Valuation

Lorenzo Vecchietti

January 2025

Contents

Introduction

The initial crucial distinction lies in whether you are valuing a business as a whole or just its equity component. A business can possess significant inherent value, but if its debt burden is excessively high, the equity stake can become worthless.

Business Valuation focuses on the total value generated by the company's assets. While equity investors receive the residual cash flows after all other obligations are met, lenders are entitled to contractually obligated cash flows (interest and principal payments). From the business's perspective, both investors and lenders provide capital. When valuing the entire business, we consider the cash flows generated by its assets before any debt payments but after accounting for necessary reinvestments to support future growth. The appropriate discount rate for business valuation reflects the overall cost of financing the firm, considering the proportion of both debt and equity used.

Equity Valuation, on the other hand, specifically evaluates the cash flow available to equity holders. This is calculated as the cash flow generated by the business *after* deducting debt payments, research and development (R&D) expenses, and other operational costs. This residual cash flow is then discounted at a rate that reflects the risk associated with investing in the company's equity. Therefore, equity valuation aims to determine the value of the ownership stake in the business.

Maintaining consistency between these two approaches is paramount. Ideally, starting with the total cash flow generated by the firm, you **should** be able to derive the equity value by simply subtracting the value of the outstanding debt.

$$V_{equity} = V_{firm} - D$$

What constitutes the debt that needs to be subtracted?

1. All interest-bearing debt obligations should be subtracted. This includes loans, bonds, and other forms of debt on which the company pays interest.
2. Accounts payable[1], representing short-term obligations to suppliers for goods or services purchased on credit, should **not** be subtracted from the cash flow to the firm. This is because accounts payable typically do not incur interest charges and are considered part of the company's operating liabilities.

> **Valuable Business with Zero Equity Value**
>
> It's possible for a company to generate substantial revenue and still have zero value for its equity holders. This scenario arises when the company carries a significant amount of debt, consuming all of its income to cover interest and principal payments. Despite the underlying business being potentially sound and generating revenue, there are no residual cash flows left for equity investors, resulting in a zero equity value.

Cost of Capital

The previous section highlighted the distinction between valuing the entire business and valuing its equity. Fundamentally, the difference lies in the cash flows being considered. The sum of the cash flows available to both debt and equity holders is termed the *cash flow to the firm*. This represents the cash remaining after accounting for depreciation, taxes, working capital adjustments, and capital expenditures. From this cash flow, the firm must compensate both its lenders (with the Cost of Debt, C_D) and its equity investors (with the Cost of Equity, C_E). These stakeholders expect a return commensurate with the risk they undertake. The overall cost of financing the company's operations is known as the cost of capital. It can be calculated as a weighted average of the cost of equity and the after-tax cost of debt, reflecting the proportion of each in the company's capital structure.

$$WACC = \frac{E}{E+D}\, C_E + \frac{D}{E+D}\, C_D(1-T)$$

Where:

[1] Accounts Payable (AP) is a short-term liability on a company's balance sheet representing the money owed to its vendors or suppliers for goods or services purchased on credit.

- $WACC$ is the Weighted Average Cost of Capital.
- E is the market value of equity.
- D is the market value of debt.
- C_E is the cost of equity.
- C_D is the cost of debt.
- T is the corporate tax rate.

Price vs. Value

Valuation is the process of determining the intrinsic worth of an asset or business. However, in the short to medium term, market prices can deviate significantly from intrinsic values. For example, if all stocks within a particular sector are overvalued due to market sentiment, a valuation based on fundamentals might not be immediately relevant for predicting short-term price movements. In such cases, investors might resort to pricing a stock relative to its peers.

It's important to recognize that not everything can be valued using traditional intrinsic valuation methods. Some assets are more appropriately priced based on market comparisons or other factors:

	Valuation	Pricing
Assets	Yes, based on the present value of expected future cash flows and associated risk.	Yes, by comparing to the prices of similar assets in the market.
Commodity	Yes, theoretically based on long-term utilitarian demand and supply dynamics (though short-term price fluctuations can be significant).	Yes, by analyzing historical price trends and current market conditions.
Currency	No, generally not valued intrinsically.	Yes, by comparing its exchange rate against other currencies.
Collectible	No, intrinsic value is difficult to determine.	Yes, based on factors like scarcity, desirability, historical significance, and current market demand.

Table 1: Distinguishing between assets that can be valued and those that are primarily priced.

Intrinsic Valuation

Introduction

Intrinsic valuation is a method of valuing an asset based on its fundamental characteristics, such as its earnings, cash flows, and overall financial health. The core principle is that an asset's true value is determined by its ability to generate future cash flows. The greater the expected cash flow and the lower the uncertainty surrounding it, the higher the intrinsic value.

Currently, the most widely used technique for intrinsic valuation is the Discounted Cash Flow (DCF) analysis.

The fundamental equation for DCF analysis states that the intrinsic value of an asset, denoted as V, is the sum of all its expected future cash flows, discounted back to the present using a risk-adjusted discount rate.

$$V = \sum_{y=1}^{n} \frac{\mathrm{E}(CF_y)}{(1+r)^y}$$

Where:

- V is the intrinsic value of the asset.
- $\mathrm{E}(CF_y)$ is the expected cash flow in year y.
- r is the risk-adjusted discount rate, reflecting the riskiness of the cash flows.
- n is the number of years in the projection period.

Alternatively, a more conservative approach involves using a subset of cash flows that can be estimated with higher certainty and discounting them at the risk-free rate. This results in the certainty equivalent cash flow (CE). Dividends are a common example of cash flows that might be treated as certainty equivalents. In this case, the valuation equation becomes:

$$V = \sum_{y=1}^{n} \frac{\mathrm{CE}(CF_y)}{(1+r_f)^y}$$

Where:

- $\mathrm{CE}(CF_y)$ is the certainty equivalent cash flow in year y.
- r_f is the risk-free rate of return.

Time Horizon

Both DCF equations require projecting cash flows for a specific number of years, n. While the lifespan of a bond is typically well-defined, estimating the lifespan of a company's equity presents a unique challenge, as it theoretically can exist indefinitely.

Despite this indefinite potential, it is possible to conclude the DCF analysis by incorporating the concept of stable growth. A company is considered mature when its growth rate stabilizes at a level that is sustainable in the long term, typically below the overall economic growth rate[2].

Firm vs. Equity Valuation

The DCF model can be applied to value either the entire firm or just the equity portion. The key difference lies in the cash flows used and the discount rate applied.

- **Firm Valuation:** When valuing the entire firm, the relevant cash flow is the Free Cash Flow to the Firm (FCFF), which represents the cash flow available to all investors (both debt and equity holders). The appropriate discount rate in this case is the Weighted Average Cost of Capital (WACC), which reflects the overall risk of the firm's assets.

[2]It is fundamentally impossible for a single company to consistently outpace the growth of the entire economy over an infinite period.

- **Equity Valuation:** When valuing only the equity, the relevant cash flow is the Free Cash Flow to Equity (FCFE), which represents the cash flow available to equity holders after all debt obligations and reinvestments are met. The appropriate discount rate here is the Cost of Equity, which reflects the riskiness of the company's equity.

