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DEVELOPING A PROGRAM TO COMPUTE DYNAMIC IMPLIED EQUITY RISK PREMIUMS AND TO VALUE A TARGET COMPANY

A Graduate Project Report submitted to Manipal Academy of Higher Education in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

Mechanical Engineering

by

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SEPTEMBER 2023

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CERTIFICATE

This is to certify that the project titled **DEVELOPING A PROGRAM TO COMPUTE DYNAMIC IMPLIED EQUITY RISK PREMIUMS AND TO VALUE A TARGET COMPANY** is a record of the bonafide work done by **Shivam Subramanian (190909050**) submitted in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY** in **Mechanical Engineering** of Manipal Institute of Technology, Manipal, Karnataka (A constituent college of MAHE, Manipal) during the year 2022 - 2023.

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CERTIFICATE OF COMPLETION

This is to certify that Shivam S., a student from Manipal Institute of Technology, has completed his project on valuation of a company.

He has demonstrated excellent knowledge and skills during this project.

I wish him the best of luck for his future endeavours.

Nandan Prabhu

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Dear sir,
Good evening. I hope you are doing well.

Please find attached, the report detailing the work that had been completed during the course of the internship as specified by the appointment letter produced by TAPMI back in March 2023. I hope the report is of high standards that is maintained by this reputed institution. I would also like to make an urgent request of you to provide a provisionary notice for the acknowledgment of the work done by Shivam S by tomorrow. This is to ensure that my 4^{th} year project processes are in place and that my degree is completed on time. I am truly sorry for the short notice, and I'll make such an oversight doesn't occur in future.

Thank you for your understanding, hoping to get a positive response.

Yours sincerely,
Shivam S
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I want to thank both of them for their patience, encouragement, and for always pushing me to do my best. I consider myself fortunate to have had the opportunity to learn from them, and I will carry the knowledge and skills they have imparted to me throughout my life and career.

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ABSTRACT

Title: *Developing a program to compute dynamic implied equity risk premiums and to value a target company*

Abstract:

The Finance industry is riddled with inconsistencies, biases and ethical complications that, more often than not, much of the populace becomes hostile towards this trade. However, through this project we employ methods to do away from these biases and inconsistencies and try to evaluate in a fair and just manner and thus producing valuation that is based on sound facts and judgement. Aswath Damodaran is widely regarded as a leading authority in the field of finance, particularly in the area of valuation. His extensive body of work encompasses a diverse range of industries, markets, and valuation approaches. This project provides a review of the key elements of Aswath Damodaran's valuation methodologies and their significance in the financial landscape. Moreover, storytelling and narrative will be of paramount importance in justifying our choice of methodology. We will further look into employing these methodologies and attempt at valuing a company of our choice and make recommendations as seen fit. Through out this project, we will also attempt at creating a computer program to calculate real time Implied Equity Risk Premium on demand and investigate the best case for better data procurement techniques and analyzing data sources for their credibility.

Methodology

Bulk of the concepts detailed by Dr. Aswath Damodaran will be used to analyze companies by valuing their intrinsic value through two different methods of intrinsic valuation: Free Cash Flow to Firm and Equity. Through these techniques, we will understand the various considerations and adjustments done by Dr. Aswath Damodaran that aims at fixing the many mistakes and gaps left by accountants and their importance in valuation and narrative.

Results and Conclusion

Through both methods of valuation, we find that the stock price of Lockheed Martin is overvalued compared to its fair share value which we calculate. However, the company has a bright future considering its current circumstances and their market share in the industry.

The program for calculating Implied Risk Premiums led us to understand a sheer lack of data in the absence of subscription-based sources which can lead to uninformed choices and decisions by beginner investors and over animosity towards the markets.

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LIST OF ABBREVIATIONS AND NOTATIONS

AAA – Rating of the highest tier

BV – Book Value

CAL – Capital Allocation Line

CAPM – Capital Asset Pricing Model

CCC – Rating example

CDS – Credit Default Swap

CE – Certainty Equivalent

CF – Cash Flow

COC – Cost of Capital

COD – Cost of Debt

COE – Cost of Equity

CRP – Country Risk Premium

CVR – Contingent Value Rights

DCF – Discounted Cash Flow

DDM – Dividend Discount Model

DR – Debt Ratio

EBIT – Earnings Before Income Taxes

EBITDA – Earnings Before Income Taxes Depreciation and Amortization

ERP – Equity Risk Premium

ERR – Expected Rate of Return

ESG – Environmental, Social and corporate Governance

EU – European Union

FAS – Financial Assistance Scheme

FCF – Free Cash Flow/s

FCFE – Free Cash Flows to Equity

FCFF – Free Cash Flows to Firm

FDA – Food and Drug Administration

FY – For Year

^GSPC – S&P 500 Trading symbol

HTML – HyperText Markup Language

IBEX – benchmark stock market index of the Bolsa de Madrid, Spain's principal stock exchange

ICR – Interest Coverage Ratio

IERP – Implied Equity Risk Premium

IPO – Initial Public Offering

IT – Information Technology

JBCS – Journal of Business Case Studies

JBER – Journal of Business and Economic Research

LEAPs – Long-Term Equity AnticiPation Securities

MBA – Master of Business Administration

MOODY’s – Moody's Investors Service, often referred to as Moody's, is the bond credit rating business of Moody's

Corporation, representing the company's traditional line of business and its historical name.

NI – Net Income

NOL – Net Operating Loss

OL – Operating Leases

PV – Present Value

Q1 – First Fiscal Quarter – January, February and March

Q2 – Second Fiscal Quarter – April, May and June

Q3 – Third Fiscal Quarter – July, August, and September

Q4 – Fourth Fiscal Quarter – October, November, and December

ROC – Return on Capital

ROE – Return on Equity

ROIC – Return on Invested Capital

SD – Standard Deviation

SE – Standard Error

SSRN – Social Science Research Network

SUM – Summation (arithmetic operator)

TAPMI – T. A. Pai Management Institute

TIPS – Treasury Inflation-Protected Securities

TTM – Trailing Twelve Month / Trailing 12 Month

TV – Terminal Value

US – United States / United States of America

WC – Working Capital

YTM – Yield to Maturity

1 INTRODUCTION

1.1 Corporate Valuation

Corporate Valuation is the practice of valuing the corporate entities in a tangible and comprehensible manner so that it is not just intuitive, but also comparable. This, therefore, necessitates an unbiased look in an industry that is riddled with biases that creep in different avenues of valuation. As one of the pioneers of valuation and it's literature, Dr. Aswath Damodaran of New York University, Stern puts down several principles and methodology for the same.

1.1.1 Principles of Valuations

1.1.1.1 Valuation is not a science, not an art – it's a craft

Valuation of a company, often, is a forward-looking perspective – this means that we are trying to forecast a future which cannot be predicted. Science is not predictive in nature. It's definitive based on an input. Valuation is not an art either; it's not an inherent skill, nor is it intuitive. Just like any craft, Valuation is a skill that needs to be practiced but can never be perfected.

1.1.1.2 Value of an asset needn't be equal to it's price

The intrinsic value of an asset can be very different from what the market has priced it at. Markets can be unpredictable and driven by emotion. However, we will further look into certain assumptions that will tie up these two in a comparable manner.

1.1.1.3. Valuation is simple and universal

The value of an asset a function of its future cash flows it generates and the risk involved with owning said asset. This can be done for anything that is not intangible or subjective.

1.1.1.4 Good Valuation = Story + Numbers

Valuation is an amalgamation of numbers and stories – where theory meets the unpredictable. This is necessary to justify any valuation models.

1.1.1.5 Valuation is an exercise on following up with the execution of its results

Valuation is not that much of a theoretical game. A pragmatic approach towards the many determinant and indeterminant factors along with justified underlying assumptions help us in getting an estimate value. The end result is to act on it and try to forecast the markets.

1.1.2 Valuation – Bias and Perception

Bias and perception can vary any valuation greatly. This is due to the underlying aspect of storytelling which is used to justify the numbers provided by a result.

1.1.2.1 Sources of Bias

1. The power of the Subconscious – Market's are susceptible to herd behaviour which can also affect your own bias towards a certain company. Valuation in the industry is also riddled with historical approach which often gives bad results in the hands of predicting the market.
2. The power of Suggestion – There is no lack of external suggestion and perceptions that are colored by the industry onto the customers. This bias can often lead to second guessing a result and furthering from the truth.
3. The power of Money – Valuations in the industry are often done in service of a client. This means that bias creeps through your value propositions to the client as a service provider.

1.1.2.1 Misconceptions about Valuation

1. "Valuation is an objective method of assessing the value of an asset" – Valuations are bound to be biased in some way shape or form. This bias is directly proportional to the monetary compensation and the client for said valuation.
2. "Valuation is an accurate estimate of fair value"
    a. There are no accurate valuations – Predicting the future can never be accurate and therefore is not conclusive of your valuation result.

b. Precision in valuation is a futile effort in terms of returns – Less precise valuations is often of assets or companies, thar are not valued due to lack of data or general interest. One of the primary goals of valuation is to recognize companies that are undervalued – and these are often the companies that are least valued by a market.

3. "Quantitative models is not always the best method to value." – Importance of simplicity in valuation cannot be overstated. While complex models have their place, however in valuation, complex models often draw from multitude of assumptions that almost always lead to a bad estimate.

1.2 Approaches to Valuation

1.2.1 Intrinsic Valuation

Intrinsic Valuation establishes a relation between the value of an asset and the cash flow generating capacity of the said asset and the risk involved. Intrinsic value is computed with a discounted cash flow valuation, with the value of an asset being the present value of expected future cash flows on that asset which is discounted at the risk associated to the valuation.

The most common method of intrinsic valuation is the Discounted Cash Flow methodology.

1.2.2 Relative Valuation or Pricing

Relative valuation returns a price for the asset depending on what others are willing to pay for similar asset which is the scaled to a common metric (earnings, revenues, subscribers) for comparison.

1.2.3 Contingent Claim or Real Option Valuation

Real option valuation helps us in valuing assets whose cash flows can change massively depending on an event happening.

For example, let's say that an oil company has reserves, and when the supply of oil in the market drops (an event) the value of these reserves will increase. Or a pharmaceutical company invests

on the research of a new drug, which if succeeds, will generate massive cash flows later. Real option valuation gives value to these assets and to an extension, these events themselves.

.

1.3 Basis for Valuation

Valuation models are primarily based on two important assumptions

1. markets are inherently inefficient and often prices assets differently, compared to its intrinsic value
2. another set of assumptions that dictate how and when these market inefficiencies will adjust to narrow to the true intrinsic value

According to economic theory, an inefficient market is one in which an asset's prices do not accurately reflect its true value, which may occur for several reasons. The market price is the most accurate estimate of value in an efficient market. The justification of this value is the ultimate goal of any valuation methodology. However, in the real-world scenario, this is not the case. The assumption that these inefficiencies will get corrected over long term gives us opportunities to value companies and to beat the market to this value.

1.4 Expanding upon the different approaches to Valuation

1.4.1 Discounted Cash Flow Valuation

Discounted cash flow valuation or DCF estimates the value of an asset by calculating the present value of the expected cash flows discounted at a suitable discount rate.

1.4.1.2 Philosophical Grounds

Every asset has an intrinsic value that may be calculated based on its cash flow, growth, and risk characteristics. Some individuals argue against the existence of intrinsic value and deem it a futile exercise and prioritize market pricing as the foremost determinant of an asset's worth.

1.4.1.3 Information Needed

- Estimated life of an asset
- Projected cash flows in the lifetime of the asset
- Suitable discount rate discount the cash flows to get the net present value

1.4.1.4 Market Inefficiency

Markets are presumptively going to price assets incorrectly and this leads to the above mentioned inefficiency. However as fresh information regarding these assets becomes available, markets are these markets are going to be receptive to these fact checks and correct themselves over time.

1.4.1.5 Advantages of DCF

1. Since the asset is being considered as a fundamental part of the company, the valuation methodology does not need to be influenced much by the market, if any at all.
2. DCF is the right way of valuation if stocks are considered to be a fundamental portion of the company, and not an asset of its own.
3. If we are assuming that the intrinsic value of a stock is determined by the fundamentals of the company, we become immune to what external factors and considerations look like, like the market's perspective about our position on a stock.

1.4.1.6 Disadvantages of DCF Valuation

1. High effort – DCF requires a high number of explicit information
2. The required inputs are noisy and difficult to estimate. Moreover, they are bias prone – they can be manipulated to provide the conclusion that is most desirable.
3. DCF valuation is fundamentally an attempt at finding the best avenues for us to acquire a long position on an undervalued stock. However, this can be seen a futile effort if the right stocks are not chosen in the first place.

1.4.1.7 When does DCF Valuation work?

1. The selected assets needs to have expected cash flows - Collectibles, rare elements, currencies cannot be considered for valuation through the method of DCF.
2. It works best for investors

a. with a lengthy time horizon, giving the market the space to correct itself and for prices to return to their actual intrinsic value.
b. are able to act as the catalyst to shift the price to its fair value, as you might if you were an activist investor or a possible buyer of the entire company.
c. are resistant to peer pressure, that is, market changes that go against what they have learned to value.

1.4.1 Relative Valuation or Pricing

By comparing an assent to similar or comparable assets on the market, its value can be calculated. The estimation is done by scaling with respect to some common factor, because price per share depends on multiple factors like scale, revenue, etc.

1.4.1.2 Philosophical Grounds

It is impossible or nearly impossible to determine an asset's inherent value. The asset's price, however, is totally determined by the market - its price is whatever the market is prepared to pay for it.

1.4.1.3 Information Needed

1. a set of equivalent or equal assets, or an item that is the same.
2. a standardized measure of values and, if the assets are not totally comparable, factors to account for the differences (in equity, this is produced by dividing the price by a common variable, such as earnings or book value).

1.4.1.4 Market Inefficiency

The Market is the ultimate defining factor of what the pricing should be. On average, markets are considered to be fairly efficient, and therefore, the comparison within the sector of the company is justified. Moreover, these uncertainties and mispriced assets stick out from their peers, so one can expect these prices to converge with what the market deems to be its price on average fairly quickly than what you would expect in DCF.

Relative pricing is not an attempt to find the intrinsic value of an asset but to merely determine the price at which it trades and is supposed to trade, given the philosophical grounds being assumed.

1.4.1.5 Advantages

1. Compared to DCF valuation, pricing is considerably more likely to reflect market perception and sentiment. This is helpful if the objective is to:
    a. The goal is to sell an asset (e.g., IPO, M&A)
    b. Using momentum-based tactics for investing
2. There will always be a sizable proportion of securities that are undervalued or overvalued in pricing. Relative pricing works best for portfolio managers since they are evaluated relative to other players in the market.
3. Pricing typically involves fewer inputs than DCF and is therefore simpler to implement.

1.4.1.6 Disadvantages

Pricing can only measure whether an individual stock is over or undervalued compared to the market. Pricing cannot determine whether a group of companies or a sector itself is overvalued. Example the .com bubble of the 2000s.

