- **Confidence Interval:** "We are 90% confident the true value lies between $95.50 and $148.70."
- **Risk Assessment:** "There is a 15% probability that the intrinsic value is less than the current market price of $100."

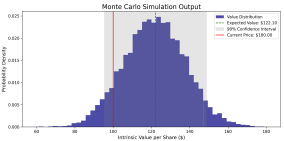

Figure: Example output of a Monte Carlo simulation on equity value per share.

The Cost of Equity (k_e): CAPM

Capital Asset Pricing Model

The CAPM Formula

The expected return on a stock (k_e) is a function of the risk-free rate plus a premium for market risk, scaled by the stock's beta.

$$k_e = R_f + \beta \times (E(R_m) - R_f)$$

- k_e**:** Cost of Equity (our discount rate for FCFE).

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Core Idea

In the CAPM world, the *only* risk that matters is market risk (β), as all other firm-specific risk can be diversified away.

CAPM Component 1: The Risk-Free Rate (R_f)

Definition

An asset with zero default risk and zero reinvestment risk.

- **The Proxy:** The yield on a long-term government bond (e.g., 10-year or 30-year U.S. Treasury).

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- **The Matching Principle:** The duration of the R_f should match the duration of the cash flows.
  - For a 5-year project, use a 5-year bond.
  - For valuing a company (with infinite life), use the longest-dated bond (e.g., 10-year or 30-year).

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- **Problem: Local Currency R_f:** What is the R_f in a country with default risk (e.g., Brazil)?
  - *Solution:* Start with U.S. T-bond rate and add the country's sovereign default spread (from its CDS price).

CAPM Component 2: The Equity Risk Premium (ERP)

Definition

The premium investors demand for holding a diversified portfolio of stocks (the "market") over the risk-free asset.

Method 1: Historical ERP

- Look at the long-term historical average (e.g., 1928-Present) of stock returns minus T-bond returns.
- **Pro:** Objective, simple.
- **Con:** Backward-looking, high standard error (survivorship bias?).

Method 2: Implied ERP

- Back-solve for the ERP that equates the current S&P 500 level with the present value of its future cash flows.
- **Pro:** Forward-looking, reflects current market risk aversion.
- **Con:** Requires complex inputs (forecasted dividends/buybacks).

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Practice

Most analysts use a supplied ERP (e.g., from Damodaran or Duff & Phelps) which is typically

CAPM Component 3: Beta (β)

The measure of non-diversifiable (market) risk

Understanding Beta

- $\beta = 1$: The stock moves perfectly with the market.
- $\beta > 1$: High-risk, cyclical (e.g., airline, luxury goods). Moves more than the market.
- $\beta < 1$: Low-risk, defensive (e.g., utility, consumer staples). Moves less than the market.
- $\beta = 0$: No correlation to the market (e.g., the risk-free asset).

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Two Ways to Estimate Beta

1. **Regression (Top-Down):** Run a regression of the stock's historical returns against the market's returns.
2. **Bottom-Up:** Estimate beta based on the company's business fundamentals and leverage. (Preferred method)

Estimating Beta (Method 1: Regression)

The statistical approach

The OLS Regression Model

Run an Ordinary Least Squares (OLS) regression on historical data (e.g., 5 years of monthly returns):

$$R_{\text{Stock},t} = \alpha + \beta \times R_{\text{Market},t} + \epsilon_t$$

Interpreting the Output

- **Slope (β):** This is the **Beta**. It measures the stock's volatility relative to the market.
- **Intercept (α):** This is **Jensen's Alpha**. A positive α means the stock outperformed its risk-adjusted expectation. A negative α means it underperformed.
- R^2 **(R-squared):** The percentage of the stock's risk that is systematic (market) risk. An R^2 of 30% means 70% of the risk is firm-specific (and thus diversifiable).
- **p-value (on Beta):** Is the Beta statistically significant? A p-value ¿ 0.05 suggests the beta estimate is unreliable.

Estimating Beta (Method 2: Bottom-Up)

The (Superior) Fundamental Approach

The Problem with Regression Beta

It's backward-looking, has high standard error, and reflects the firm's *past* business mix and leverage.

The Bottom-Up Beta Process

1. **Identify Comps:** Find publicly traded, "pure-play" companies comparable to your target firm's business.
2. **Get Regression Betas:** Find the regression beta (β_L) for each comparable firm.
3. **Un-lever Betas:** Strip out the effect of each comp's debt to find the "asset" beta (β_U).

$$\beta_U = \frac{\beta_L}{1 + (1 - t) \times (D/E)}$$

4. **Average β_U:** Take the average (or median) unlevered beta of all comparable firms. This

Cost of Debt (k_d) & Synthetic Ratings

Estimating k_d

- **If firm has bonds:** The k_d is the Yield-to-Maturity (YTM) on its long-term, straight bonds.
- **If firm has a rating:** Use the R_f + the default spread for that rating (e.g., "A" rated spread is 1.2%).