Furthermore, the growth rates used in the projections must align with the chosen valuation approach. For firm valuation, the growth in operating earnings should be estimated, while for equity valuation, the growth in net income or Earnings Per Share (EPS) is required.

It's important to note that these growth rates are typically different. They tend to increase as you move from operating income to net income due to the impact of fixed costs like interest expenses.

DCF Models

There are several variations of the DCF model, each focusing on a different definition of cash flow:

Dividend Discount Model (DDM): This model values equity based on the present value of its expected future dividends. The challenge with this approach is that dividend payouts are discretionary and determined by the company's management. A company might choose to retain cash for reinvestment or other purposes, resulting in lower or no dividends, even if it has the capacity to pay them.

Free Cash Flow to Equity (FCFE) Model: This model estimates the potential dividends a company could pay by calculating the cash flow available to equity holders after accounting for taxes, reinvestments, and debt payments. It provides a more comprehensive view of the cash flow available to shareholders than just the actual dividends paid.

Free Cash Flow to Firm (FCFF) Model: This model values the entire firm by discounting the cash flow available to all its investors (both debt and equity holders). It is often used as a starting point for equity valuation, where the value of debt is then subtracted to arrive at the equity value.

> **Example: DDM and Tech Companies**
>
> Many technology companies, such as Google (now Alphabet), historically did not pay dividends, despite having the financial capacity to do so. These companies often prioritize reinvesting their earnings for growth. Applying a DDM model to such companies might lead to an undervaluation, as it doesn't capture the potential value creation from reinvested earnings.

	DDM	**FCFE**	**FCFF**
Cash flow	Dividends	Potential dividends = FCFE	FCFF
Expected growth	In equity income and dividends	In equity income and FCFE	In operating income and FCFF
Discount rate	Cost of equity	Cost of equity	Cost of capital
Steady state	When dividends grow at a constant rate forever	When FCFE grows at a constant rate forever	When FCFF grows at a constant rate forever

Table 2: Summary of the different DCF approaches.

The Process

The general process for conducting a DCF analysis involves the following steps:

1. **Gather Data:** Collect historical and current financial data for the company being valued. This includes analyzing (1) profitability trends, (2) past growth rates, and (3) the capital expenditures required to support growth.
2. **Analyze and Cluster Data:** Examine the historical data to identify different phases of the company's development and performance. This helps in understanding past trends and forming assumptions about the future.

3. **Forecast the Future:** Project the company's future financial performance, including revenues, expenses, and investments.

If a company has historically maintained stable profit margins, forecasting its future performance primarily involves estimating its revenue growth. However, this is often not the case, as margins can fluctuate due to various factors.

A common approach to estimate future growth is based on the relationship between the percentage of revenue reinvested in growth ($i_{\%}$) and the return on capital ($r_{capital}$). The arithmetic relationship between these factors and the growth rate ($g_{\%}$) is given by:

$$g_{\%} = i_{\%} \times r_{capital}$$

The challenge lies in accurately forecasting how these key quantities ($i_{\%}$ and $r_{capital}$) will evolve over the projection period.

Cost of Equity

The discount rate to be utilized is the cost of equity or the cost of capital. Once the right one[3] is chosen, it must be estimated.

- **Cost of capital** is the rate at which you would lend the money to the company. This depends on the credit history and on the risk of the company. This allows the computation of the *default spread* with respect to the risk-free rate.
- **Cost of equity** is much more complicated to compute. It is the return that the investors expect to get for their investment.

The estimation of the right discount rate is the only element in the DCF framework that carries the risk concept. Both cost of capital and cost of equity increase if the risk is higher.

To get the risk adjusted discount rate you need:

- risk-free rate
- equity risk premium in the market
- relative risk of the company with respect to the other equity

Uncertainties

The economic uncertainty is impossible to reduce ($\leftrightarrow$ estimation uncertainty can be reduced with more research). Markets and economies change over time unpredictably.

Uncertainties related to a single firm are *micro* (product release, competition...). Macro uncertainties are those related to the whole economy.

Most common uncertainties are 'continuous' (i.e., the exchange rate). But some risks are discrete (and unpredictable): regulations, nationalizations, wars... cannot be predicted. The continuous risk is well estimated, discrete one is not.

Models assume that the risk that should be rewarded is the risk perceived by the marginal investor who is assumed to be diversified. So it is just the economic, macro, continuous risk that should be incorporated into the cost of equity. **Not all risk counts**.

This is reflected by the market structure: institutional investors are well diversified and they are the ones that have an effect on pricing.

Expected return models

Expected return models, like CAPM, calculate the return investors require, which is precisely the company's cost of equity (a component of its cost of capital).

CAPM

CAPM is the model that assumes perfect diversification. It assumes no transaction cost and no private information (the price of the market is the right one, there is no concept of 'cheap' or 'expensive' equity). In the CAPM, the model portfolio is the one with every traded asset in the market $\rightarrow$ market portfolio. The higher or lower risk of a generic portfolio is given by the β factor that multiplies the market risk premium.

$$E(R) = R_f + \beta(R_m - R_f)$$

APM

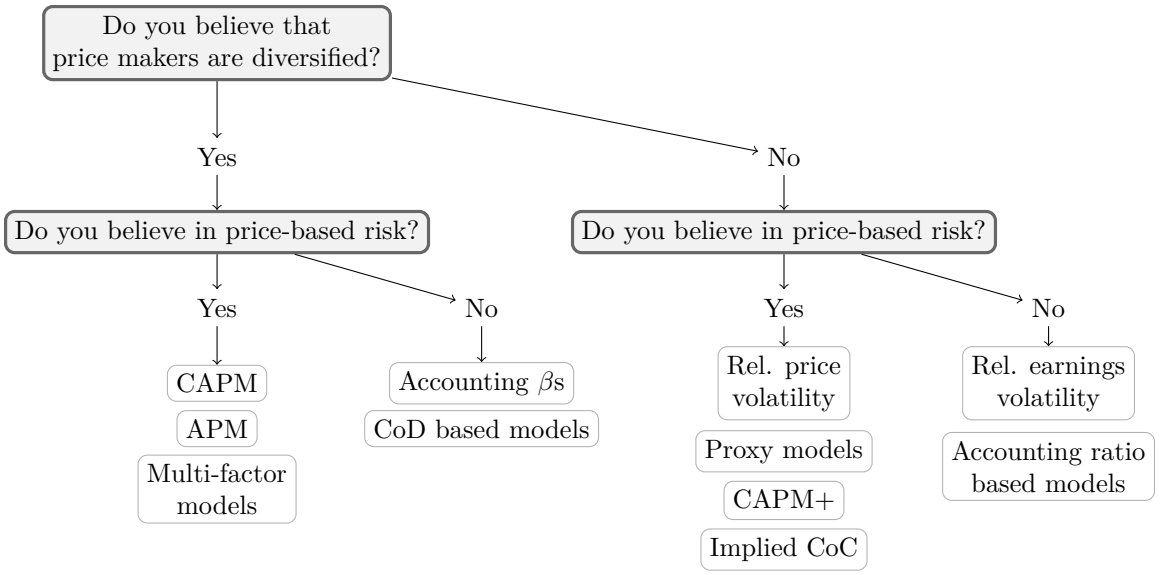
In the APM the higher return of equities with respect to the risk-free rate is justified by the presence of multiple risk factors (micro and macro). Each risk factor is associated with a risk premium $(R_i - R_f)$ and a sensitivity (β) of the portfolio to the specific risk factor.

$$E(R) = R_f + \sum_i \beta_i(R_i - R_f)$$

[3] depending on the cash flow considered.