1. Pricing is a relative performance and competition avenue for analysts. When a market moves, your measure of success becomes whether you won more or lost less compared to other analysts.
2. Since pricing requires less inputs, there are some non-explicit, or implicit assumptions that each individual analyst makes - performance is largely based on whether these implicit assumptions are right - it's important to make assumptions explicit.

1.4.1.7 When does Relative Valuation work?

1. Surplus data on related assets that are priced similarly in the market is readily available.
2. The price can be standardized among businesses of various sizes, capacities, etc. using a common and comparable variable.
3. It works better for investors who:
    a. have short time-horizons - price errors are fixed far faster than intrinsic

b. are rated on a relative benchmark, which means that their performance is measured against that of other investors.
c. can profit from mispricing in the market by purchasing underpriced assets and selling overpriced equities, respectively. The more difficult task is finding these companies.

There are various assets that can never be valued through an intrinsic valuation. However, these assets can be priced relative to their peers. For example, currency, collectibles, etc. In this scenario, pricing is the inly valid method of valuation.

1.4.2 Contingent Claim Valuation or Option Pricing

Options are derivative securities - they cannot exist on their own.

1. They are based on an underlying asset and derive their value from this asset.
2. Only when the value of the underlying asset exceeds (or falls short of) an exercise price that is established at the time the option is created will a call (or put) option pay out. The option is regarded as worthless if this contingency does not materialize.
3. They have a fixed life, or a life under contract.
4. If these characteristics are be found in a security, we can make an option out of it.

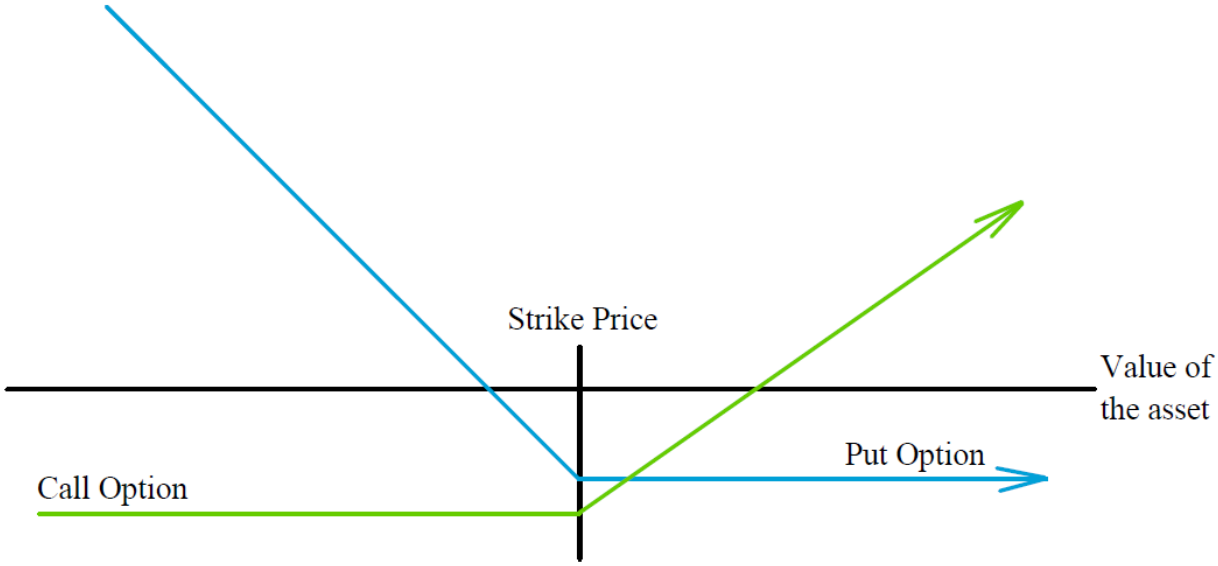


Figure 1.4.2.1 This figure demonstrates the value of an option depending on the value of an asset given a strike price.

1.4.2.2 Direct example of Options

1. Listed Options: These are options that are issued by, listed on, and traded on an option exchange that are based on traded assets.
2. Warrants: These are company-issued call options on other assets listed on the stock exchange. Although warrants are traded on the market, the corporation receives all the proceeds of the exercise of these options.
3. Contingent Value Rights: These are company-issued put options on publicly listed companies. The corporation receives the proceeds from these CVR.
4. Scores and LEAPs: These are long-term call options on equity stocks.

1.4.2.3 Indirect example of Options

1. Equity in a troubled company: An option to liquidate a company with negative earnings and heavy leverage. It is a call option on the company's assets.
2. If a natural resource corporation decides to utilise its reserves, they may be viewed as call options on the underlying resource.
3. A company's patent or an exclusive license might be thought of as a call option on the project or product they are pertaining to. During the term of the patent, the company is the owner of this option.
4. The ability that a company has to diversify an existing investment into new markets or new goods, especially in big markets like India, China can be considered an option.

1.4.2.4 Advantages

1. Models for Option Pricing enable us to value assets that we would not otherwise be able to. For instance, shares in severely troubled companies, patents in emerging biotechnology companies, etc.
2. Models for option pricing offer new perspectives on what determines an asset's value.

1.4.2.5 Disadvantages

1. When it comes to actual options, such as patent and natural resource options, many of the inputs for the option pricing model are challenging to get.

2. Options have an underlying asset that provides their value. As a result, the work is doubled because option pricing is added on top of an existing valuation.
3. There is a chance of counting assets twice when determining your option pricing and underlying asset assessment.

1.5 Summary

There are only 3 Valuation Approaches:

1. Intrinsic Valuation
2. Relative Valuation or Pricing
3. Contingent Claim Valuation

The three methods can produce various value estimates for the same asset at the same time.

To really understand valuation, one must be able to comprehend and apply each of the three methods. Each one has its own merits and demerits and can give important insights into the overall valuation of a company or an asset. Mastering valuation is to use these three approaches to derive the different perspectives and create a story that is not just viable, but also accurately predicting the future.

2 Literature Review

2.1 Discounted Cash Flow Valuation Priors

2.1.1 Equity Valuation

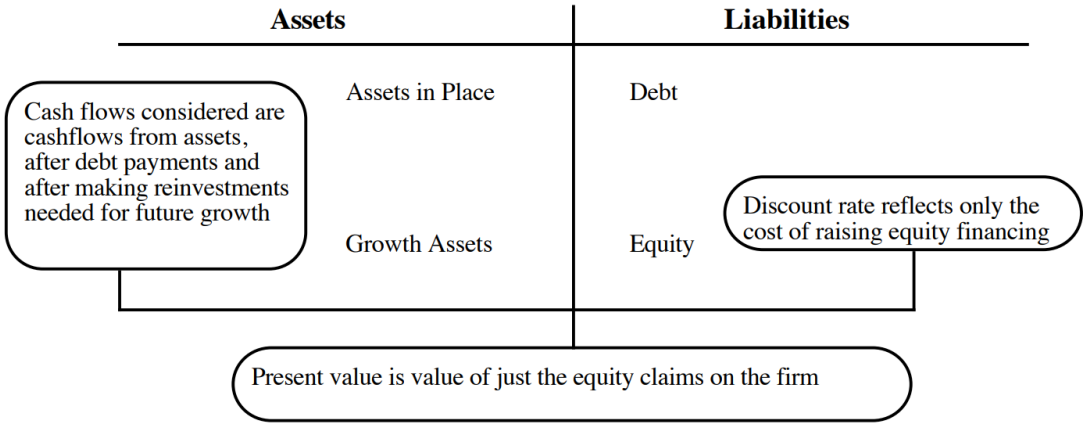


Figure 2.1.1.1 Equity Valuation in a nutshell

$$Equity = Total\ Assets - Total\ Liabilities$$

Equity valuation's focal point is the equity investor as the sole capital supplier. Equity Valuation, thus takes the following inputs:

1. Cash flows after all debt and liabilities are paid - The CF considered are ones that are available to the equity investors. It's cash flow after all debt and liabilities.[1]
2. Cost of Equity – as the discount rate that accounts for the risk of the equity in the company[1]

2.1.2 Firm or Business Valuation

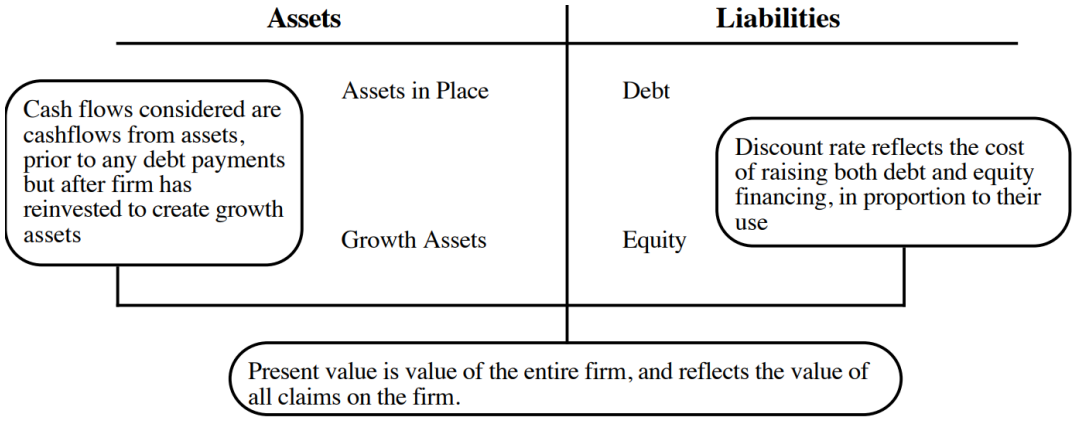


Figure 2.1.2.1 Firm Valuation in a nutshell

Firm Valuation looks at two different stakeholders in the business who supply capital:

1. The Equity investors and,[1]
2. The Lenders who provide debts, e.g., bond holders, etc.[1]

Your cash flows reflect both of these parties, and accounts for cash flows to each of them from the company.

1. As an equity investor, you get
    a. dividends
    b. left over cash flows, etc.
2. As a lender, you get
    a. interest payments
    b. principal payments, etc.

This collective cash flow that these two parties - owners and lenders get out of the firm is called - cash flows to the firm.

The rate of discount to value the PV of these cash flows cannot be the cost of equity but also the cost of debt on the debt that is provided by lenders – the return they want for providing the capital. This is the weighted average of what investors want - the cost of equity and what the lenders want - the cost of debt - this is the cost of capital.

2.2 The Essence of Intrinsic Value in DCF

Based on an asset's fundamentals (i.e., the intrinsic characteristics), you value said asset.

For assets that generate cash flows, the intrinsic value will depend on the size of the predicted cash flows during the asset's lifetime and the likelihood of those cash flows will being realised.[2]

DCF is just another method of intrinsic valuation.

1. DCF is just a method of calculating intrinsic value. There are many other ways to do it also.
    a. DCF = PV of cash flows which is discounted at a rate adjusted to reflect the risk involved in owning the equity.
2. DCF is a modern technique - intrinsic valuation predates DCF.
    a. Intrinsic valuation has been done for ages based on different weighing procedures.

2.2.1 DCF fundamentals

2.2.1.1 When the expected cash flows are known, along with the discount rate which is adjusted to include the risk involved, the present value is determined by, [1], [2]

$$Value\ of\ asset\ = \frac{E\,(CF_1)}{(1+r)} + \frac{E\,(CF_2)}{(1+r)^2} + \frac{E\,(CF_3)}{(1+r)^3} + \cdots \ldots + \frac{E\,(CF_n)}{(1+r)^n}$$

- E(CF) = Expected CF
- r = risk-adjusted discount rate

2.2.1.2 When the certainty equivalent cash flows are known the PV of the asset is determined by,[1], [2]

$$Value\ of\ asset\ = \frac{CE\,(CF_1)}{(1+r_f)} + \frac{CE\,(CF_2)}{(1+r_f)^2} + \frac{CE\,(CF_3)}{(1+r_f)^3} + \cdots \ldots + \frac{CE\,(CF_n)}{(1+r_f)^n}$$

- CE(CF) = Certainty Equivalent Cash flow; rf = risk-free rate

Certainty Equivalent Cash flow is a cash flow that is guaranteed to happen - therefore, as the name suggests, there is no risk on cash flows that are certain to happen, and therefore a risk-free rate is used as the discount rate.

2.3 The first steps in Discounted Cash Flow Analysis

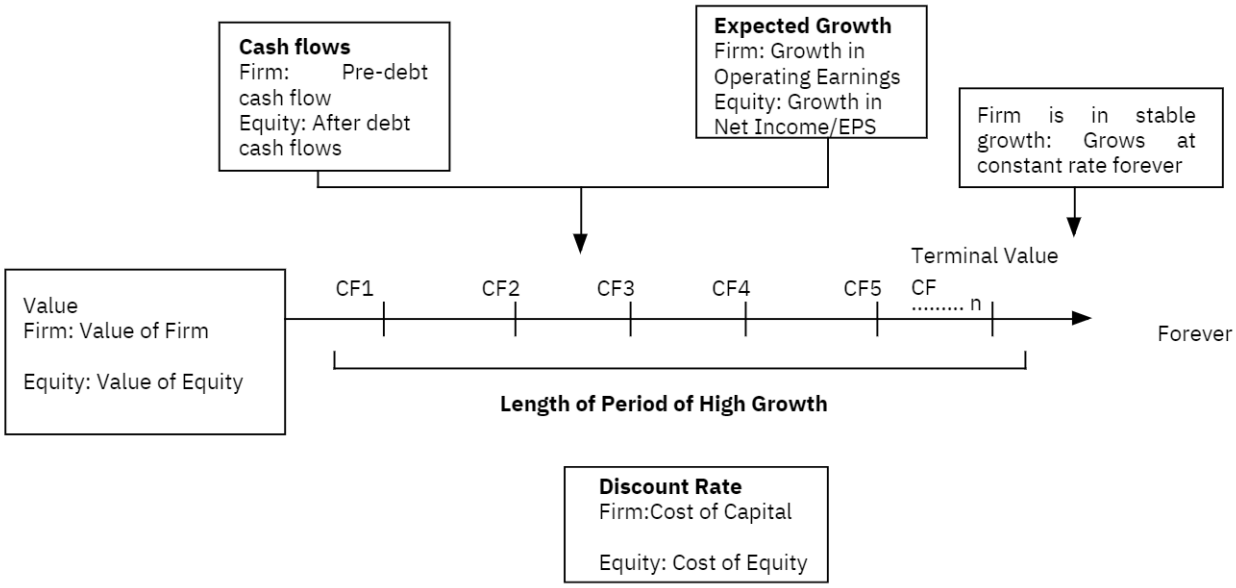


Figure 2.3.1 Generic DCF Valuation model highlighting both equity and firm valuation methods

A generic DCF Valuation model, like the one above, has the following assumptions:

1. A time period of high growth for the company (in case of high growth companies, in terms of mature companies, this needn't be the case) is considered after which a terminal value for the company is determined. [2]
2. A fixed growth rate is being assumed at which the cash flows are expected to grow in the foreseeable future and forever. This is the terminal value. The terminal value of the company assumes that the firm has reached its maturity and thus is calculated at very conservative growth rates.[2]
3. The fixed growth rate cannot overshoot the risk-free rate of the country, or on this case, the growth rate of the economy of the company. The growth rate of an economy is an average of growth rates of all the companies within, which therefore, has the high growth and the mature companies. Therefore, as a conservative measure, mature companies are assumed to not show growth higher than that of the economy. Therefore, it is important to determine the time period for the terminal value wisely.[2]

2.3.1 Different approaches to DCF

2.3.1.1 The Dividend Discount Model

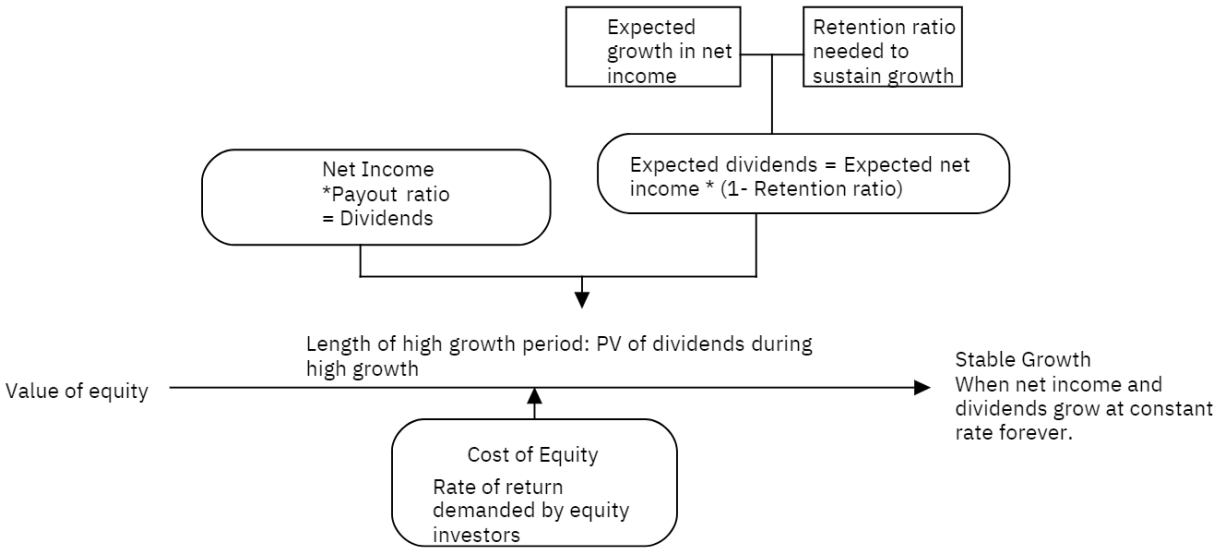


Figure 2.3.1.1.1 Generic DDM Valuation model highlighting the time horizon and the inputs required

The Dividend Discount Model is easy and straightforward,

1. The cash flow to equity, aka, cash flows to the investors is solely considered to be the dividends that the company pays out.[2], [3]
2. Cost of Equity of the company is considered the rate of discount for cash flows.[2], [3]

2.3.1.2 The Free Cash Flow to Equity (FCFE) Model

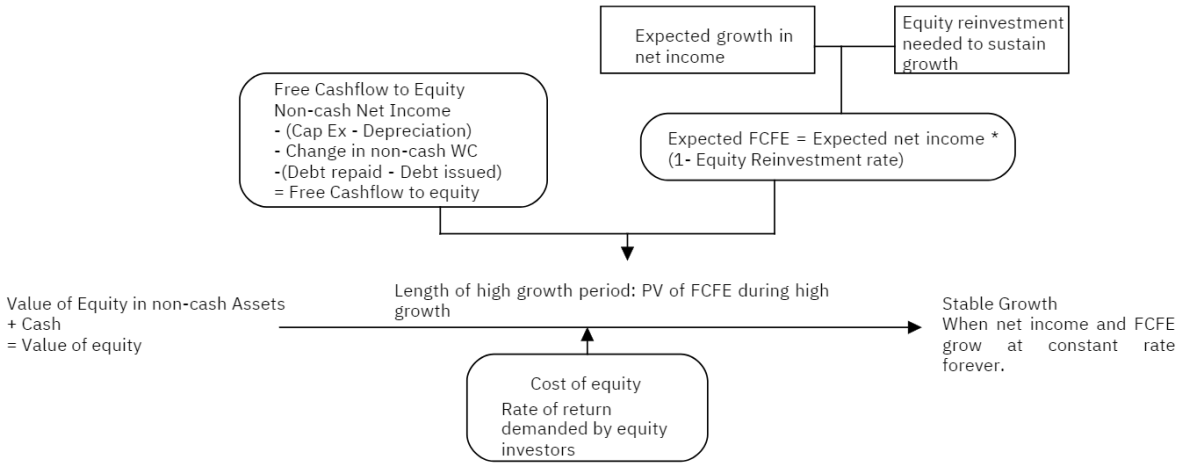


Figure 2.3.1.2.1 Generic FCFE Valuation model highlighting the time horizon and the inputs required

Taking it a couple steps forward, the Free Cash Flow to Equity Model looks at "potential" dividends payable to investors to get a better estimate of the equity in the firm - this enables us to value a wide range of companies apart from those that are only dependent on dividends as concrete cash flows to equity investors. [2], [4]This is especially useful in the case of:

1. Companies in the IT industry often don't pay out dividends, e.g., Google and rely on buy backs[2]
2. Companies are not obliged to pay dividends, which means that if we only consider a dividend discount model, there is potential "value" that we are overlooking.[2]

2.3.1.3 The Free Cash Flow to Firm (FCFE) Model

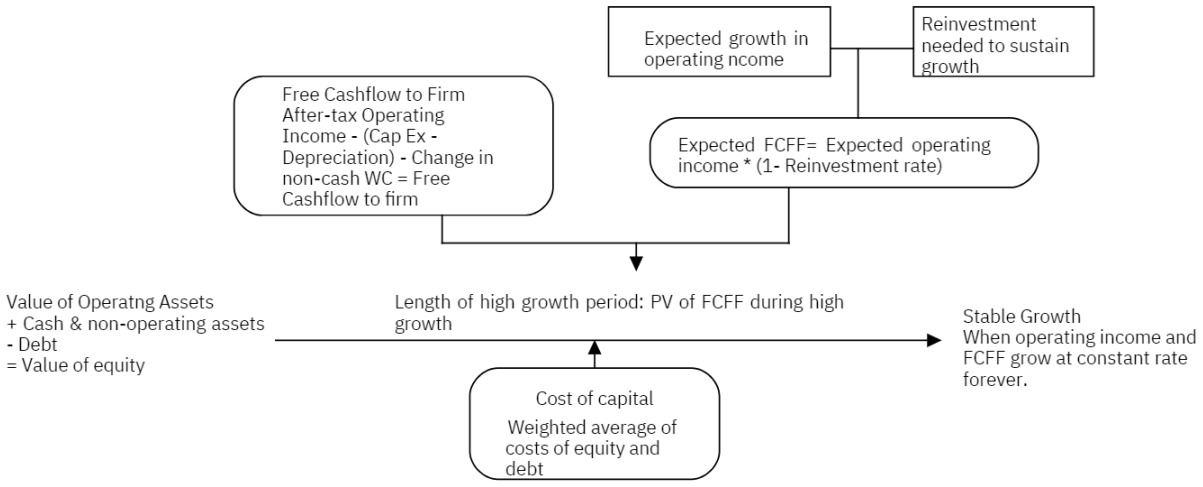


Figure 2.3.1.3.1 Generic FCFF Valuation model highlighting the time horizon and the inputs required

In the same premise of the previous method, we are looking at valuing the entire firm - which means, we are looking at the Free Cahs Flow to Firm available.[2], [5], [6] It's using the same method, but to value the business as a whole which includes debt and equity.

The model considers the following-

1. The cash flows is considered to be the Free Cash Flow to Firm available[2], [5]
2. Cost of Capital is the discount used - because we are considering the FCF to the Firm as a whole, which includes debt.[2], [5]

2.4 Risk and Return Models

2.4.1 Generic Cost of Equity calculation in a DCF Model

$$\boldsymbol{E(r) = R_f + \beta * ERP}$$

- E(r) = Risk Adjusted Cost of Equity
- Rf = Risk-free rate in the currency of analysis
- β = Relative risk of company / equity in question
- ERP = Equity Risk Premium required for average risk equity

The risk of an investment is the risk, if bought, incurs in the portfolio of market upon buying the asset. A market portfolio is a portfolio that includes every single traded asset out there. That is captured with one number, the beta, which is relative to this market portfolio. [2], [5], [7]

2.4.2 Risk and Cost of Equity: Marginal Investor assumption and its complications

2.4.2.1 Not all risk counts

One needs to identify the type of risk that affects a valuation.

- Estimation vs Economic Uncertainty
    - Estimation uncertainty arises due to lack of data, or wrong inputs/methodology in the valuation model. [2]Example, you are valuing TESLA and you don't know how many electric cars were sold on 2013 - this can be fixed by gathering more data.
    - Economic uncertainty arises because you are trying to forecast the future – this cannot be fixed by collecting more data. Markets and economies change all the time and even the best of the models fail to capture these changes.[2]
- Micro vs Macro Uncertainty
    - Micro Uncertainty: Uncertainty over the firm's products' prospective market, the competition it will encounter, and the caliber of its management. [2]
    - Macro Uncertainty - Reflects the possibility that changes in the macroeconomic environment will have an impact on the company.[2]Example, how quickly will India grow, etc.
- Discrete vs Continuous Uncertainty
    - Discrete Uncertainty - Risks that lie dormant for periods but show up at certain points of time. [2]In case of companies in certain economies - what if nationalization happens (example in Venezuela)? What if a drug, in the FDA compliance pipeline, fails to adhere to the strict standards of the process to approval?
    - Continuous Uncertainty - Risk that is always present. [2]Example, if you are a US company in Europe, every time the Dollar-Euro exchange rate changes, so do your cash flows.

Of these risks, it's the Economic, Macro and Continuous uncertainties that affect your valuation.[2], [5]

2.4.2.2 Risk in perception of the Marginal Investor

Risk should be determined as it is perceived by the Marginal Investor - the investor who owns a substantial stock of the firm, can price the company because, to an extent, drives the supply and demand by constantly trading in the markets. [2], [5] The question is not what one stock will

bring as risk, it's what the one additional stock will do to the portfolio - it's codependent to the current portfolio.

2.4.2.3 Diversification effect

The second assumption about the Marginal Investor is that their portfolio is heavily diversified and therefore, only those uncertainties that cannot be diversified against should fall under cost of equity. [2], [5]These are economic, macro, and continuous risks.

2.4.3 Cost of Equity: Competing Models

Beta Coefficient or β is the measure of its volatility with respect to the volatility of the market.[2], [8], [9]

$$Beta\ Coefficient(\beta) = \frac{Covariance(R_e, R_m)}{R_m}$$

- Re = return of an individual stock
- Rm = the return on market
- Covariance = changes in the returns of a particular stock compared to changes in the market's returns
- Variance = how far the market's data points spread from the average value

2.4.3.1 Capital Asset Pricing Model (or CAPM)

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

- Rf is the risk-free rate
- Rm is the expected return on the market
- Rm - Rf is the equity risk premium/market risk premium

CAPM is a commonly used model to calculate the Cost of Equity and is generic in its assumptions. [2], [10], [11]There are two big assumptions that drive this model:

- There are no transaction fees - buying a stock costs nothing, which is getting true now, with Robinhood, Zerodha, etc.[2], [10]
- There is no private information / you can't pick stocks – CAPM considers the portfolio for its use as the Market portfolio.[2], [10]

"Diversification benefit" - the benefit of diversification when one stock is added to a portfolio of a number of stocks reduces the overall risk - however, this benefit drops as the portfolio gets more and more diversified.[2]

Given the assumptions of the CAPM model, how can we plan to maximize returns? There is only one sweet spot, if you go by the Capital Allocation Line and the efficient frontier plot, there is only the Sharpe point.[2], [12]

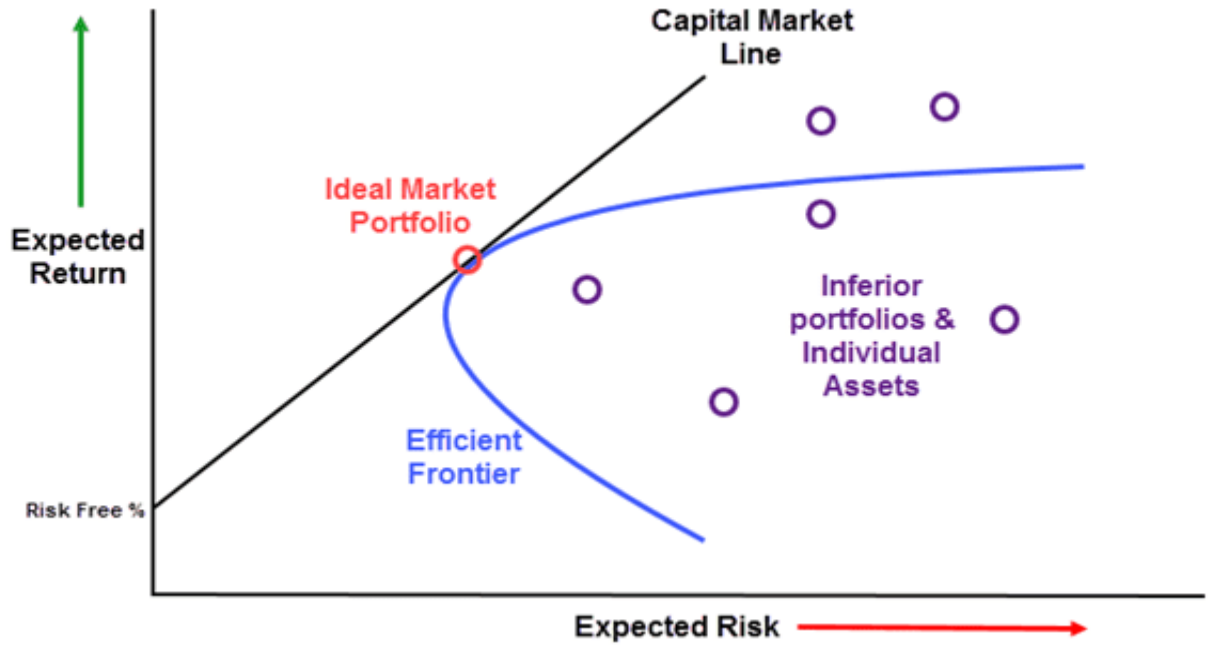


Figure 2.4.3.1.1 CAL and Efficient Frontier

The "Tangency Point" or "Optimal Portfolio" is the location where the CAL is tangent to the efficient frontier, which is a curve reflecting portfolios with the maximum expected return for a specific amount of risk. [12] This portfolio offers the highest predicted return for a given level of risk or the lowest risk for a given level of return, demonstrating the most effective asset allocation that balances risk and return.[12] However, for a market portfolio, this is already achieved. How can we maximize returns?