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Quantitative Method: Synthetic Ratings

What if the firm is unrated? We can estimate a rating using its financials.

1. **Calculate Interest Coverage Ratio:**

$$\text{Ratio} = \frac{\text{EBIT}}{\text{Interest Expense}}$$

2. **Compare to Rating Table:** Match the firm's ratio to a table of spreads by rating.

Beyond CAPM: The Fama-French 3-Factor Model

Why CAPM is Not Enough

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CAPM is a single-factor model (β_{market}). It only explains $\sim$60-70% of stock return variations. Fama and French (1993) observed that two other factors consistently explain returns:

- **Size:** Small-cap stocks tend to outperform large-cap stocks.
- **Value:** High Book-to-Market (Value) stocks tend to outperform low Book-to-Market (Growth) stocks.

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The 3-Factor Model (A Multiple Regression)

$$k_e = R_f + \beta_m(R_m - R_f) + \beta_s(\text{SMB}) + \beta_v(\text{HML})$$

- **SMB (Small Minus Big):** The return premium of small stocks over large stocks.
- **HML (High Minus Low):** The return premium of value stocks over growth stocks.
- β_s and β_v are the stock's new sensitivities to these factors.

The Core Concept of Multiples

Definition

Valuing an asset by comparing how "similar" assets are priced by the market. We standardize the price by dividing by a key metric.

$$\text{Multiple} = \frac{\text{Price}}{\text{Standardized Metric (e.g., Earnings, Sales)}}$$

The 3-Step Process

1. **Identify Comps:** Find a set of comparable companies (e.g., in the same industry, with similar risk/growth).
2. **Calculate Multiple:** Calculate the median or average multiple for the comparable set.
3. **Apply to Target:** Multiply this average multiple by the target firm's metric to get an implied value.

Example

Equity Multiple: Price-to-Earnings (P/E)

Formulas

$$P/E = \frac{\text{Price per Share}}{\text{Earnings per Share (EPS)}} = \frac{\text{Market Cap}}{\text{Net Income}}$$

- **Trailing (LTM) P/E:** Uses last 12 months' EPS.
- **Forward (NTM) P/E:** Uses next 12 months' *forecasted* EPS.

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What Drives P/E?

The P/E ratio is not just a "mood" indicator. It is driven by fundamentals. From the Gordon Growth model: $\frac{P_0}{E_1} = \frac{\text{Payout Ratio}}{k_e - g}$

- P/E is **higher** for firms with:
  - Higher Growth (g)
  - Higher Payout Ratios
- P/E is **lower** for firms with:
  - Higher Risk (higher k_e)

Enterprise Value Multiple: EV/EBITDA

Formulas

$$\text{EV/EBITDA} = \frac{\text{Enterprise Value}}{\text{EBITDA}}$$

$$\text{EV} = \text{Market Cap} + \text{Total Debt} - \text{Cash}$$

Why is EV/EBITDA so popular?

It is superior to P/E for comparing firms with different:

1. **Capital Structures (Leverage):**
   - EV is capital-structure-neutral (includes debt).
   - EBITDA is pre-interest (capital-structure-neutral).
2. **Tax Rates:**
   - EBITDA is pre-tax.
3. **Depreciation Policies:**
   - EBITDA is pre-D&A (a non-cash, accounting-driven expense).

Valuation: Precedent Transaction Analysis

Definition

A form of relative valuation that looks at the multiples from *past M&A deals* rather than current trading prices of "comps".

- **Process:**
  - Find M&A deals involving similar companies.
  - Calculate the multiple (e.g., EV/EBITDA) the acquirer paid.
  - Calculate the median multiple from these deals and apply to your target.

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- **Key Difference: The Control Premium**
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  - This "control premium" is baked into the transaction multiples.

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Result

Precedent Transaction Analysis almost always results in the **highest valuation range** of all methods, as it reflects what a strategic buyer might pay.

The Problem

A simple comps analysis (e.g., "the average P/E is 15x") is flawed. No two companies are perfectly comparable.

- The "comp" might have 20% growth, but your firm only has 10%.
- The "comp" might have low risk (low β), but your firm has high risk.
- We need a way to *control* for these differences.

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The Solution: Multiple Regression

We can run a regression for the entire sector to find the *fundamental drivers* of the multiple.