The difficulty of the APM model is that it requires users to quantify multiple factors.

There are a lot of alternatives to the CAPM and APM models:



Inputs for Cost of Equity Estimation

Risk-Free Rate

The parameter that is present in all these models is the risk-free rate. Hence, it is of paramount importance to estimate it in the best way possible.

For US stocks, the risk-free rate estimation is relatively easy. As the United States are considered reliable enough not to default anytime in the future, their TBill is the risk-free rate for US companies (whose earnings reports are in US dollars).

But what duration of the T-Bills is the right one to choose? Since the cash flows from the equities can persist forever, the right one should be the 30-years T-Bill. This leads to some difficulties down the road → it is better to use the 10-years T-Bills.

For a European company (whose earnings reports are in euros) which is the right risk-free rate? Each country's bonds has their rate.

And what about the evaluation of a company in a country which has a non-null default rate? It is possible to subtract from the bond rate a spread dependent on the rating of the country. There is a market where it is possible to buy an 'insurance' (Credit Default Swap) against the default risk. This happens for bond denominated in EUR or USD. When the country is not issuing a foreign-currency bond, an average spread of other countries with the same sovereign-rating should be use.

> **Indian companies risk-free rate** India has a local currency sovereign rating[4] of BAA3. The default spread over the risk-free rate for such rating is equal to 2.39%. So the risk-free rate for Indian companies, considering that the yield to maturity on the 10-year bond is 7.18%, is 7.18-2.39=4.78%.

The only important element in evaluating risk-free rates is the currency we are using. The currency is like a unit of measure, we must be coherent to it.

Default spreads To evaluate the default spread there are different ways:

- Compare the bond rate in USD, if the country issues it, with T-Bills. The difference is due to the default risk. The same approach is valid with EUR issued bonds compared with German's bond.
- Check the CDS market
- Average CDS market information to get the default spread associated with a rating

It is also possible to evaluate risk-free rate for currencies, c, whose government doesn't issue bonds using the following formula involving expected inflation i:

$$r_{f_c} = (1 + r_{f_\$})\frac{1 + i_c}{1 + i_\$}$$

Equity Risk Premium

The equity risk premium measures the expected added return that the investor expects when investing in equities for their non-free risk nature. The problem is that this premium is not observable, it should be estimated with one of these methods:

- Historical ERP estimation
- Implied ERP estimation

Historical risk premium In order to evaluate the equity risk premium, it's possible to resort to historical data. This data is highly irregular, and a meaningful time frame would be long enough that the data is not representative of the stock market. The other issue is that the standard deviation is really high because of the noisiness of the equity market.

Using an historical risk premium leads also to a contradiction: bad years lower the risk premium, but the investor wants a higher risk premium after those years as he sees the risk as higher.

Finally, there might be a survival bias error: the US market is the one that flourished the most, will still be it? Also, other market have a shorter data history → inaccurate.

Historical-Country Corrected Risk Premium As said, many countries do not have a long equity market history. For those, it is possible to correct the US equity risk premium with the default spread of the country.

$$\text{ERP}_i = \text{ERP}_{\text{US}} + \text{DS}_i$$

But actually one expects equities to be riskier than a government bond. So it is possible to choose a different path. Stocks are more volatile than bonds and that can be considered the results of having different risks. So we measure the two volatility and use them to correct the default spread to get the equity risk spread.

$$\text{ERP}_i = \text{ERP}_{\text{US}} + \text{DS}_i\frac{\sigma_i}{\sigma_{\text{bond}_i}}$$

But what is the equity risk premium of other AAA countries? It must be the same of the US one, else capitals could move towards the developed market with the higher ERP.

There are also countries that do not have ratings. In this case it is possible to resort the 'Political Risk Service' score and associate the score with a premium.

In case of a company operating in multiple countries it is possible to weight the ERP (as well as the country risk premium) with the geographical revenue distribution. The only problem of this approach is that other risk are not considered (i.e., facilities in emerging market and revenues in developed market)

> **Shell** Shell is selling oil in developed countries, but a lot of production is in Oman and Nigeria. There is a risk there that is not accounted for just using revenues for the ERP calculation. In this case is better to use the percentage of oil&gas production by country.

When companies are particularly exposed to one risky country, another possible weighting is used: λ.

$$\lambda = \frac{\%_{\text{domestic rev}}}{\%_{\text{domestic rev}_{\text{avg}}}}$$

λ can be then lowered or increased by:

- the usage of risk management products that mitigate country specific risk → lower the λ

- the firm being of national interest $\rightarrow$ increase the λ

$\lambda = 1$ means that you are exposed as the average company to the market risk, $\lambda < 1$ lower risk than average, $\lambda > 1$ higher risk than average.

Implied Equity Risk Premium In this case we are trying to evaluate the ERP on the basis of the current market price: given how much the investors are paying for stocks, how much are they expecting? Obviously this is highly affected by age, gender, geographical regions...

Given:

- Price paid for the equity (p)
- Risk free rate (r_f)
- Cash flows to the investor in the previous year (c_{-1}) due to dividend and buybacks
- Growth expected by analysts g

Assuming that cash flows can keep that growth for 5 years and then will grow at the rate of the economy (at the risk-free rate), we can subdivide the equity risk premium from the risk-free rate:

$$\begin{cases} p = \underbrace{\sum_{i=1}^{5} \frac{(1+g)^i \cdot c_{-1}}{(1-r)^i}}_{5-\text{year constant growth}} + \underbrace{\frac{\left((1+g)^5 \cdot f_{-1}\right)(1+r_f)}{(1-r_f)(1+r)^5}}_{\text{constant risk-free growth forever}} \\ r = r_f + r_e \end{cases}$$

The only two unknowns are the expected return, r, and the equity risk premium, r_e. With a numerical method is possible to move the system and get the equity risk premium expected given the current prices and the current cash flows to equity holders.

The big advantage of using implied risk premium is that it takes in consideration the market phase. During a market crash, the historical risk premium barely change as the weight of the current period is extremely low.

De facto, using implied risk premium is way more effective (positively correlated) in predicting the actual premium.

Relative risk measures

β is the main measure of the relative risk (the one associated with the stock) compared to the market.

Regression β is typically computed with a regression. Stock returns are compared with market returns computing variance and covariance:

$$\beta_i = \frac{\text{Cov}(r_i, r_m)}{\text{Var}(r_m)}$$

Because of this definition, β is always backward looking and extremely noisy.