It's by borrowing money and investing in the portfolio. There is no optimization possible.[2]

2.2.3.2 Arbitrage Pricing Model (or APM) and Multi Factor Model

$$E(R) = R_f + \sum \beta_j (R_j - R_f)$$

- Rf is the risk-free rate
- βj is the beta relative to the jth macro factor
- Rj is the risk associated to the jth macro factor

The arbitrage pricing model and the multi factor pricing model are modern methods where different sources of market risks are recognized and a beta is set against each of them.[2], [5]

The difference between those two is the approach:

- The APM considers these factors to be statistical, unnamed
- The Multi Factor pricing model gives economic names to these factors - inflation, interest rates, etc.

2.2.3.3 Proxy Rates

$$E(R) = a + \sum b_j Y_j$$

- a and b are regression coefficients
- Y is the proxy coefficient

With access to more data in the last two years, the risk valuation models have evolved. Recently, proxies have come in use to supplement determining risk which is often a daunting venture.[2], [5]

Examples of use case:

1. Smaller companies (in terms of market cap) tend to experience higher growth rates than larger companies. If we assume that markets are efficient over very long time periods, we can assume that the size, here, the market cap, is indicative of risk. Smaller companies (having lower market cap) are riskier than larger companies (having higher market cap).
2. Low price to book stocks - stocks where the market value of equity is a value lower than the book value of equity tend to earn higher than stocks with a high price to book ratio. This is an example of a proxy that we can use.

Therefore, in Summary, you need three major ingredients to use any risk and return model:

1. Risk-free Rate, which is a market wide constant
2. Equity Risk Premium – which is also a market wide constant
3. Equity Beta – the only variable that is specific to the chosen company

2.5 Risk-free Rate

For an asset to be risk-free, the expected value and the actual return value should be the same. There is no deviation from the rate of return. [2], [7]

Condition 1: It should have no default risk[2], [13]

- Default risk is the risk that a lender takes on in the chance that a borrower will be unable to make the required payments on their debt obligation.
- Quite evidently, a risk-free rate means that it requires the default risk to be zero.

Condition 2: It should have no reinvestment risk.[2], [13]

- Reinvesting on the same asset should not introduce risk to the portfolio.
- For example, T.Bonds of the US government can be reinvested at the end of their maturity at similar risk rates which are easily determined.

There are 3 major considerations to assuming a risk-free rate.

1. A Risk-free Rate is not exclusive to the Time Horizon of your investment[2], [13] - This means that the risk-free rate changes for a time horizon for 1 year, 5 years, etc. This is because, the risk-free rate doesn't remain consistent, it changes over time.
2. Currencies need to be consistent[2], [13] - A risk-free rate varies greatly depending on the currency and is currency-specific.
3. Government securities are not risk-free, at least not all of them [2], [13]- Some governments have a default risk. Assuming that a government would not default in its own local currency is disproven - half of all sovereign defaults in the last 50 years have been of them defaulting in their local currency.

2.5.1 Determining Risk-free Rates for different countries

2.5.1.1 Risk-free Rate in US Dollars

US Treasury Bonds (T-Bonds) are relatively risk-free and are available in multiple time horizons. US T-Bonds have never defaulted, and US is a relatively stable economy. Therefore, they are a good place to start. Intuitively, it quite apparent to choose the longest time horizoned T-Bond, because DCF has a terminal value and this value stretches time to basically infinity. However, there are certain considerations that we have to keep in mind of:

- When you lock in a time horizon, all the other inputs get locked in too. When choosing, say 30 year T-Bond rates, it is quite difficult to find other inputs for the same time horizon.
- Most corporate bonds, which are necessary to asses to get a default spread of the company, only have a 10 year long term.

Therefore, more often than not, it is actually desirable to select the 10 year T-Bond rate.[13]

2.5.1.2 Risk-free Rate in Euros

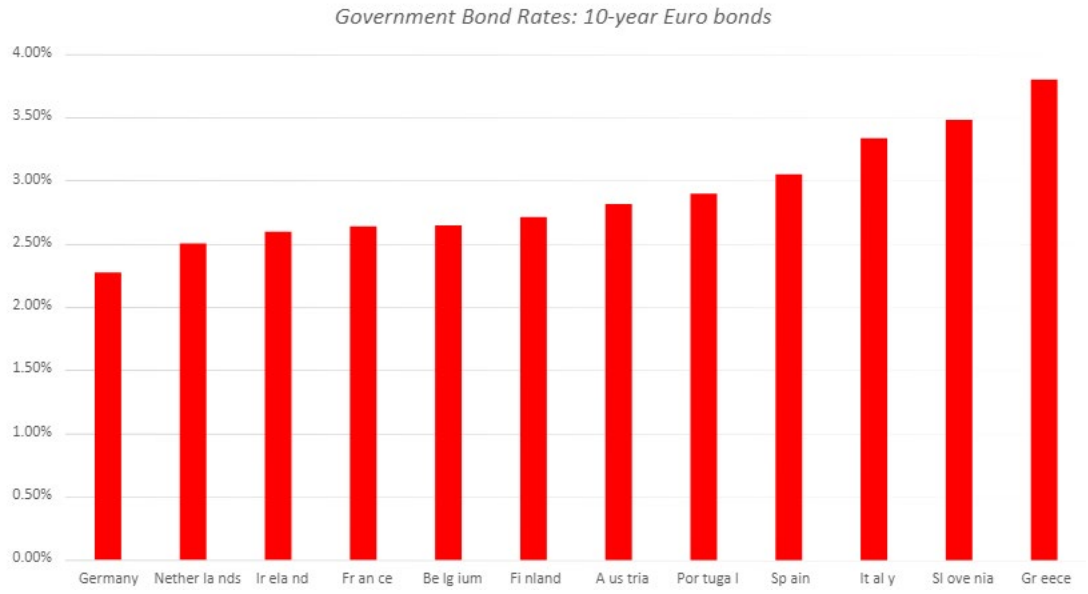


Figure 2.5.1.2.1 Government Bond Rates: 10 year Euro Bonds

In these scenarios, it is desirable to select the risk-free rate that is the least within the EU, here that's for the Germany.[13] This is because money within the EU can flow easily because of the same currency system and therefore, the entire count of nations can be considered one market.

The default spread measures how far an asset's risk rate deviates from its risk-free rate. Other currencies' spreads is calculated this way.

2.5.1.3 Determinant ways to extract the Default Spread in any currency

Condition 1: The country has US Dollar denominated bonds

The difference between the Dollar Denominated Bond rate of the country and the T-Bond rate of the US Dollar would result in the Default Spread of that country on that day.[2], [13]

$$\text{Default Spread} = \text{Emerging Govt. Bond Rate } (in\ USD) - \text{US TBond rate with same maturity}$$

Condition 2: The country has a CDS Spread

One can assess the Credit Default Swap Market – an insurance market against the default risk of bonds of other nations – to get the default spread for a country.[2]

$$Default\ Spread = Sovereign\ CDS\ Spread (with\ perhaps\ an\ adjustment\ for\ frictions)$$

It is desirable to adjust for the CDS market frictions by subtracting the US CDS spread value from the spread value of the target country.

Condition 3: The country doesn't have US Dollar denominated bonds nor a CDS Spread but has a sovereign rating

The following data can be used to estimate the default spread as updated by Dr. Aswath Damodaran.

S&P Sovereign Rating	Moody's Sovereign Rating	Default Spread
AAA	Aaa	0.00%
AA+	Aa1	0.49%
AA	Aa2	0.60%
AA-	Aa3	0.73%
A+	A1	0.86%
A	A2	1.04%
A-	A3	1.47%
BBB+	Baa1	1.96%
BBB	Baa2	2.33%
BBB-	Baa3	2.69%
BB+	Ba1	3.06%
BB	Ba2	3.68%
BB	Ba3	4.40%
B+	B1	5.51%
B	B2	6.73%
B-	B3	7.95%
CCC+	Caa1	9.17%
CCC	Caa2	11.02%
CCC-	Caa3	12.24%
CC+	Ca1	13.75%
CC	Ca2	14.68%
CC-	Ca3	15.25%
C+	C1	16.25%
C	C2	17.50%
C-	C3	19.00%

Table 2.5.1.2.1 Aswath Damodaran's data sheet for country ratings and Default Spread

This data is derived by taking the average default spreads of countries with the same sovereign rating and assuming the same for the country that has the same sovereign rating but doesn't have information to organically calculate its default risk by the above two methods.[2]

Condition 4: The sovereign doesn't have US Dollar denominated bonds nor a CDS Spread nor a sovereign rating

This is usually the case for smaller economies, like Rwanda, and one would need to employ crafty ways to get an estimate. One possible way is to look at the country risk score - PRS (Europe based) provides a country risk score, which is numerical. You can then try to find a country with the same score but is also applicable to find by any of the above 3 methods.

[2]Then you can find the default spread for that country and take that as the default spread for the initial country.

These multiple approaches can yield different results for the same country. Understanding the value of consistent data consumption above accurate data is more crucial. Since DCF has the risk-free rate and the default spread as components of both numerator and denominator in finding the PV, until you are consistent with your data sources and thoroughly carve out the necessary metric, it shouldn't pose too much of a variation in the resulting value.[2]

2.5.1.4 Real risk-free rate – when inflation rates are skyrocketing

For countries like Ghana or Zimbabwe, where the inflation rate is too hard to deal with, we can employ a strategy to value companies using a real risk-free rate. This is a much more tedious process and should be done only if no other options are available to use.

1. Look into inflation-indexed securities of mature markets like the TIPS (Treasury Inflation-Protected Security) of the US to determine the real risk-free rate.
2. Counter the inflation of the currency which creeps into cash flows and use an appropriate growth rate to account for the inflation.
3. Value the company using the above two inputs.

2.5.1.5 Scaling risk-free rate of a target country using the risk free rate of a mature country market using inflation rates[2]

$$Risk\ Free\ Rate_{Currency} = (1 + Risk\ free\ Rate_{US}) * \frac{\left(1 + Inflation\ Rate_{Foreign\ country}\right)}{(1 + Inflation\ Rate_{US})}$$

2.5.1.6 Negative Risk-free Rates

If risk-free rates are negative, your discount rate would be low/negative which would also show up as a negative component of the growth rate. The expected cash flow would be lower thus balancing out both the numerator and the denominator component.[2], [14], [15]

2.5.2 Characteristics of Risk-free Rates

2.5.2.1 Risk-free rates vary across countries

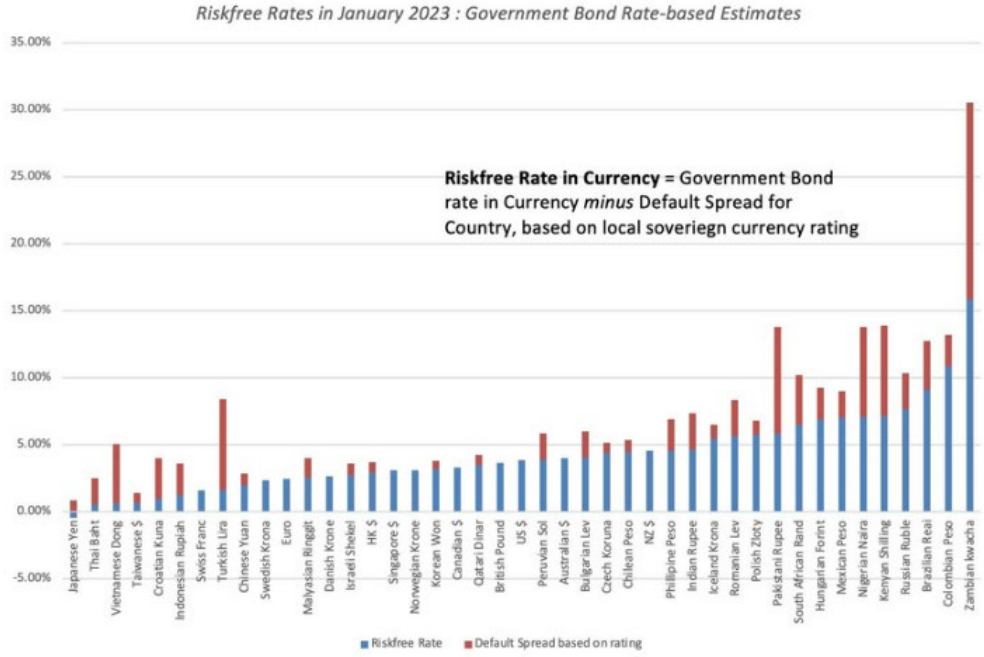


Figure 2.3.2.1.1 Risk-free Rates of different countries

Here, the height of the column, which represents the total government bond rate, is represented by:

- Red portion: Default spread
- Blue portion: Risk-free rate

Risk-free rate (the blue portion) varies across countries due to varying inflation rates:

1. High inflation rates = high risk-free rates[2], [15]
2. Low inflation rates = low risk-free rates[2], [15]
3. Deflationary currencies = negative risk-free rates[2], [15]

However, these are not of major concern in valuation because inflation is also captured by the growth estimate which comes in the numerator, while the risk adjusted discount rate, in the denominator. This leads to a cancellation effect, which gives us a good enough estimate.[2]

2.6 Equity Risk Premiums

2.6.1 Estimating Equity Risk Premium: Historic averages

	Arithmetic Average		**Geometric Average**	
	Stocks – T. Bills	Stocks –T.Bonds	Stocks – T. Bills	Stocks –T.Bonds
1928-2022	8.17%	6.64%	6.34%	5.06%
Standard Error	*2.05%*	*2.15%*		
1973-2022	7.30%	5.14%	5.87%	4.12%
Standard Error	*2.51%*	*2.75%*		
2013-2022	12.64%	13.08%	11.50%	12.32%
Standard Error	*5.50%*	*4.81%*		

Table 2.6.1.1 Historical averages of the rate of T.Bills and T.Bonds of US

$$True\ Average\ =\ Calculated\ Average\ +/-\ 2 * Standard\ Error$$

Historical averages have certain implicit assumptions that we need to be aware about before we use this data:

- Your first assumption, if you use these numbers without their errors, is that the past has been extremely consistent. [2]However, this is not the case. We cannot ignore the massive standard errors within these samples which show us levels of uncertainty in the population sample. In conclusion, these estimates are extremely noisy.
- Your second assumption is that mean reversion will happen - that things will revert to the way they used to be.[2] Valuation is a forward-looking venture. Historical risk premiums, here for the US T.Bonds and Bills, are from the years of 1928-2022: this covers much of the period of centricity of US in the global economy. There are many more comparable players now. Quite simply put, we cannot determine the future by implying that history will repeat itself. In conclusion, looking at the US markets for these estimates introduces *Survivorship Bias* – that is, bias, towards the US economy, that it will perform in the same way.[2]

For historical premiums to truly show small standard errors, we can calculate the number of years of data required:

For standard errors = 1%

Let's consider standard error of data sample for T.Bonds between 1928 – 2022, n = 94 years, SE = 2.05%

$$SE\ =\ \frac{SD}{\sqrt{n}}$$

SE = Standard Error; SD = Standard Deviation; n = sample size

Using this formula,

$$\frac{2.05\%}{1\%} = \frac{SD}{\sqrt{94}} * \frac{\sqrt{n1}}{SD}$$

n1 = 395 years, which is not feasible to obtain.