Pricing Method: Sector Regression Analysis

Example: Regressing P/E Ratios

The Model

For all firms in the sector (e.g., 100 software companies), run the model:

$$P/E = a_0 + b_1(\text{Exp. Growth}) + b_2(\text{Beta}) + b_3(\text{Payout Ratio})$$

Example Regression Output

$$P/E = 5.5 + 0.85(\text{Growth}) - 3.2(\text{Beta}) + 0.15(\text{Payout})$$

- This tells us *exactly* what the market is paying for:
- +0.85: For every 1% of growth, the market adds 0.85 to the P/E.
- -3.2: For every 1 point of Beta, the market subtracts 3.2 from the P/E.

Pricing Method: Sector Regression Analysis

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Application: Finding the "Correct" Multiple

Contingent Claim (Option) Valuation

When to Use It

DCF and Relative Valuation work well for "assets-in-place".
Option pricing is needed when the cash flows are **contingent** on an event.

Examples of "Real Options"

- **A Patent:** A pharmaceutical company has a patent. This is a "call option" to invest in drug production *only if* the Phase 3 trials are successful.
- **Undeveloped Land/Reserves:** An oil company has land with reserves. This is a "call option" to drill *only if* the price of oil (S) rises above the cost of extraction (K).
- **A Startup's Equity:** The equity in a cash-burning startup is a "call option" on the firm's future value.

The Black-Scholes-Merton Model

The foundational model for pricing European options

The Formula (for a Call Option, C)

$$C(S,t) = N(d_1)S - N(d_2)Ke^{-r(T-t)}$$

Where:

$$d_1 = \frac{\ln(S/K) + (r + \sigma^2/2)(T-t)}{\sigma\sqrt{T-t}}$$

$$d_2 = d_1 - \sigma\sqrt{T-t}$$

The 5 Key Inputs

1. **S:** Current Stock Price (Price of underlying asset)
2. **K:** Strike Price (Cost to exercise the option)
3. **r:** Risk-Free Rate
4. **T-t:** Time to Expiration

The "Greeks": Risk Sensitivities

How the option's price changes with inputs

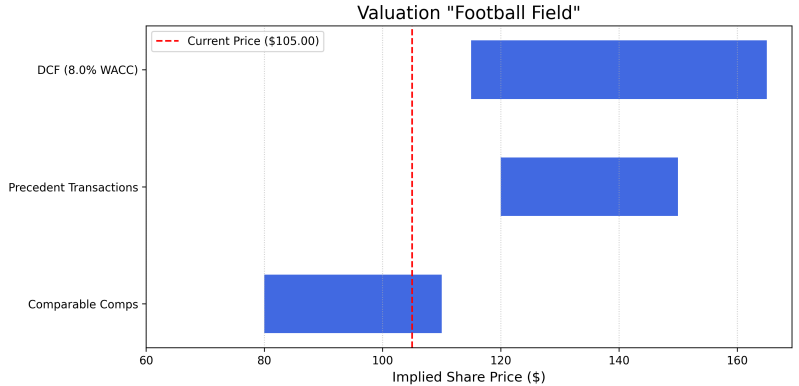
The Greeks are the partial derivatives of the option price.

- **Delta (Δ):** $\frac{\partial V}{\partial S}$
  - Sensitivity to the underlying asset's price.
  - The "hedge ratio".
- **Gamma (Γ):** $\frac{\partial^2 V}{\partial S^2}$
  - Sensitivity of Delta to the asset's price.
  - Measures "convexity".
- **Vega (ν):** $\frac{\partial V}{\partial \sigma}$
  - Sensitivity to volatility.
  - Long options have positive vega.
- **Theta (Θ):** $\frac{\partial V}{\partial t}$
  - Sensitivity to time decay.
  - Almost always negative for long options.
- **Rho (ρ):** $\frac{\partial V}{\partial r}$
  - Sensitivity to the risk-free rate.

The "Football Field": Summarizing the Valuation

The Final Output

A "football field" chart is a bar chart that shows the valuation ranges from all methods on one graph. This is the primary summary slide for an investment banking pitch.



Final Summary

DCF (Intrinsic Value)

- What a business is *worth* based on its fundamentals.
- Relies heavily on assumptions about g, k_e, and β.
- Quantitative methods like **Monte Carlo** can help us model this uncertainty.

Relative Valuation (Pricing)

- What a business is *priced at* relative to its peers.
- Can be a "sanity check" or a source of investment ideas.
- Quantitative methods like **Regression** can refine this analysis and control for fundamental differences.

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Econometric Models (CAPM, Fama-French)

These models provide the necessary (and complex) discount rates (k_e) to bridge the future to the present. Understanding α and β is the core of risk and performance measurement.

References

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