Relative Price Volatility In this case we are looking at the total standard deviation of the prices of the equity and not just the portion that is due to the market.

$$\beta = \frac{\sigma_p}{\sigma_m}$$

Proxy model For estimating β, a proxy model considers generic factors such as industry sector or company size and use those to select an appropriate β that will be shared with all the companies that shares the same factors.

> **Practical Proxy Model** For instance, a large, stable company in the consumer goods sector might have a beta close to 1, indicating its movements closely track the market. Conversely, a smaller, more volatile biotech firm might have a beta greater than 1, reflecting its higher sensitivity to market fluctuations.

It is in general good to have a proxy-model-based approach at least to have a critical evaluation of the β that you are using. Something to evaluate is:

- **Service or Product** How discretionary is this service/product? The more it is, the higher the β, like in the following cases:
  - Cyclical business
  - Luxury goods business
  - High prices goods business
  - Growth firms will
- **Operating Leverage** Companies with high fix costs will have higher betas. Scaling up will lead to lower advantages, like in the following cases:
  - Firms with high infrastructure need
  - Small and young firms

  The only problem with this approach is that it's difficult to split fixed and variable costs just looking at the balance sheet. Most of the time we'll have to assume that in the same sector the cost structure will be similar.
- **Financial Leverage** Debt level influence the β. You can move from the unlevered to the levered β, considering the tax discount effect, with:

$$\beta_L = \beta_U \left(1 + \frac{D}{E}\underbrace{(1-t)}_{tax}\right)$$

CAPM+ The proxy model approach is used often even with the classical CAPM. Instead of changing the β analysts might do things like increase the cost of equity for small companies.

Accounting Ratio Based Model It is possible to use something like debt ratios or cash holdings.

$$\Downarrow$$

Steps to compute β

- Select the businesses in which the company is operating.
- Compute the regression β for each company (and compute the average).
- Compute the unlevered β removing the effect of (average) debt.
- (Compute the average β.)
- Weight the different βs with the different operating revenues for different sectors.
- Compute levered β

$$\boxed{\text{CoE} = r_f + \beta_L r_e + \lambda r_p}$$

Cost of Debt & Cost of Capital

Cost of Debt

The cost of debt represents the rate a company pays to borrow money for the long term. While companies often utilize both short-term and long-term debt, it's crucial to focus on the long-term cost of debt for valuation purposes as it reflects the sustained borrowing rate. Although short-term debt might have a lower initial cost, its impact will eventually be reflected when it needs to be refinanced.

One common method to estimate the cost of debt is to start with the current yield on a 10-year Treasury Bond (considered a risk-free rate) and add a default spread. Rating agencies, such as Moody's and Standard & Poor's, assess the creditworthiness of bonds. For publicly traded companies, the typical bond yield associated with a specific credit rating is readily available.

Synthetic Rating

When a company's bonds are not officially rated, it's possible to estimate a synthetic rating. A significant factor in determining the default spread is the **Interest Coverage Ratio (ICR)**, calculated as $\frac{\text{EBIT}}{\text{Interest Expenses}}$. A higher ICR indicates a greater ability to cover interest payments, thus lowering the perceived risk. Additionally, the size of the company (large or small) can also influence the estimated rating. By considering both the ICR and company size, we can approximate a bond rating and, consequently, a relevant default spread.

> **Example: 2004 A+ Synthetic Rating**
>
> In 2004, a large company with an ICR between 5.5 and 6.5, or a small company with an ICR between 7.5 and 9.5, could be assigned an A+ rating. The typical default spread associated with an A+ rating at that time was 0.7%.

Country Effects

Historically, rating agencies often imposed a constraint where a company could not have a credit rating higher than the sovereign rating of the country in which it was incorporated. While this rule might have evolved, the country of incorporation still significantly influences a company's bond rating and, consequently, its cost of debt. To account for this, we can expand our cost of debt calculation:

$$\text{CoD} = r_f + \underbrace{\kappa\ s_c}_{\text{country default spread}} + \underbrace{s_f}_{\text{firm default spread}}$$

Where:

- r_f is the risk-free rate.
- s_c is the default spread of the country.
- κ is a factor reflecting the sensitivity of the company's rating to the country's rating (often 1).
- s_f is the firm-specific default spread.

Tax Effect

Interest payments on debt are typically tax-deductible, which effectively reduces the cost of debt for the company. To reflect this tax advantage, we multiply the pre-tax cost of debt by (1 - marginal tax rate). It's important to use the company's **marginal tax rate**, which is the tax rate applicable to the next dollar of earnings, rather than the effective tax rate. For example, the average marginal tax rate in the US in 2024 was around 25%.

$$\text{CoD} = \text{CoD}_{\text{pre-tax}}(1 - t)$$

Combining the country effect and the tax effect, we arrive at the final formula for the cost of debt:

$$\boxed{\text{CoD} = (r_f + \kappa\ s_c + s_f)\,(1 - t)}$$

Subsidized Debt

Some companies may have access to debt with interest rates lower than the prevailing market rates, often through government programs or mandated bank loans.

It's crucial to recognize that this subsidized debt is usually temporary and shouldn't be used to artificially lower the long-term cost of debt. Ignoring it, however, can lead to an inflated cost of capital. A reasonable approach is to:

1. **Calculate the total savings** generated by the subsidized debt over its lifetime: $D_{\text{savings}} = (r_m - r_s) \cdot D$, where r_m is the market interest rate, r_s is the subsidized rate, and D is the amount of subsidized debt.
2. **Discount these savings** back to the present value using an appropriate discount rate (often the market cost of debt): $D_{\text{sav, actual}} = \sum^{n} \frac{D_{\text{savings}}}{(1+r)^i}$.

$$D_{\text{sav, actual}} = \sum^{n} \frac{(r_m - r_s)D}{(1+r)^i}$$

It's also important to consider any additional costs or restrictions that might be associated with such subsidized debt.

Cost of Capital

The Cost of Capital (CoC), also known as the Weighted Average Cost of Capital (WACC), represents the average rate of return a company must earn on its existing assets to satisfy its creditors and shareholders. When calculating the CoC, we need to determine the appropriate weights for the Cost of Debt (CoD) and the Cost of Equity (CoE).

Since every Discounted Cash Flow (DCF) valuation inherently assumes a hypothetical acquisition of the company today, the weights used for debt and equity should reflect the company's current capital structure.

$$\boxed{\text{CoC} = w_E\text{CoE} + w_D\text{CoD}}$$

Where:

- w_E is the weight of equity in the capital structure.
- CoE is the cost of equity.
- w_D is the weight of debt in the capital structure.
- CoD is the cost of debt (after tax).

Convertible Bonds

Calculating the cost of capital becomes more complex when a company has hybrid instruments like convertible bonds. A convertible bond has characteristics of both debt (regular interest payments) and equity (the option to convert into shares). To address this, we need to separate the debt and equity components of the convertible bond.

Debt Portion To determine the value of the debt component, we calculate the present value of the future interest payments and the face value of the bond, discounting them at the market interest rate for a non-convertible bond with the same risk profile (based on the company's rating).