2.6.2 Estimating the Country Default Risk derived Equity Risk Premium

The default spread of a country can be added to the mature market Equity Risk Premium to derive the total Equity Risk Premium for the country.[5]

$$Total\ ERP\ =\ CRP\ +\ Mature\ Market\ ERP$$

However, adding country default spreads on bonds to a value derived from the equity market poses inconsistency, therefore, a new method had to be established.

2.6.3 An equity volatility-based approach to derive ERP

$$Total\ ERP\ =\ Risk\ Premium_{\ US} * \frac{\sigma_{Country\ Equity}}{\sigma_{US\ Equity}}$$

- Risk Premium US = Equity Risk Premium of the US
- σ Country Equity = Standard Deviation of the equity market of the target company
- σ US Equity = Standard Deviation in the US equity market

This is essentially scaling up the US ERP using Standard Deviation of the equity markets of the two countries as measures of volatility.[5]

However, this method fails in the hand of comparable vastly different liquidities or illiquid markets. This is because illiquid market usually show a smaller standard deviation. This would indicate that they are safer, but the problem arises with the mobility of money, which is nonexistent in these markets which needs to be comparable for the two entities being compared using this method.[5]

2.6.4 The modern ERP

The modern ERP approach compares the bond market and the equity market within the same country to derive a plausible ERP. [2]The implicit assumption being that bond markets and equity markets within the same country are lot more comparable in terms of liquidity than between two different countries.[2]

$$Country\ ERP\ =\ Default\ Spread\ on\ country\ bond\ * \frac{\sigma_{Country\ Equity}}{\sigma_{Country\ Bond}}$$

To obtain the Default Spread on a country bond, follow the steps as mentioned before.

2.6.5 Country Risk Premium to Corporate ERP

2.6.5.1 Estimating CRP exposure

Method 1: Assume that all businesses in the nation are equally vulnerable to country risk.

$$E(Return) = RiskFreeRate + CRP + \beta(MatureERP)$$

Approach 2: Assume that a company's exposure to country risk is similar to its exposure to other market risk.

$$E(Return) = RiskFreeRate + \beta(CRP + MatureERP)$$

Location Based CRP: CRP of the country that a company is based out of is considered as the one that the company is exposed to.[16]–[18]

Operation Based CRP: Weighted average of CRPs is taken of countries where the company is operating, weighted by a choice of factors (revenues or operating income). If a company is exposed to a lot of countries, one can use weighted average by region.[16]–[18]

Certain pain points,

- Revenue based CRP weighting forgoes a multitude of factors like production in different countries, etc. This can be especially misleading for heavy manufacturing companies having global operations. [16]–[18]
- Moreover, using the same beta for macroeconomic risk (Mature ERP) and the country risk premium (CRP) (as stated in approach 2) leads to the assumption that the exposure to both these entities is of the same magnitude, which may be wrong. [16]–[18][16], [18]

2.6.5.2 Estimate a lambda for calculating exposure country risk

Country risk exposure depends on

1. Countries/regions where you generate revenues[16], [18]
2. Countries/regions where your production occurs [16], [18]
3. And other variables that dictate this exposure
    - Utilization of risk management products: Companies can utilise insurance to offset all or a large portion of country risk, as well as options/futures markets.[16], [18]
    - Governmental wayforwards and National industry interests: There are industries that are thought to be crucial to the interests of the nation, and governments frequently have a significant role in these businesses, either formally or informally. These industries are more vulnerable to national risk.[16], [18]

It is therefore a possibility that exposure to country risk can be refined further to incorporate all these variables, and hence the introduction of "lambda".[2], [16], [18]

$$E(Return) = RiskFreeRate + \lambda(CRP) + \beta(MatureERP)$$

2.6.5.2.1 Revenue- Based Lambda

According to revenues earned, the factor " λ " calculates how exposed a company is to country risk in relation to the national average. So, if a company has its revenues significantly more than the average company's revenues from India, it is said to be more exposed to country risk and vice versa. [2], [16], [18]

$$\lambda = \frac{\%\ revenues\ domestically_{firm}}{\%\ revenues\ domestically_{average\ firm}}$$

2.6.5.2.2 Price/Return Based Lambda

Here, the factor " λ " calculates the value of a stock based on the overall performance of a nation's bond market. Companies whose revenues come from the target country in greater proportions experience more price sensitivity to the target country's bond market.[2], [16], [18]

2.6.5.3 A kickback to reality

It is common practice by investment bank analysts to use country risk premium of the country of origin of a company and to call it a day.[2] Emerging market companies with substantial exposure in developed markets are thus affected by the analysts' assumptions of higher risk exposure to an emerging market CRP and thus heavily undervaluing the company. [18]This is where we as an analyst, can spot inefficiencies and try to bring fruit to our labor.

2.7 Implied Equity Risk Premiums

Implied Equity Risk Premiums are a forward-looking premium which is formulated on estimated cash flows and growth rates and thus capturing the market's essence not through existing data, but by forecasting it.[2], [19], [20]

We calculate it how we calculate the YTM of a bond, but here, it's for the index:[2], [19]

1. Equate future cash flows to current price, the future cash flows include:
    a. Dividends

b. Buybacks

2. Give a growth rate on this index, as per analysts for the first 4 years of the valuation
3. Give a terminal value with a growth rate equal to the nation's economic growth rate in years 5 and beyond; in this case, the T.Bond rate forever.
4. The IERP would be the discount rate you get.

Calculating the implied equity risk premium for the US on Jan 2023

- S&P 500 on 1/1/23 = 3839.50
- Base year cash flow (TTM) = Dividends (TTM) + Buy backs (TTM) = Cash to investors (TTM)
- Base year cash flow (TTM) = 65.54 + 116.46 = 181.99
- Analysts growth rate for first 5 years = 6.41%
- Risk-free rate = 3.88% = growth rate at Terminal Value

	TTM	2023	2024	2025	2026	2027	TV
Earnings	219.49	233.55	248.52	264.44	281.38	299.41	311.03
Expected Growth	6.14%	6.14%	6.14%	6.14%	6.14%	6.14%	3.88%
Cash to Earnings	89.78%	89.78%	89.78%	89.78%	89.78%	89.78%	89.78%
Dividends + Buybacks	181.99	209.68	223.12	237.41	252.62	268.81	279.24

Table 2.7.1 Implied Equity Risk Premiums calculation

$$3839.50 = \frac{209.68}{(1+r)} + \frac{223.12}{(1+r)^2} + \frac{237.41}{(1+r)^3} + \frac{252.62}{(1+r)^4} + \frac{268.81}{(1+r)^5} + \frac{279.24}{(r-0.0388)(1+r)^5}$$

Solving for r yields, r = Implied Expected Rate of Return on Stocks = 9.82%

Implied Equity Risk Premium (1/1/23) = r – risk-free rate = 9.82 – 3.88 = 5.94%

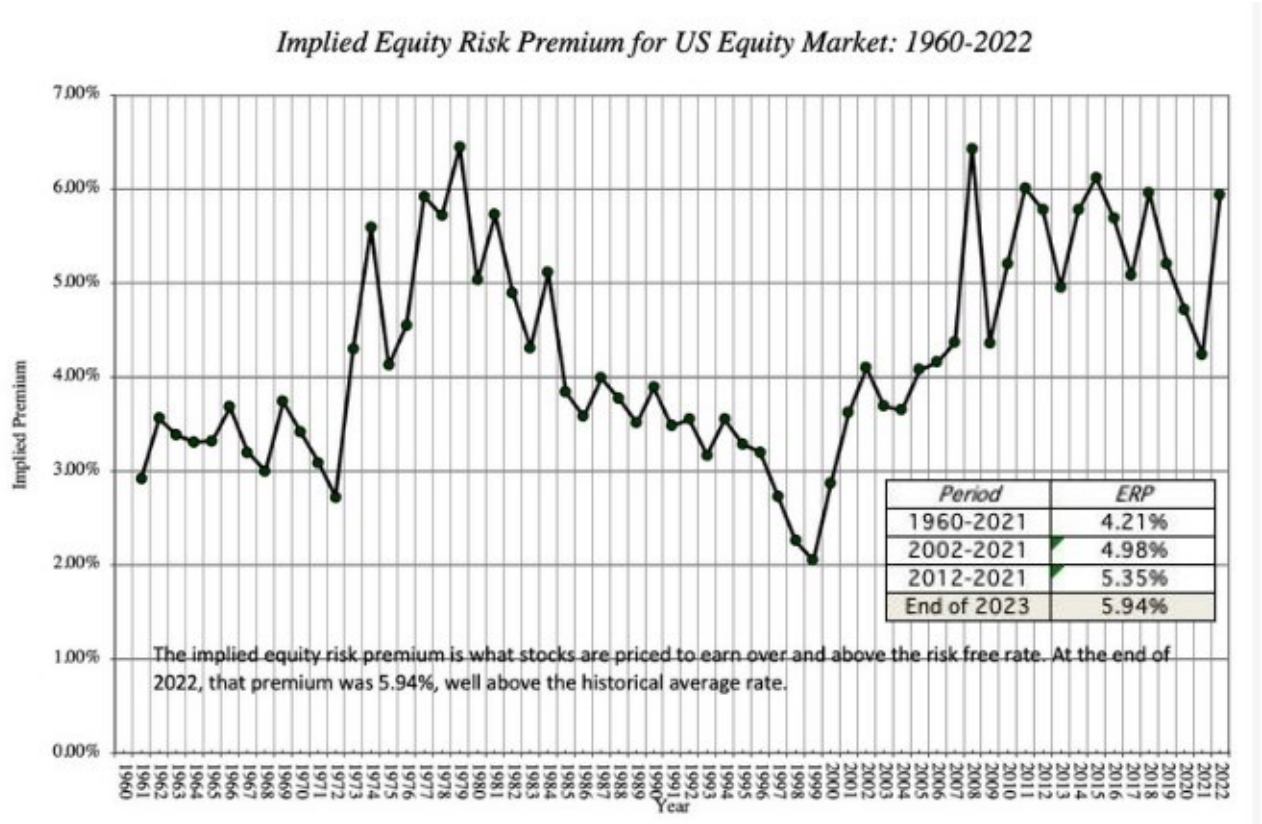


Figure 2.7.1 Implied Equity Risk Premiums across 1960-2022

Through this graph, we are able to see that the Implied Equity Risk Premiums are a better estimate of risk premiums than just historic averages which bore a lot of standard deviation.[2]

2.8 Betas

Beta (β) measure the volatility of a security compared to the market as a whole.[2]

2.8.1 The CAPM Beta or the Regression Beta and it's unreliability

1. High standard error and noisy value. [2], [5], [21]Similar to previous use cases of historical data, quite simply put, the sample sizes for the market, let a lone a company in the case of betas, is too small to get a reliable beta value with low standard error.
2. It's backward looking,[2], [5], [21] the Beta is going to capture the company over the last x number of years and doesn't reflect the current standing.
3. Instead of the present leverage, it depicts the firm's average financial leverage during the time period.[2], [5], [21]

2.8.1.1 Adjusted Beta

More often than not, adjusted beta is basically raw beta moved towards 1 by a factor of 1/3. [2], [21]While this gives a number that is pleasant to work with, the basis behind this calculation is meaningless. And yet, the current financial institutions stand by this metric.

$$AdjustedBeta = (2/3)Beta + (1/3) * 1$$

This is not a meaningful venture to investigate.

2.8.2 Bottom-up Betas

2.8.2.1 Three fundamental questions

Bottom-up Betas allows us to ask relevant present time questions to integrate in our beta calculation:

- "What kind of Business are you? What do you do? What do you sell?"
    - The kind of business allows us to understand the relative risk of different commodities depending on the Elasticity of demand on these commodities. Commodities and services like food, groceries, which are evergreen and one cannot live without will have lower betas. Conversely, luxury markets will have higher betas.[2]
    - The number of current business ventures of a company is also an important aspect to understand the risk associated to the exposure to different market segments.
- "What is the cost structure? How much of it is fixed costs and how much is variable?"
    - Fixed costs lead to rigid cash flows which occur regardless of external appreciation and depression of markets. For example, a car manufacturer would have to make the same fixed costs to procure raw materials regardless of whether the car business segment is doing great or terrible. Fixed costs are associated to higher betas.[2]
    - Variable costs are flexible in nature thus warrant lower betas.
- "What is the financial leverage of the company?"
    - Interest payments on your borrowings introduce fixed costs to your cash flows and thus pushing your risk and thus the beta higher and vice versa.[2]

2.8.2.2 Adjusting Beta for leverages

2.8.2.2.1 Adjusting operating leverage as debt and counter asset

Unlevered betas should be lower for companies whose fixed expenses as a percentage of overall costs are lower.[9] As a result, it is necessary to separate fixed costs from variable costs for each firm in a sector which yields an unlevered betas as a function of business and operating leverage components.[9]

$$Unlevered\beta = PureBusiness\beta\left(1 + (FixedCosts/VariableCosts)\right)$$

The biggest problem here is Informational. Often, you will run into informational gaps is what is fixed and what is variable in costs. Typically, we utilize the same unlevered beta for all the firms in a business based on the assumption that their operating leverage is comparable.

286.2.2.2 Adjusting for financial leverage in the debt

We presume that debt has a beta of 0, or no market risk. The debt-to-equity (D/E) ratio and the unlevered beta can be used to calculate the beta of equity alone. [9]

$$\beta_L = \beta_U \left(1 + \left((1-t)D/E\right)\right)$$

However, in cases where the company is B rated or CCC rated and below, the market risk on defaulting is noticeable and thus, the component of market risk on leverage carries as beta of debt (β debt).[9]

$$\beta_L = \beta_U \left(1 + \left((1-t)D/E\right)\right) - \beta_{debt}(1-t)(D/E)$$

2.8.2.3 Determining Bottom-up Betas

1. Understand the different businesses that the firm has revenues from.[2], [22]
2. Determine a large number of companies in the same sector for each business and determine their regression betas – all regression betas are levered [2], [22]
    a. Take an average beta using these values
    b. Unlever the beta using average debt to equity ratio for all these companies using the relation between levered and unlevered beta
3. Determine the value of each business of your company and compute a weighted average of the unlevered betas using suitable weights like revenues, etc. [2], [22]
4. Utilizing your company's market debt to equity ratio and the relationship between the equations for levered and unlevered beta once again, calculate your firm's overall leveraged beta. [2], [22]

2.8.2.4 Advantages of Bottom-up Betas

1. Less Noisy
    a. A bottom-up beta's standard error will be considerably less than that of a single regression beta because we are using exponentially more data by considering 100s of companies, thus increasing the sample size which reduces the standard error.[2]
    b. Betas reflect exposure to macroeconomic risk.