Given:

- Face value of the bond, F.
- Market interest rate for similar non-convertible bonds, r_{rating}.
- Years to maturity, M.
- Stated coupon rate of the convertible bond, r_b.

The value of the debt portion (D) can be calculated as:

$$D = \frac{F}{(1 + r_{\text{rating}})^M} + \sum_{i=1}^{M} \frac{r_b F}{(1 + r_{\text{rating}})^i}$$

Equity Portion The value of the equity component (E) is then derived by subtracting the value of the debt portion from the market capitalization (MC) of the convertible bond:

$$E = MC - D$$

Once we have separated the debt and equity values, we can use these values to calculate the weights for the Cost of Debt and Cost of Equity in the WACC calculation.

Example: Cost of Capital - Embraer (currency USD)

Cost of Equity

Item	Value
Risk-free rate (10-year US Treasury Bills)	4.29%
Levered Beta (β_L) (using the gross debt ratio)	1.07
Equity Risk Premium (ERP)	4.00%
Lambda (λ) (regression against Brazil bond)	0.27
Country Risk Premium (Brazil)	7.89%

$$\text{CoE} = r_f + \beta_L \cdot \text{ERP} + \lambda \cdot \text{CRP} = 4.29\% + 1.07(4.00\%) + 0.27(7.89\%) = 10.7\%$$

Cost of Debt

Item	Value
Risk-free rate	4.29%
Firm Default Spread	4.00%
Country Default Spread	1.00%

This is then adjusted for the marginal tax rate in Brazil (34%):

$$\text{CoD} = (1-t)(r_f + s_c + s_f) = (1 - 0.34)(4.29\% + 1.00\% + 4.00\%) = 0.66 \times 9.29\% = 6.13\%$$

Weights

Item	Value
Market Value of Equity (Market Cap)	3350 mln BR
Market Value of Debt (computed as a bond)	
Interest expenses from income statement	222 million BR
Weighted average maturity of debt (M)	4 years
Debt from balance sheet (Face Value, F)	1953 million BR

$$\text{D} = \frac{F}{(1+\text{CoD})^M} + \sum_{i=1}^{M} \frac{C_i}{(1+\text{CoD})^i}$$

Where C_i represents the interest payment in year i.

$$\text{D} = \frac{1953}{(1+0.0613)^4} + \sum_{i=1}^{4} \frac{222}{(1+0.0613)^i} \approx 2083\text{mlnBR}$$

Cost of Capital

Now we can calculate the WACC using the market values of equity and debt:

$$\text{CoC} = w_E\text{CoE} + w_D\text{CoD} = \frac{3350}{3350+2083}10.7\% + \frac{2083}{3350+2083}6.13\% = \frac{3350}{5433}10.7\% + \frac{2083}{5433}6.13\% \approx 8.94\%$$

It's also straightforward to convert the Cost of Capital to a different currency by considering the inflation rate differentials between the two currencies:

$$\text{CoC}_{\text{currency}} = (1 + \text{CoC}_\$) \left(\frac{1 + i_{\text{currency}}}{1 + i_\$} \right) - 1$$

Where i_{currency} and $i_\$$ are the expected inflation rates in the target currency and the base currency.

Cash Flows

The two most important cash flows to be computed are the one to the firm and the one to equity. The important quantities are:

- EBIT, operating earnings
- NI, net income, earnings after interest expenses
- t, the tax rate
- i, reinvestments for future growth
  1. $i =$ cap.ex. $-$ depreciation $+$ change in noncash working capital
  2. $i = \text{EBIT}(1 - i_{\text{rate}})$
- d, net debt cash flow $d =$ new debt $-$ repaid debt

FCF to the Firm	**FCF to Equity**
$\text{FCFF} = \text{EBIT}(1-t) - i$	$\text{FCFE} = \text{NI} - i + d$

Measuring Earnings

Accurate earnings measurement relies on timely cash flow data, typically sourced from accounting records. However, these records may require updates to reflect current financial performance.

Updated numbers To ensure data relevance, prioritize the use of trailing twelve months (TTM) figures. This approach offers a more current snapshot of a company's financial health compared to relying solely on historical data. While consistency is desirable, prioritizing up-to-date information is paramount. Even partial updates can significantly improve the accuracy of earnings analysis.

Manually compiling TTM figures is achievable using a company's 10-K (annual report) and 10-Q (quarterly report) filings, readily available through regulatory databases.

Update revenues in the third quarter

$$\text{r}_{\text{updated}} = \text{r}_{\text{10K}} - \text{r}_{\text{first 3 q. last year}} + \text{r}_{\text{first 3 q. this year}}$$

Normalize income When looking at the numbers it is essential to consider if the TTM result is an outlier or not. We can compare to the firm's history and to other comparable firms (it is a shift in the market?). In the outlier is something that won't repeat in the future, then you can average that number in time (i.e., the last 5 years).

Clean accounting data Until a few years ago (2019), operating leases were not treated as debt. But it is a contractual cash flow that should be treated as debt. In some companies this is a big deal: air companies, retail business, restaurants.... Leases are the way there companies are contracting debt. When converting a lease to debt we are also creating an asset (that the debt bought). The leases expenditures (OLE) have to be subtracted after the operating income computation that in turns must include the depreciation costs. So we have to adjust the operating income.

$$AOI = OI + OLE - d$$

The other aspect to correct is the capitalization of R&D:

- Choose amortizable life (depending on sector)
- Collect R&D expenses for as long as the amortizable life
- Sum to CapEx the unamortized R&D for the period

The CAPEX is subtracted from the earnings to obtain FCF (both to equity and to firm) so the cash flow results will be the same but the overview of what the company is doing is much better.

SAP R&D

Using data in the table below (numbers in million EUR), we can correct the operating income adding there year R&D expenditures (that we now must consider CapEx) and subtracting this year amortization of research assets.

$$\text{AOI} = \text{OI} + \text{R\&D}_{\text{exp}} - \text{R\&D}_{\text{amm}} = \text{OI} + 1020 - 903$$

The value of research asset is 2914.

Year	R&D Exp	% Unamortized	Unamortized	Y. Amortization
Current	1020.02	5/5=1	1020.02	0
-1	993.99	4/5=0.8	795.19	198.8
-2	909.39	0.6	545.63	181.88
-3	898.25	0.4	359.3	179.65
-4	969.38	0.2	193.88	193.88
-5	744.67	0.0	0.0	148.93

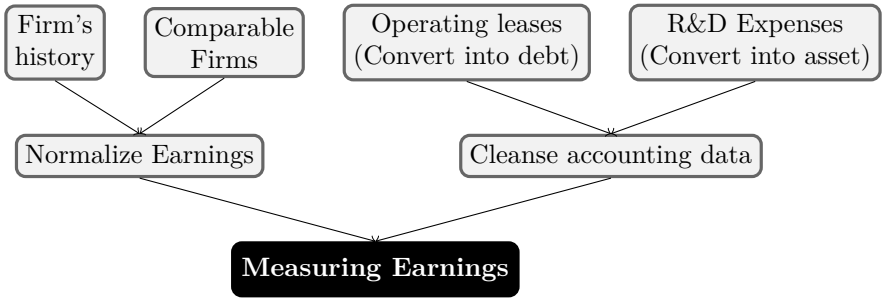


Figure 1: From report to actual earnings

Cash flows of money losing companies

Money losing company The correction that can be done is to average across the last 5 years. This can work only if:

- The company lost money only recently, averaging will yield a positive cash flow.
- The problem that caused the loss has been resolved/was unique.
- The business has not changed

Business Losses Companies with negative OI, high CapEx or high debt payment. You can discount the projected FCFE to today, but the real question is: will the company survive?

If the company is very young you can estimate the profit margin from the mature companies in the same business and use it for long term estimations.

If the company has structural issues, look at the industry average and move towards that margin over time.

Recurring vs One-Time Expenses/Losses If the company is incurring a one-time expense, you should not consider it. $\text{OI} = \text{OI}_{\text{reported}} + \text{Expense}$. If it is recurring (even if not annual), you have to consider it - annualized.

If the loss is cyclical you can average the earnings across one cycle.

Accounting malfeasance

There is obviously no easy way to be 100% sure of this, but there are a few warning signals:

- In the operating cash flow section of the cash flow statement of the company, you can get the cash earnings of the company. In the income statement you get the accrual earnings. In a healthy company one is higher than the other alternatively year by year. If the accrual earning is always higher than cash earnings, than there is something wrong (the company may sell stuff for credit to increase the accrual earnings)
- Sudden changes in standard expense items (SG&A, R&D)
- Big difference between tax income and reported income

Tax Rate

While the tax rate used for the cost of debt calculation is always the marginal rate, the one on OI is a bit more nuance.

The company's effective tax rate on the OI might be different from the country marginal tax rate. The reason for this is that the company might pay taxes in multiple countries or because of tax deferring.

On the other hand, the lower tax rate cannot be maintained forever. In initial years we start from effective tax rate, in the following years we go to the marginal one progressively.

Free Cash Flow to Equity (FCFE)

Traditionally, FCFE analysis focused solely on actual dividends paid. However, this approach can be misleading because:

- Companies may retain earnings and pay out less than their potential dividends.
- Some companies might overpay dividends, potentially funding them through new equity issuance, leading to undervaluation.

A more accurate approach is to determine the **potential dividend** a company can afford, independent of its actual dividend policy.

Potential Dividend Calculation

The potential dividend is derived from the residual cash flow available after necessary investments and debt obligations are met.

Required Data from the Cash Flow Statement (CFS)

To calculate FCFE, we utilize the following data from the CFS:

- **Net Income (NI):** Found in the operating activities section of the CFS.
- **Capital Expenditures (CapEx):** Located in the investing activities section.
- **Depreciation:** Listed in the operating activities section.
- **Changes in Non-Cash Working Capital:** Found within the operating activities section.
- **Debt Repayment/New Debt:** Located in the financing activities section.

The sign of each item in the CFS indicates whether it represents a cash inflow or outflow.

Crucially, projecting the future evolution of these variables is essential for accurate FCFE estimation. A common and useful assumption is that a company will finance its investments with a constant debt-to-equity ratio (DR). This assumption simplifies the calculation by allowing us to determine the portion of capital expenditures and changes in non-cash working capital funded by equity investors.

This assumption leads to the following FCFE equation:

$$\text{FCFE} = \text{NI} - (1 - \text{DR}) \times \text{i}$$

Disney (1997) FCFE Estimations

- Net Income = 1533 mln
- CapEx = 1746 mln

- Depreciation = 1134 mln
- Change in non-cash working capital = +477 mln
- Debt-capital ratio = 0.2383
- Dividends = 345 mln
- This allows the computation of the FCFE and a comparison with issued dividends.

$$\text{FCFE} = 1533 - (1 - 0.2383) * (1746 + 1134) + 477 * (1 - 0.2383) = 704\text{mln}$$

The difference between the dividends payed out and the FCFE is wide.

But this would mean that increasing the DR, so financing investments from debt and not from equity, will lead to higher FCFE. But this is compensated from the levered β. Net effect will depend on the company.

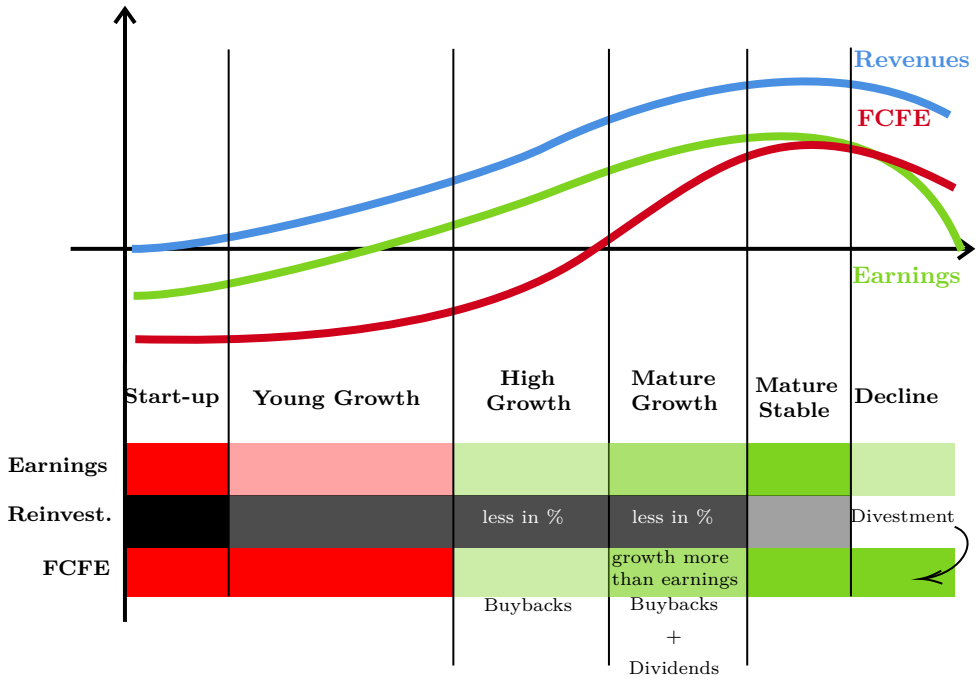


Figure 2: FCFE cycle. It is always important to understand in which phase the company is in and that the firm itself understands this.

Growth

Estimating growth requires careful consideration, as the compounding effect significantly impacts future cash flows. Additionally, different growth rates for various balance sheet items have distinct meanings.