2. Updated value
    a. The firm's business mix and financial leverage can change, and this can be reflected in the bottom-up beta. Betas for regressions represent the past.[2] Let's say a company ventures into a new business today, a regression beta cannot reflect this, but we can still compute a bottom-up beta for the same.
3. Don't need prices.
    a. Bottom-up betas can be estimated without historical stock prices. [2]So, we can value IPOs, sections and divisions in a conglomerate or privatized companies.

2.9 Cost of Debt

The rate at which a business can take on long-term debt is known as the cost of debt. [23]

The risk-free rate, specific to the company, is multiplied by a default spread to obtain COD. We can derive these default spreads from rating agencies.[2], [5]

2.9.1 Estimating Synthetic Ratings

The interest coverage ratio is an important metric used by the rating agencies like MOODY's to give ratings. [2], [5]

$$Interest\ Coverage\ Ratio\ =\ EBIT/Interest\ Expense$$

EBIT = Expenses Before Interest and Taxes

The interest coverage ratio measures how much operating income a company generate for every $1 interest expense. The higher the number, the safer the company. [2], [5] Reverse engineering these ratings yields us a table correlating the interest coverage ratio and the estimated bond rating, corresponding to the default spread.

Interest Coverage Ratio	*Rating*	*Spread*
> 8.5	AAA	0.75%
6.5-8.5	AA	1.00%
5.5 ❒6.5	A+	1.50%
4.25- 5.5	A	1.80%
3- 4.25	A-	2.00%
2.5-3	BBB	2.25%
2- 2.5	BB	3.50%
1.75-2	B+	4.75%
1.5-1.75	B	6.50%
1.25-1.5	B-	8.00%
0.8-1.25	CCC	10.00%
0.65-0.8	CC	11.50%
0.2-0.65	C	12.70%
<0.2	D	14.00%

Table 2.9.1 2023 table correlating the ICR and default spread for high market cap companies

2.10 Cost of Equity

The rate of return that an investor needs from an equity investment to justify taking on the associated risk is known as the cost of equity. [23]

Section 2.4.5 mentions multiple methods of calculation E(Return) this is the cost of equity.

Using IERP =

$$E(R) = R_f + \beta(IERP)$$

2.11 Cost of Capital

Cost of Capital is the company's minimum return expected that would be necessary to justify any financing activities.[23]

The cost of capital is the weighted average of the cost of debt, cost of equity, weighted with market value of equity and market value of debt respectively. [2], [5]

$$Cost of Capital = Cost of Equity \frac{Market\ Value\ of\ Equity}{Market Value of (Debt + Equity)} + Cost of Debt(1 - t) \frac{Market\ Value\ of\ Debt}{Market Value of (Debt + Equity)}$$

t = Marginal Tax rate

The marginal tax rate is the rate of tax levied by the government on the last dollar of a company's income. [2], [5] The Marginal tax rate is used to reap the benefits of tax deductions by reporting the interest payments at this higher tax bracket. [2], [5]

2.11.1 Generating a Nominal Real Cost of Capital from a Dollar Cost of Capital

This is necessary to convert COC to other currencies when necessary.[2]

$$Cost of Capital_{\ country} = (1 + Cost of Equity_{\$}) \frac{1 + Inflation_{country}}{1 + Inflation_{\$}}$$

2.12 Hybrids and Preferred Stock

Hybrids are part debt and part equity. Some examples are:

2.12.1 A Convertible Bond

A Convertible Bond is a standard bond that has a conversion option to Equity. [2]It has both an equity portion and a debt portion to it that can be essentially decomposed for easier valuation.[2] The steps to do the same are:

1. Use face value of the convertible debt and value it at a discount rate of a straight bond in the company. The company would have a rating which would then correspond to a default rate. Use that rate as the discounting value.[2]
2. Use the interest rate and maturity to get the cash flows.[2]
3. Treat this as a straight bond but use a straight bond interest rate and value it. Discount back the cash flows, including the face value at maturity at the discount rate chosen.
4. This value is the Debt portion of it.[2]
5. To calculate the equity portion of the bond, deduct this amount from its market value.[2]

2.12.2 Preferred Stock

In US, preferred stock act more like Bonds. You get a dividend that is set up front. So unlike equity, where you get residual cash flow, in preferred stock, your dividend yields are set up front. It's a very expensive debt - there is no tax benefit because it is considered equity.[2]

By itself, it's an extraordinarily inefficient way to raise capital. Two types of companies might use this:[2]

1. Very young companies issue convertible preferred stock, but really, that is just a conversion option.
2. Financial service companies - it allows banks to play the regulatory capital game. Normally, when a bank borrows money, it suffers. The regulators measure their capital ratios and debt is not counted for tier 1,2 or 3 capital ratios. However, preferred stock is counted as equity. Through this, banks try to meet the regulatory capital requirements.

Therefore, when valuing banks, there are three different components for capital:[2]

1. Equity
2. Debt
3. Preferred stock - needs to be treated as its own component with a cost - the cost of preferred stock is just the preferred dividend yield = Dividend/Price.[2]

$$Preferred\ Dividend\ Yield\ =\ Dividend/Price$$

2.13 Free Cash Flow

The cash a company generates after cash outflows like for operations and maintenance of capital assets. There are two types:[2]

1. Free Cash Flow to Equity (FCFE) is an after debt cash flow
2. Free Cash Flow to Firm (FCFF) is a pre debt cash flow

2.13.1 Free Cash Flow to Firm[5]

$$EBIT(1 - taxrate) - (CapEx - Depreciation + ChangeinnoncashWorkingCapital) = FCFF$$

$$EBIT(1 - taxrate) - Reinvestment = FCFF$$

$$EBIT(1 - taxrate) * (1 - ReinvestmentRate) = FCFF$$

Reinvestment rate: Reinvestment as a % of after-tax operating income

2.13.2 Free Cash Flow to Equity[5]

$$NetIncome - (CapEx - Depreciation + ChangeinnoncashWorkingCapital) + (NetDebtIssued - DebtRepaid) = FCFE$$

$$Net\ Income - Reinvestment\ +\ New\ Debt\ Cashflow =\ FCFF$$

$$NetIncome * (1 - EquityReinvestmentRate) = FCFF$$

$$Equity\ Reinvestment\ Rate = \frac{Reinvestment\ -\ Net\ Debt\ Cashflow}{Net\ Income}$$

2.13.3 Accounting Updating and Corrections

2.13.3.1 Updating Earnings – Trailing Twelve Month

Trailing twelve month or TTM is the most recent 12 month's financial data. [2]To get trailing 12 month numbers you just need:

1. One annual report (10 K reports)
2. The most recent quarterly reports (10 Q reports)

$$TTMRevenue = Revenues(in last 10K) - Revenues from 2 quarters of last year + Revenues from first 2 quarters of current year.$$

2.13.3.2 Correcting Accountings Earning

1. Operating expenses and financial expenses shouldn't be combined.
    a. Financial Expense: Any tax-deductible obligation you have to fulfil, regardless of your operating performance: Failure to meet results in a loss of business control.[24], [25]
    b. Until 2012, accounting convention treated operating leases as operating expenses, skewing income statements and balance sheets.[2]
2. Operating expenses and capital expenses shouldn't be combined.
    a. Any expense that is anticipated to yield benefits over several years is a capital expense.[2]
    b. Numerous costs (such as R&D) fit this pattern but are classified as operating costs by accountants.[2]

2.13.3.2.1 Operating Leases

Debt is any source of capital that gives rise to contractual commitment.[2]

1. Bank loans - interest expense (contractual commitment)
2. Bonds - coupons
3. Lease - monthly/yearly rental - it's contractual - therefore it's debt

Operating leases should be classified as finance expenses with the following adjustment to earnings and capital because they result in contractual commitments.:[2], [24], [25]

- Operating Lease Debt Value: Operating Lease PV commitments using the discount rate for the pre-tax cost of debt
- Asset for leasing: Operating leases are turned into debt, and a corresponding asset of equal value is likewise created.
- Depreciation must be applied to this counter asset.
- Operating Earnings + Operating Lease Expenses - Depreciation on Leased Asset = Adjusted Operating Earnings.
- Interest Rate: Operating Earnings - Operating Leases - Depreciation.[2], [24], [25]

$$\begin{aligned} &Adjusted\ Operating\ Earnings \\ &\quad = Operating\ Earnings + Operating\ Lease\ Expenses \\ &\quad - Depreciation\ on\ Leased\ Asset \end{aligned}$$

Therefore, this correction

- Adds debt to your balance sheet[2]
- Restates the operating income by only subtracting the depreciation of the leased asset and not the entire expense.[2]

2.13.3.2.2 Research & Development Expenses

Despite the fact that R&D costs are intended to foster future growth, accountants report them as operational expenses in accordance with their accounting requirements- this remains paradigm in describing a capital expenditure. [26]Therefore, to capitalize R&D expenses,

1. Give R&D a specific amortization period (2-10 years, depending on the business)
2. Gather prior R&D costs for the duration of the amortizable life
3. Total the period's unamortized R&D expenditures. By adding together the 1/5th of the R&D expense from five years ago and the 2/5th of the R&D spend from four years ago, the research asset may be calculated if the amortizable life is five years.
4. The sum of unamortized values gives the current asset value of the R&D expenses which is added to Equity, since it's financed by the equity investors.
5. The sum of amortization values gives the total amortization due this year. Amortization of each R&D expense is individualistic. Each R&D expense gets written off 1/amortizable period each year till there is no amortizable value left off the R&D expense.[2], [5], [26]

2.13.3.2.3 One-Time and Non-recurring charges

Truly one-time charges can be written off for the sake of consistency within the valuation. However, companies usually hide annual charges by bundling them together for a period and marking them as an extraordinary expense in a single year. These charges usually recur and have to be normalized by adding back to the yearly expenses of the valuation.[2]

2.13.3.2.4 Accounting Malfeasance/ Fraud[2]

Some red flags to look out for in financial reports:

- Income from unspecified sources
- Income from asset sales or financial transactions which doesn't affect the business revenue
- Sudden changes in expense items
- Regular restatements of the books
- Consistent trend of Accrual Income exceeding Cash Earnings

2.13.3.2.5 Dealing with Negative or Abnormally Low Earnings

- Case 1: One timer extraordinary charge[2]
    - Take this one-time expense out and recompute the income.
- Case 2: Macro factor (commodity price drop or recession) [2]

    - Example, 2020 oil prices dropped and every oil company lost money - you can fix by normalizing revenues
    - You can look at their income over a period before these sudden changes
- Case 3: Young company working on a specific business model [2]
    - As a young company, it takes years to achieve positive earnings and their journey towards a mature company needs to be mapped out through the valuation
- Case 4: Structural problems at company [2]
    - Losses due to manufacturing inefficiencies need to be gradually pathed out to profits if the company is working on them currently

2.13.3 Taxes and Reinvestment

2.13.3.1 Taxes

The marginal tax rate should be gradually increased to the effective tax rate in the future, as you approach maturity.. [2]

2.13.3.2 Net Capital Expenditures

$$Net\ Cap\ Ex = \ Capital\ Expenditures - Depreciation$$

R&D costs and acquisitions need to be taken into account in the net capex because they meet the requirements for a capex but aren't recognized as such by accountants.[2], [5], [26]

- Once research and development costs are classified as capital costs, the adjusted net cap ex will change to

$$\begin{aligned} &Adjusted\ Net\ Capital\ Expenditures \\ &= Net\ Cap\ Ex + Current\ \ Year\ \ R\&D\ expenses \\ &- Amortization\ \ of\ Research\ \ Asset \end{aligned}$$

- Capital expenditures also include purchases of additional businesses. [2] The revised net cap ex is

$$\begin{aligned} &Adjusted\ Net\ Capital\ Expenditures \\ &= Net\ Cap\ Ex + Acquisitions\ of\ other\ firms \\ &- Amortization\ \ of\ such\ Acquisitions \end{aligned}$$

    - Most businesses don't buy new businesses every year. Therefore, a normalised acquisitions metric should be applied (looking at an average across time).

2.13.3.3 Working Capital (WC)

Accounting Definition

$$WC = Current\ Assets - Current\ Liabilties$$

Valuation Definition[2], [5]

$$WC = non - cash\ Current\ Assets - non - debt\ Current\ Liabilties$$

Non-cash current assets are basically wasting assets:

- Inventory – idle stock that is not making money
- Accounts receivable - it does not generate interest

If your cash is invested and is generating money, it's not a wasted asset. If you earn below market rates, it's a wasting asset.[2]

No debt Current Liabilities: We must transfer our short-term debt as well as the short-term element of our long-term debt to our cost of capital debt.[2] So, now, non-debt current liabilities are:

- Accounts payable

2.13.4 Measuring Potential Dividends

The cash flows that remain after a company has made any "investments" it has to make for future growth and net debt repayments (debt repayments minus new debt issues) are the cash flows that could be distributed as dividends. (company bonds where basically the company has borrowed debt, it is cut from the repayments, obviously)) [2]

2.13.4.1 Estimating cash flows for FCFE

FCFE is easy to calculate as it comes out of one financial statement: The statement of cash flows. Cash flows to equity for a levered firm:

Net Income

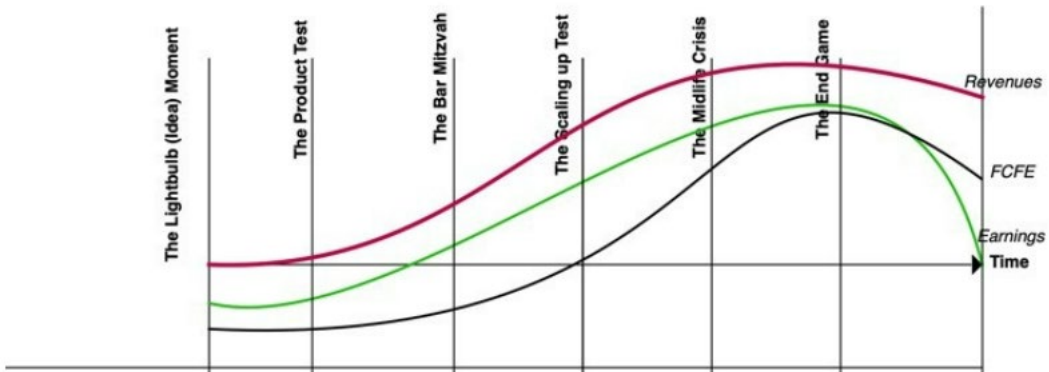
- (Capital Expenditures - Depreciation) **[from the investing section]**

- changes in non-cash working capital **[from the operating section]**

- (New Debt issues - Debt Repaid) **[from the financing section]**

= **FCFE**

2.13.5 FCFE in the life cycle of a company



Lifecycle Stage	Start-up	Young Growth	High Growth	Mature Growth	Mature Stable	Decline
Earnings	Large net losses	Net losses narrow	Net profits turn positive	Net profits grow quickly	Net profits level off, with debt as wild card.	Net profits decline
Reinvestment needed for growth	Very High	High	Remain large, but scale down in percent.	Continue to decrease on scaled basis.	Low	Divestment (creating positive cash flows)
Debt cash flow (Debt issued - repaid)	Usually none	Usually none	If debt exists, net positive, but small.	Net debt cash flow positive.	Net debt cash flow neutal.	Net debt cash flow negative.
Free CF to Equity (Potential cash return)	Negative	May get more negative, with growth	Turns positive as growth slows	Positive & growing (faster than earnings)	Positive & more stable	Positive & higher than earnings.
Cash from/to Equity	Equity Issuances		Self-funding	Equity Buybacks	Dividends + Buybacks	Liquidating Dividends

Figure 2.13.5.1 Lifecycle of a company and relevant metrics

- Net income, as a toddler company, is going to be a net loss. Given high growth in the future, the reinvestment is going to be substantial. FCFE would be a big negative number, and this is called a cash burn. Cash Burn in the early stages is a feature, not a cause for alarm for a high growth company. [2]
- As the company matures, the net income will jump over to the positives but since it is still a growing company, the FCFE will lag still and be in the negatives.
- As growth starts to level off, the FCFEs will turn positive. Reinvesting takes a back seat and the existing investments are bearing fruits and turning profits. [2]

One can use this graph to see when to start giving dividends and determine the life stage of the target company for valuation.