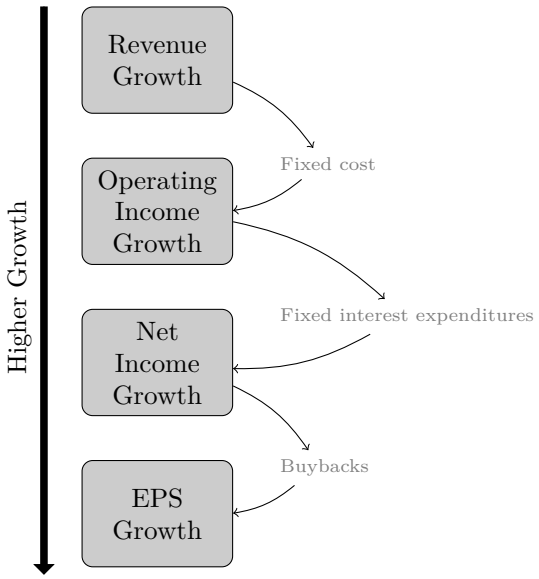


Figure 3: Difference in growth rates. Growth rates for revenues will be the lower. As fixed costs don't scale up with revenues, OI growth will be larger. Also interest expenditures are fixed, so net income growth will be even larger. Finally EPS is subject to firms buyback.

It's crucial to avoid using an incorrect growth rate, especially an analyst's EPS (Earnings Per Share) growth rate, when projecting revenue growth. Doing so will almost certainly lead to an overvaluation of the company.

Historical Growth

Two primary methods for estimating growth involve analyzing historical data and considering analysts' forecasts.

However, relying solely on historical data is often a weak predictor of future growth. Growth is inherently more forward-looking than backward-looking.

Furthermore, historical growth rates are sensitive to the specific time period chosen for analysis. The selected period should align with the company's current phase and may not be relevant if the company has undergone significant operational changes.

Growth rates can be estimated using regression models or simple averages. Importantly, growth rates should always be calculated using the **geometric average** rather than the arithmetic average to accurately account for compounding.

Arithmetic Growth Rate:

The arithmetic growth rate represents a constant rate of growth over a specific period. Given a series of values (revenues, EBITDA, EBIT, etc.) for N years, denoted as v_{i0}^{N}, the arithmetic growth rate (g_a) is calculated as:

$$g_a = \frac{\sum_{i=1}^{N} \frac{v_i - v_{i-1}}{v_{i-1}}}{N-1}$$

Geometric Growth Rate:

The geometric growth rate, also known as the Compounded Annual Growth Rate (CAGR), explicitly considers the effect of compounding. Given a starting value (s) in the first year and an ending value (e) after N years, the geometric growth rate (g_g) is:

$$g_g = \left(1 + \frac{e - s}{s}\right)^{\frac{1}{N-1}} - 1$$

The arithmetic and geometric growth rates will be equal only when the growth is perfectly steady. Greater volatility (higher standard deviation) in growth rates will lead to a larger divergence between the two, highlighting the importance of using the geometric growth rate for accuracy.

Negative Earnings

Calculating growth rates based on historical earnings becomes problematic for companies experiencing losses. A negative denominator in the growth rate calculation will invariably result in a negative growth rate, even if the company has recently become profitable or is successfully reducing its losses.

While some may attempt to address this by using the absolute value of the denominator or using the last profitable year's earnings as the base, these methods are generally unreliable. It is often best to disregard these numbers and focus on alternative methods for estimating growth in such situations.

Extrapolation Danger

When valuing a company experiencing rapid growth, it is unrealistic to project such high growth rates indefinitely into the future. Market limitations and the increasing difficulty of maintaining high growth as a company scales make this unsustainable.

Extensive research suggests that a typical stock's future growth is not strongly correlated with its past growth. While exceptions might exist for dominant companies like the "Magnificent Seven," this general principle holds.

The primary value of historical growth data lies in providing **context**. Significant deviations between estimated future growth and historical growth should prompt critical questions: What fundamental changes are driving this difference? If a company is undergoing a transformation, and the historical growth rate persists, why isn't the transformation yielding different results?

Analyst Forecasts

The primary focus for analysts is on earnings per share (EPS) growth. Historical data suggests that analyst predictions tend to be slightly closer to actual EPS compared to time series predictions, although the difference is minimal.

These modest results occur even though analysts typically concentrate their efforts on a limited number of companies and their EPS.

"All-America Analyst" teams often exhibit marginally better performance due to:

- **Superior Information:** They may have access to more comprehensive or timely data.
- **Market Influence:** Their analyses, particularly sell ratings, can significantly impact market behavior as investors react to their recommendations.

The Analysts' Problems:

1. **Tunnel Vision:** Analysts often specialize in a single industry sector, potentially limiting their broader perspective.
2. **Lemmingitis:** There's a tendency for analysts to converge on similar opinions and forecasts.
3. **Stockholm Syndrome:** Analysts may develop an affinity for the management of the companies they cover, leading them to prioritize protecting the company's interests over those of other stakeholders. This can explain why sell ratings have a stronger impact.
4. **Factophobia:** Analysts may cling to a narrative or story, even when contradictory evidence or facts emerge.

Fundamental Forecast

Fundamental forecasting relies on two key components:

- **How much are you investing?** (Reinvestment Rate)
- **How well are you investing?** (Return on Investment - ROI)

The specific metrics used to answer these questions vary depending on the earnings measure being considered, as outlined in Table 1. The expected growth rate is then calculated as the product of the reinvestment rate and the corresponding ROI.

Table 1: Reinvestment measure and return on investment for different earnings measures.

Earnings Measure	Reinvestment	ROI
EPS	Retention Ratio	ROE
Net Income from Op.	Equity reinvestment rate	Non-cash ROE
OI	Reinvestment Rate	ROC

This approach is most effective when the return on capital (ROC) and margins are relatively stable, as is typical for mature companies. However, if the ROC changes independently of reinvestment (e.g., due to efficiency improvements), the company can experience growth (*efficiency growth*) even if the product of the reinvestment rate and initial ROC is zero.

It's also crucial to recognize that generating value from growth requires earning a return on invested capital that exceeds the cost of that capital.

EPS Growth Estimation

The **Retention Ratio** indicates the proportion of earnings that are reinvested back into the company:

Efficiency Growth

The change in Return on Capital (ROC) or Return on Equity (ROE) significantly influences expected growth, even without new investments. The percentage change in ROC/ROE contributes directly to growth. This component is termed 'Efficiency Growth'.

$$g_{\text{additional,efficiency}} = \frac{RO^*_{t+1} - RO^*_t}{R^* C_t}$$

This efficiency growth rate, $g_{\text{additional,efficiency}}$, should be added to other growth estimations and calculated using the relevant return metric (ROE or ROC).

It's important to note that efficiency growth is generally sustainable only for a limited period.

> **Efficiency Growth Effect on OI Growth Rate**
>
> If the firm has a reinvestment rate of 0.5 and a ROC that increases (in the next year) from 0.08 to 0.1, the baseline growth of Operating Income (OI) will be only 5%. However, due to the ROC increase (of 25%), the actual growth rate will be 0.05 + 0.25 = 30%.

Estimating Growth in a General Case

How can we estimate growth when the return on equity or capital is changing? A three-step process can be employed:

1. **Estimate Growth Rate:**

    1. Estimate the total addressable market size. Begin with the current market size (considering geographical factors) and project its future growth.
    2. Estimate the firm's potential market share. This will depend on the company's size, the size of its competitors, and any competitive advantages it possesses.