2.13.6 Estimating FCFE when Leverage is Stable

If the leverage is stable, this means that DR = Debt/Capital Ratio = constant

$$FCFE = NetIncome - (1 - DR)(CapEx - Depreciation) - (1 - DR)(WorkingCapitalNeeds)$$

If Debt Ratio is to remain constant, all debt repayments have to be covered by new issues of debt, because if equity is used, the Debt ratio will change. This allows the debt to increase as the company grows and keeps the DR stable.

2.14 Growth Rates

A growth rate is defined as the percentage change of any variable over a period of time. In financial terms, growth rates are often looked at for variables like revenues, income, etc. Growth comes from two important choices. [2], [5]

- Magnitude of reinvestment - Reinvestment growth [2]
- Quality of reinvestment - Efficiency growth [2]

2.14.1 Estimating Fundamental Growth from new investments

2.14.1.1 Earnings Per Share

Reinvestment Rate is measured as % of net income used for reinvestment

$$Retention\ Rate = \%\ of\ net\ income\ retained\ by\ the\ company = 1 - Payout\ ratio$$

Return on Equity is given by:

$$Return\ on\ Equity = \frac{Net\ Income}{Book\ value\ of\ equity}$$

2.14.1.2 Net Income from non-cash assets or FCFE

Equity reinvestment rate is the rate we need to use here:

$$Equity\ reinvestment\ rate = \frac{(Net\ Cap\ Ex + Change\ in\ non\ cash\ WC - Change\ in\ Debt)}{Net\ Income}$$

What's the difference between the Retention rate and equity reinvestment ratio?

- Retention ratio - dividends is what is paid out, and whatever is retained is reinvested.
- Equity Reinvestment Rate - you are actually looking at what the company is investing back into the business.

Retention rate is bound to two values, 0 or 100% - either you retain none of your income or you use all of it for reinvestment.

Equity reinvestment rate is not bound to this because the definition changes drastically – this assumption of "reinvesting income" is broken here, because one can easily raise fresh capital, have this number less than zero (negative reinvestment rate) or, more importantly, greater than 100%.

Non-Cash Return On Equity

$$Non - cash\ Return\ on\ Equity = \frac{Net\ Income\ from\ non - cash\ assets}{Book\ Value\ of\ Equity\ -\ Cash}$$

Net Income can come from:

- operating assets and,
- cash you have accumulated in the company.

On cash, you can make like 4.8% - the T.Bill rate right now.

Similarly, book value of equity is invested in:

- operating assets and,
- cash.

2.14.1.3 Operating Income or FCFF

Reinvestment Rate - looks into the reinvestment rate of both equity and debt

$$Reinvestment\ Rate = \frac{(Net\ Cap\ Ex + Change\ in\ non\ cash\ WC)}{After\ Tax\ Operating\ Income}$$

$$After\ Tax\ Operating\ Income = EBIT(1 - t)$$

You are looking at it as a % of your after tax operating income.

Return on Invested Capital or ROC

$$Return\ on\ Invested\ Capital = \frac{After\ Tax\ Operating\ Income}{Book\ Value\ of\ Equity\ +\ Book\ Value\ of\ Debt\ -\ Cash}$$

These are called sustainable growth rates: you multiply the reinvestment rate and the return to get growth indicator. [2], [27], [28]

2.14.1.3 Growth of Operating Income when ROC is Changing

A second growth component must be included when the return on capital changes.

$$Expected\ Growth\ Rate\ =\ ROC_{t+1} * \ Reinvestment\ Rate\ +\ \frac{(ROC_{t+1} - ROC_t)}{ROC_t}$$

ROC t = ROC on t'th time period

ROC t+1 = ROC on t+1'th time period

This second component is called the Efficiency growth metric.

2.14.2 Top Down Growth

Top down growth is a 3 step process with multiple inputs required: [2]

1. Projecting Revenues
    a. Market Size and Growth
        i. Current Market Size
        ii. Expected Growth in Market
    b. Market Share
        i. Company's current market share
        ii. Industry economics
        iii. Strength of company's competitive advantages
2. Estimating Target margins
    a. Target Operating Margin
        i. Unit Economics
        ii. Economies of scale
        iii. Competition
    b. Pathway to profitability
        i. Company's current operating margin
        ii. Profitability versus Growth trade off
        iii. Business model
3. Estimating the capital that needs to be invested
    a. Current (Historical) Sales to Capital
        i. Company's historical sales to capital
        ii. Industry average sales to capital ratio
    b. Future Sales to Capital
        i. Scaling Effects
        ii. Excess Capacity
        iii. Lag between investment and growth

$$Sales\ to\ Capital\ = \frac{Revenues}{Book\ Equity\ +\ Book\ Debt\ -\ Cash}$$

2.15 Terminal Value

The Terminal Value is the measure of cash flows of your company at its maturity after growth phase. This value is massive that needs to be heavily scrutinized and should be reflective of what the real-world scenario portrays. This value is added after a company's anticipated cash flows for its growth phase have been used up. [2]

2.15.1 Ways of estimating terminal value

2.15.1.1 Liquidation Value

For dying businesses or those that you foresee to have no competitive advantage in the future, everything is liquidated at the time of liquidation as per your forecasts and the value is calculated. [2]

2.15.1.2 Going Concern (perpetuity)

$$TV\ in\ year\ n = \frac{CF_{n+1}}{(r-g)}$$

g = growth rate forever

This method is used for companies that have long lives, that is greater than 40 years. Perpetual growth can never exceed the risk-free rate.[2]

2.15.1.3 Going Concern (finity)

$$TVinyearn = PVofCFinyears(n+1)to(n+k)$$

This method is for companies that have shorter lives (10-15 years) and where you can estimate cash flows to the end period. [2]

2.15.1.4 Pricing

This is the most used metric by investment banks [2]

You basically get the year 10 EBITDA and multiply it with an estimated multiple - by examining publicly traded businesses operating in the same market. [2]

Basically, we make the biggest value of an intrinsic valuation into a pricing number. This is not good practice for intrinsic valuation. Instead, this is called forward pricing. [2]

2.15.2 Justifying reinvestment and growth in the terminal value

Growth means to reinvest, and in the terminal value, you have to be careful:

- Sustainable growth is useful in the terminal values
- Your growth has to be tied to ROC and reinvestment rate only, because you can't keep increasing your efficiency in perpetuity.

$$TV\ in\ year\ n = \frac{EBIT_{n+1}(1-t)\left(1-\frac{g}{ROC}\right)}{(Costof Capital - g)}$$

- EBIT = Expenses Before Interest and Taxes
- g = Growth Rate
- ROC = Return on Capital

2.15.3 Should excess returns be equated to zero?

Some (McKinsey, for example) contend that in stable growth, the return on capital should always equal the cost of capital. Some (McKinsey, for example) contend that in stable growth, the return on capital should always equal the cost of capital.However, this is not what is observed in the real world scenario.[2]

Sometimes, the ROC can be over the COC, while the growth declines. These are some companies, where you can assume the ROC to be higher than COC for a very long time, because they have a strong and sustainable competitive advantage in perpetuity. [2] Example, Coca-Cola.

Mature companies have certain factors that you should consider when you are valuing high growth and mature companies, as your valuation is taking these companies to their maturity [2]:

- Betas should be close to one
- Debt ratios are comparable to the average in the sector of business
- Lower COC
- Lower risk and easier debt
- In growth, ROC tends to COC
- In growth, ROE tends to COE
- Debt ratios closer to industry averages
- The reinvestment needs and dividend payout ratios should reflect lower growth and excess returns:
    - Stable period payout ratio = 1- g/ROE
    - Stable period reinvestment rate = g/ROE

2.16 Models of Valuation

2.16.1 Choose the appropriate model

1. To value the equity of a company, you need the following:
    a. Free cash flows to equity, which is post debt cash flows
    b. Cost of equity that reflects the leverage of the company
2. To value the firm, you need the following:
    a. Free cash flows to firm, which is pre debt cash flows
    b. Cost of Capital that reflects the mix of debt in the company
3. Within the context of equity valuation, we can discount dividends or FCFE
    a. If you can estimate FCFE, always use it
    b. If you cannot estimate FCFE, dividends is a good choice. This is the case for banks, because estimating the constituents of FCFE (like hybrids and preferred stock) is such a hassle that it is more convenient to do dividends discount model.

So, the different cases are:

Case 1: If your company has stable leverage, both FCFE and FCFF are applicable.

Case 2: But like most firms, this is not the case in real life, where the debt ratio and usually without relevant information for the same, it is easier to do FCFF than FCFE. Because, for FCFE we have to calculate debt repayments and debt issuances – which is dynamic, even between 10Qs.

2.16.4 Choosing the right discount rate

- Use cost of equity when using the FCFE model
- Use cost of capital when using FCFF model

2.14.4.1 Currency considerations

Currency of the discount rate and the risk-free rate should match the currency of cash flows chosen.

2.14.4.2 Nominal versus Real terms

- Use real cost of capital for real cash flows
    - Real terms should be used for countries in economies with high inflation rate (>10%) [2]
- Use nominal cost of capital for nominal cash flows
    - Nominal terms should be used for countries in economies with lower inflation rate (<10%) [2]

2.16.3 Choosing the growth rate

2.16.3.1 Case 1: Already a mature company

- Large company that is growing at a rate comparable to the rate of growth of the surrounding economy or
- The company is, due to legality and the law of the land, unable to grow at a higher growth rate
- Company demonstrates the traits of a stable business (average risk and reinvestment rates)

We need to utilize a stable growth and an appropriate model for these companies [2]

2.16.3.2 Case 2: On the way to a mature company

- A sizable business with moderate growth (<= overall growth rate + 10%) or
- The business only sells one product and has entry hurdles with a limited lifespan (e.g., patents)

We need to use a two stage, multi growth inputted model - High growth number for, say, first 5 years and for the next stage, grow it at the risk-free rate [2]

2.16.3.3 Case 3: Small and high growth company

- Smaller company having a very accelerated growth rate (> Overall growth rate + 10%)
- Has many obstacles for entry to a business
- has qualities of a high-growth company

We need to use a multi growth rate inputted model with severel level of stages – an n stage model. So, basically transition from say a high growth rate, e.g., 50%, to the growth rate of the economy, say 3% in multiple stages seen fit. [2]

3 PROBLEM STATEMENT AND OBJECTIVES

3.1 Problem Statement

Corporate Valuation in industry is a field of ambiguity and strict models that needs to be structured and documented. In the current state of valuation, investment banks and analysts alike make inconsistent and baseless assumptions that often bring in biases that are often motivated by monetary benefits and corporate relationships.

The valuation in question is of Lockheed Martin Corporation as a stable mature company which has seen high growth phases due to its relatively recent defense contracts with the United States. Through valuation, a comparable intrinsic value of the stock of the equity needs to be determined before fact checking the numbers and tying up loose ends by justifying the same with stories and predictions on the future operations of the company.

3.2 Objectives

The project aims to

1. Develop an understanding the concepts outlined by Dr. Aswath Damodaran and understanding its use cases against the current methodology in the industry of finance
2. Produce an initial valuation report on a company of our choice – a mature company with consistent dividends and a high growth company, using Dr. Aswath Damodaran's methodology and tools.
    a. Acquiring data from relevant sources
    b. Study the different use cases under this methodology
    c. Produce an initial Intrinsic Valuation Report
3. Produce a thorough valuation report for the company which requires us to build a justifiable story for the various inputs and thus fact checking the valuation and the methodology.
    a. Produce the final Intrinsic Valuation report with storytelling
4. Produce a stock value against the market price and give suggestions as – buy, sell, hold with respect to the valuation produced.
5. Develop a python program to get real time Dynamic IERP for the commoner.

4 METHODOLOGY AND EXPERIMENTAL SET UP

4.1 Methodology

This section outlines the steps that will be taken to attain the objectives of the project, which are to develop an understanding of the various methods of valuation as detailed by Dr. Aswath Damodaran and to use this methodology to asses the company of choice via an in-depth literature review.

4.1.1 Conducting Literature Review

The first step in our methodology is an in-depth literature review to develop an understanding of the various methods of valuation as detailed by Dr. Aswath Damodaran. This review was structured in twelve parts and has been presented by Chapter 2 previously.

These twelve parts refer to the various inputs and use cases that are required by a Discounted Cash Flow Model to not just function, but also to tailor each valuation to the working of the target company. We also discuss the various use cases and processes required to clean the data acquired from accounting principles.

1. Discounted Cash Flow Valuation Priors
2. The Essence of Intrinsic Valuation in DCF
3. The first steps in Discounted Cash Flow Analysis or DCF Valuation
4. Risk and Return Models
5. Risk-free rate
6. Equity Risk Premiums
7. Implied Equity Risk Premiums
8. Betas
9. Cost of Debt
10. Cost of Equity Cost of Capital
11. Cost of Capital
12. Hybrids and Preferred stock
13. Free Cash flow
14. Growth Rates
15. Terminal Value
16. Choosing and using the right model

4.1.2 Data and information collection

This step involves in identifying relevant data from various sources for the need of valuation. This includes data and information from but is not limited to:

1. 10 K or Annual Reports on the company
2. Bloomberg Terminal data for macroeconomic data
3. Earnings calls data
4. Online finance tickers like Yahoo Finance
5. Analysts websites for analysts forecasts and estimates
6. Literary sources like Investopedia, Dr. Aswath Damodaran’s data dump and tools, etc.