    After determining the target market share, apply an appropriate growth rate to reach it over time. Realistically, consider a higher growth rate in the initial stages, gradually slowing down as the company becomes larger.

2. **Estimate Operating Margins:**

1. Set target operating margins. These margins are influenced by:
   - Unit economics
   - Economies of scale
   - Competition
2. Define the path to achieve these target margins. Some companies prioritize growth over immediate margin improvement, while others may need to focus on business model enhancements.

3. **Estimate Capital Needed for Growth:** The Sales to Invested Capital ratio indicates how much capital is required to generate revenue increases.

$$\text{Sales to Capital} = \frac{\text{Revenues}}{\text{BV Equity} + \text{BV Debt} - \text{Cash}} = \frac{\Delta\text{Revenues}}{\text{Reinvestment}}$$

This ratio is often determined based on historical data. However, it's a simplified metric that doesn't account for:

- The time lag between investments and revenue generation (e.g., in the pharmaceutical industry).
- Potential economies of scale in capital deployment.

AirBnB

Market Size & Share The hospitality market (the relevant market even though AirBnB operates as an internet software platform) has an addressable size of $650 billion. AirBnB's disruptive potential could expand this market to $800 trillion. Given AirBnB's dominance model (network effects benefiting both hosts and guests), it could capture a 30% market share. After payouts to homeowners, AirBnB retains 14% of the booking value as revenue.

Margins Based on competitors like Booking and Expedia, an estimated 25% operating margin is reasonable.

Year	Bookings	Revenue	Growth	Op. Margin
LTM	26.5	3.71		
1	37.68	5.28	42.2%	-10.0%
2	52.75	7.39	40.0%	-3.0%
3	71.21	9.97	35.0%	5.0%
4	96.14	13.46	35.0%	4.0%
5	124.98	17.50	30.0%	7.5%
6	156.22	21.87	25.0%	10.0%
7	187.47	26.25	20.0%	13.0%
8	215.59	30.18	15.0%	17.0%
9	230.68	32.30	7.0%	21.0%
10	235.29	32.94	2.0%	25.0%
Terminal	240.00	33.60	2.0%	25.0%

Table: Grey cells represent fixed values: market share multiplied by market volume yields booking volume, the terminal operating margin is 25%, and the first row contains known revenues.

Sales to Capital Historical data can be used to estimate the Sales to Capital value.

Year	Δ Revenue	Sales to Capital	Reinvestment
LTM		1.92	
1	1.57	2.00	3.13
2	2.11	2.00	4.22
3	2.58	2.00	5.17
4	3.49	2.00	6.98
5	4.04	2.00	8.08
6	4.37	2.00	8.75
7	4.37	2.00	8.75
8	3.94	2.00	7.87
9	2.11	2.00	4.23
10	0.65	2.00	1.29
Term.	0.66	2.00	1.32

Table Grey cells represent fixed values With this data, it becomes possible to calculate key financial metrics such as EBIT, net EBIT, Invested Capital, and ROIC.

Accounting Fixes

The accuracy of these calculations heavily relies on accounting practices. Therefore, it's crucial to address potentially misleading aspects in financial statements.

- **Normalization:** Adjusting for unusually positive or negative years to reflect a more typical performance.
- **Misclassification:** Reclassifying items like operating leases as debt and capitalizing R&D expenses (treating them as assets) to avoid understating invested capital.
- **Write-Offs:** Recognizing that writing off a failed project reduces the book value of equity, which can artificially inflate the return on invested capital and growth rate. The poor investment decision should actually lead to a decrease in ROC.
- **Acquisitions:** Analyzing the 'goodwill'[5] recorded on the balance sheet. It's important to identify the portion of goodwill that represents a genuine competitive advantage versus the amount paid in excess of the fair value of the acquired business. The latter should be scrutinized.

[5]Goodwill is an intangible asset that arises when one company acquires another for a price in excess of the net fair value of the acquiree's identifiable assets and liabilities.

Terminal Value

A company's growth cannot continue indefinitely, and projecting cash flows forever is impractical. Therefore, we use a 'Terminal Value' to represent the firm's worth beyond its explicit forecast period. This value allows us to finalize the discount formula.

$$v = \sum_{t=1}^{N} \frac{CF_t}{(1+r)^t} + \frac{TV}{(1+r)^N}$$

Three primary approaches exist for calculating Terminal Value:

1. **Liquidation:** This method assumes the company's assets are sold off. It's suitable for businesses with limited competitive advantages or those heavily reliant on a single individual.
2. **Stable Growth:** This approach assumes the company will grow at a constant rate in perpetuity.
3. **Multiple:** This method applies a valuation multiple (e.g., to EBITDA). **Caution:** This approach is generally discouraged for fundamental valuation as it relies on relative valuation rather than intrinsic value.

Stable Growth

This method posits that the company will grow at a constant, sustainable rate. A crucial condition for this assumption is that the stable growth rate must be lower than the overall economy's growth rate. This raises the question of how to estimate the economy's growth rate. A common proxy is the risk-free rate[6].

$$g_{econ} \approx r_f$$

The risk-free rate comprises expected inflation and the real interest rate, while economic growth consists of expected inflation and the real growth rate.

In the long run, the real growth rate generally cannot be lower than the real interest rate, as the increase in goods and services must be sufficient to cover the promised returns. While the real growth rate can be higher to compensate for risk-taking, this difference tends to narrow as economies mature. Given that some companies within the economy will still experience growth, assuming the extra growth comes from these companies is a prudent approach.

Determining the point at which a firm reaches stable growth involves considering several factors:

- **Size:** Particularly in relation to its operating market.
- **Current Growth Rate (Revenue):** High current growth is unlikely to be sustained indefinitely.
- **Differential Advantages & Barriers to Entry:** Stronger advantages and barriers suggest a longer period of higher growth.

A company in a stable growth phase typically exhibits characteristics of a mature business:

1. $\beta \approx 1$ (Beta close to the market average)
2. Lower cost of debt (Investment-grade credit rating, e.g., BBB or higher)
3. Higher Debt Ratio (DR)

Finally, the growth rate's significance diminishes as the excess return (Return on Capital - Cost of Capital, or ROC - CoC) decreases. For most companies without long-term competitive advantages, the ROC will gradually converge towards the CoC. Under this scenario, the Terminal Value becomes less dependent on the growth rate, g.

$$\mathrm{TV} = (\mathrm{EBIT}_{\mathrm{n+1}}(1-\mathrm{t}))\frac{1-\frac{\mathrm{g}}{\mathrm{ROC}}}{\mathrm{CoC}-\mathrm{g}}$$

with:

- r_f = inflation + **real** interest rate
- g = inflation + **real** growth rate

[6]Accounts Payable (AP) is a short-term liability on a company's balance sheet representing the money owed to its vendors or suppliers for goods or services purchased on credit.

In the long term, the real growth rate cannot be lower than the real interest rate, since the growth in goods/services has to be enough to cover the promised rate. In the long term, the real growth rate can be higher than the real interest rate, to compensate risk taking. However, as economies mature, the difference should get smaller and since there will be growth companies in the economy, it is prudent to assume that the extra growth comes from these companies.