4.2 Experimental Set Up

Company of choice: Lockheed Martin Corporation

Traded as: NYSE: LMT

Industry: Aerospace, Defense

Country of Origin: United States

Date of Valuation: August 2023

Excel spread sheets and tools used to obtain result:

- Model.xls
- fcffsimpleginzu.xls
- fcfe.xls
- Ratings.xls
- ERPSep23

5 RESULT ANALYSIS AND DISCUSSION

5.1 Trailing Twelve Month

Before we start, we have to devise the trailing twelve month financial statements to understand the current scenario of the company and its financial statements. To do this, we take the last two quarterly reports of 2023, the last 10 K of 2022 and subtract the first two quarters of 2022 and add back the first two quarters of 2023. By doing this, we get the following financial statements

5.1.1 Income Statement (TTM)

(in millions, except per share)	TTM
Net sales	
Products	56495
Services	10958
Total net sales	67393
Cost of sales	
Products	-50520
Services	-9683
Severance and other charges	-100
Other unallocated, net	1468
Total cost of sales	-58835
Gross profit	8558
Other income (expense), net	66
Operating profit	8624
Interest expense	-772
Non-service FAS pension (expense) income	441
Other non-operating (expense) income, net	-4
Earnings from continuing operations before income taxes	8289
Income tax expense	-1229
Net earnings from continuing operations	7060
Net loss from discontinued operations	
Net earnings	7060
Earnings (loss) per common share	
Basic	
Continuing operations	27.4
Discontinued operations	
Basic earnings per common share	27.4
Diluted	
Continuing operations	27.3

Discontinued operations	
Diluted earnings per common share	27.3
	0
Cash dividends paid per common share	11.8

Table 5.1.1.1 Income Statement TTM

5.1.2 Latest Balance Sheets from last 10 Q

(in millions)	2023 - 10Q2
Assets	
Current assets	
Cash and cash equivalents	3,673
Receivables, net	3,427
Contract assets	13,008
Inventories	3,498
Other current assets	481
Total current assets	24,087
Property, plant and equipment, net	7,966
Goodwill	10,795
Intangible assets, net	2,336
Deferred income taxes	4,518
Other noncurrent assets	7,276
Total assets	56,978
Liabilities and equity	
Current liabilities	
Accounts payable	3,466
Salaries, benefits and payroll taxes	2,896
Contract liabilities	8,184
Current maturities of long-term debt	283
Other current liabilities	2,875
Total current liabilities	17,704
Long-term debt, net	17,262
Accrued pension liabilities	5,373
Other noncurrent liabilities	7,399
Total liabilities	47,738
Stockholders' equity	
Common stock, $1 par value per share	251
Additional paid-in capital	
Retained earnings	17,068
Accumulated other comprehensive	-8079

Total stockholders' equity	9,240
Total liabilities and equity	56,978

Table 5.1.2.1 Latest Balance sheets from 10-Q pertaining to Q2 FY2023

5.1.3 Statement of Cash Flows (TTM)

in millions	TTM
Operating activities	
Net earnings	7,016
Adjustments to reconcile net earnings to net cash provided by operating activities	0
Depreciation and amortization	1,387
Stock-based compensation	253
Equity method investment impairment	0
Tax resolution related to former IS&GS business	0
Deferred income taxes	-652
Pension settlement charge	0
Severance and other charges	100
Changes in:	0
Receivables, net	460
Contract assets	-575
Inventories	-287
Accounts payable	537
Contract liabilities	160
Income taxes	-119
Qualified defined benefit pension plans	-348
Other, net	-53
Net cash provided by operating activities	7,879
Investing activities	0
Capital expenditures	-1,747
Other, net	-60
Net cash used for investing activities	-1,807
Financing activities	0
Issuance of long-term debt, net of related costs	5,919
Repayments of long-term debt	0
Repurchases of common stock	-5,294
Dividends paid	-3,064
Other, net	-121

Net cash used for financing activities	-2,560
Net change in cash and cash equivalents	3,512
Cash and cash equivalents at beginning of year	1,490
Cash and cash equivalents at end of year	5,002

Table 5.1.3.1 Statement of Cash Flows TTM

We are now ready to start with the initial valuation.

5.2 Choosing the right model

Here, we take the use of the spreadsheet Model.xls to aid us in understanding the right model to choose. This spreadsheet is a culmination of the sections 2.14 Choosing and Using the right models.

Inputs: (Aug 2023)

1. Are the earnings positive? **Yes**
2. The expected inflation rate in the economy = 3.20%
3. The expected real growth rate in the economy = 2.00% (Here, the inflation-adjusted bond coupon rate of US is being used – the inflation-adjusted rate portrays the real growth rate in the economy)
4. Expected growth rate in earnings of the company = 2.8% (Analyst growth rate)
5. Current debt ratio = 60.91%

$$Current\ Debt\ Ratio\ = \frac{Market\ Value\ of\ Debt}{Market\ Value\ of\ Debt + Market\ Value\ of\ Equity}$$

   a. Market value of equity = outstanding shares * stock price = $104170 Million
   b. Market value of debt = PV (debt, cost of debt, maturity) = $ 14442.86 Million
      i. Cost of debt = 5.18% (we get this from the ratings.xls sheet)
         1. ICR = EBIT/ Interest expense = 8624/772 = 11.17
         2. The synthetic rating is AAA corresponding to a default spread of 0.74%
         3. The current 10 year US Treasury Bond is trading at 4.44% = risk-free rate (US$)
      ii. Therefore COD = Default spread + risk-free rate = 5.18%
      iii. Weighted average maturity = t =18 (from Table 5.2.1) (rounded)
      iv. Total debt = net Long term debt + short term portion of long term debt = 17262+283 = $ 17545 Million

v. Annuity = Average interest payments over last three years (2022 - 2017) = (772+623+569+591+653+668+651)/7 = $ 639.71 Million

vi. Market Value of Debt = PV Annuity (Book Value of Debt, Average Interest payments, COD, Weighted average maturity) = PV (17545, 639.71, 5.18%, 18)

$$PV_{Annuity} = \left(\frac{Annuity}{r}\right)\left(1 - \frac{1}{(1+r)^t}\right) + \frac{Book\ Value\ of\ Debt}{(1+r)^t}$$

c. PV = Market Value of Debt = $ 14442.86 Million

d. Current Debt ratio = 14442.86 / (14442.86 + 104170) = 0.1217 = 12.71%

	Principle (P)	**Maturity (t)**	**Principle*Maturity**
	0	1	0
	0	2	0
	500	2	1000
	1000	3	3000
	750	4	3000
	400	7	2800
	800	9	7200
	1000	10	10000
	500	12	6000
	1054	13	13702
	1336	19	25384
	1000	22	22000
	1326	23	30498
	750	27	20250
	1578	29	45762
	850	30	25500
	1000	31	31000
	500	5	2500
	850	11	9350
	650	32	20800
	650	39	25350
	750	40	30000
	1598	4	6392
Total Debt	18842	SUM of P*t =	341488
		Weighted average maturity of total debt	18.12376605

Table 5.2.1 Weighted Average Maturity of Total Debt

6. Is this debt ratio expected to change significantly = No
7. Cumulative Dividends payout = $3064 Million
8. Feasibility of calculating cap ex and working capital = Yes
9. Net Income = $7060 Million
10. Depreciation and Amortization = $1387 Million
11. Capital Spending = Cap Ex = $1747 Million
12. Change in Non-cash Working Capital = $ 2993 Million
    a. Non-cash Working Capital = non-cash Current Assets - non - debt Current Liabilities
    b. Non-cash WC = (24087-3673) – (17704-283) = $ 2993 Million

FCFE = NI - (Capital Spending - Depreciation) *(1- Debt Ratio) - Δ WC (1-Debt Ratio) = $5749.31 Million

The output of the model demands an FCFE analysis using current earnings with no high growth period and a stable growth in the terminal value.

5.3 Initial Free Cash Flow to Equity Valuation

5.3.1 Net Income

We are not going to normalise earnings for this FCFE valuation as that is not a consideration for the scope of this section.

Net Income = $ 7060 Million

Net Income without interest from cash = Net Income – Last year cash * shirt term government bond rate (here, 1 year govt. bond rate)

Net Income without interest from cash = 7060 - 3673*0.0545 = $ 6859.82 Million

5.3.1 Cost of Equity

5.3.1.1 Risk-free Rate

The current 10-year US treasury bond rate = risk-free rate = 4.44%

5.3.1.2 Beta of the stock

The Bottom up Beta of the stock is calculated. The primary source of revenues of the company is in the Aerospace/Defense sector. Here, we can get the average regression beta of the industry by gathering data from 77 different companies around the global.

Industry average unlevered β = 1.2293

5.3.1.2 Equity Risk Premium

The current Implied Equity Risk premium for the United States = 4.83%

*Cost of Equity = risk-free rate + unlevered β * IERP*

Cost of equity = 4.44 + 1.2293*4.83 = 10.38%

5.3.3 Growth Rate in Net Income

5.3.3.1 Adjusted Net Income by capitalizing R&D expenses

R&D expenses can be extracted from the 10 K reports of the company. These expenses need to be Capitalised. The amortization period for R&D projects in this industry is roughly 10 years.

R&D expense in the current year = 1700, and this get's amortized from next year.

Year	R& D Expenses
-1	$1,500.00
-2	$1,300.00
-3	$1,300.00
-4	$1,300.00
-5	$1,200.00
-6	$988.00
-7	$839.00
-8	$751.00
-9	$697.00
-10	$616.00

Year	R&D Expense	Unamortized portion		Amortization this year
Current	$1,700.00	1.00	$1,700.00	
-1	$1,500.00	0.90	$1,350.00	$150.00
-2	$1,300.00	0.80	$1,040.00	$130.00
-3	$1,300.00	0.70	$910.00	$130.00
-4	$1,300.00	0.60	$780.00	$130.00
-5	$1,200.00	0.50	$600.00	$120.00
-6	$988.00	0.40	$395.20	$98.80
-7	$839.00	0.30	$251.70	$83.90
-8	$751.00	0.20	$150.20	$75.10
-9	$697.00	0.10	$69.70	$69.70
-10	$616.00	0.00	$0.00	$61.60
Value of Research Asset =			$7,246.80	$1,049.10

Amortization of asset for current year =	$1,049.10

Tables 5.3.1 a) R&D Expenses upto year (-10); b) Amortization and counter asset calculation

Amortization of an asset occurs at a (R&D Expense*1/amortizable period) rate per year till it is completely exhausted on year 10. Each year, the amortization of this asset is written off. Therefore, the amortization of each R&D expense in the last 10 years is added and the sum is considered the amortization for the current year. The unamortised portion of each is summed and is considered the R&D counter asset.

5.3.3.2 Adjustments to other Financial line items

Adjusted Net Income = Net Income from non-cash assets + Current year R&D expense – amortization for the current year = 6859.82 + 1700 – 1049.10 = 7510.72

5.3.3.3 Non Cash ROE (ROE)

$$Non - cash\ Return\ on\ Equity = \frac{Net\ Income\ from\ non - cash\ assets}{[Lastyear]Book\ Value\ of\ Equity - Cash}$$

Non Cash ROE = (7510.72)/(9266-2547) = 1.1178 = 111.78%

5.3.3.4 Equity Reinvestment rate

$$Equity\ reinvestment\ rate = \frac{(Net\ Cap\ Ex + Change\ in\ non\ cash\ WC - Change\ in\ Debt)}{Net\ Income\ from\ non\ cash\ assets}$$

Net Cap Ex = Cap Ex – Depreciation

Equity Reinvestment rate = (1747-1387 + 2993 – 2000)/ (6859.82) = 0.1972 = 19.72%

5.3.3.5 Growth rate

Growth Rate = Equity Reinvestment Rate * Non-cash ROE = 1.1178*0.1972 = 0.22047

Growth Rate = 22.05%

5.3.3 Present Value of FCFEs in growth

FCFE = Net Income * (1 - Equity Reinvestment Rate) = net income available to investors

Present Value at the end of growth (here, for t = 5 years) =

$$PV = \frac{NI_0 * (1 + EqRR) * (1 + ROE)^1}{(1 + COE)^1} + \frac{NI_0 * (1 + EqRR) * (1 + ROE)^2}{(1 + COE)^2} + \frac{NI_0 * (1 + EqRR) * (1 + ROE)^3}{(1 + COE)^3} + \frac{NI_0 * (1 + EqRR) * (1 + ROE)^4}{(1 + COE)^4} + \frac{NI_0 * (1 + EqRR) * (1 + ROE)^5}{(1 + COE)^5} + \dots$$

$$PV = \sum_{i=1}^{t} \frac{NI_0 * (1 + EqRR) * (1 + ROE)^i}{(1 + COE)^i}$$

This is calculated in a spread sheet.

	1	2	3	4	5
Expected Growth Rate	22.05%	22.05%	22.05%	22.05%	22.05%
Net Income	$8,372.25	$10,218.13	$12,470.99	$15,220.55	$18,576.32
Equity Reinvestment Rate	19.72%	19.72%	19.72%	19.72%	19.72%
FCFE	$6,720.95	$8,202.75	$10,011.27	$12,218.52	$14,912.41
Cost of Equity	10.38%	10.38%	10.38%	10.38%	10.38%
Cumulative Cost of Equity	110.38%	121.83%	134.48%	148.43%	163.83%
Present Value	$6,089.05	$6,732.84	$7,444.70	$8,231.82	$9,102.16

Tables 5.3.3.1 PV calculation for growth period

Calculating this, gives us the total value PV = $37,600.58

5.3.4 Value of the Terminal Equity Value

Growth rate in Stable Phase = g = 4.44% = risk-free rate

ROE for stable growth rate = 10%

Stable Equity reinvestment ratio = Growth rate in stable phase / ROE for stable phase = 44.4%

Cost of Equity in stable phase (considering beta doesn't change) = 10.38% = COE = r

$$Terminal\ Value = \frac{FCFE_t(1 + g)}{(r - g)}$$

Here, t = 5

Terminal Value = {18576.32*(1-0.444)* (1+0.0444)} / {(0.1038-0.0444)} = $ 181675.47 Million

Present Value of Terminal Equity Value = $1,10,890.20 Million

5.3.5 Value of equity in firm

Value of Equity in firm = Present Value of terminal value + Present value of FCFEs in high growth phase + current value of cash and marketable securities

Value of Equity in firm = 110890.20 + 37600.58 + 3673 = $ 152,163.78 Million = $ 152.163 Billion

Value per share = Value of Equity / Total Outstanding shares = $ 152,163.78 Million / 251.83 Million = $604.23

5.3.6 Conclusive remarks

The current market price = $ 413.65

The output of the intrinsic valuation model = $604.23

Therefore, based on this initial intrinsic valuation model, the recommendation is to buy the stock.

5.4 Implied Equity Risk Premiums Valuation

Calculating the implied equity risk premium of the US market is of paramount importance, as this number serves as the benchmark upon which the risk premiums of other countries is built upon.

5.3.1 Inputs

Calculating the implied equity risk premium for the US on Jan 2023

- S&P 500 on 1/9/23 = 4508
- Base year cash flow (TTM) = Dividends (TTM) + Buy backs (TTM) = Cash to investors (TTM)
- Base year cash flow (TTM) = 171.87
- Analysts Top Down growth rate for first 5 years = 7.14%
- Risk-free rate = 4.11% = growth rate at Terminal Value
- Estimated base year earnings = 218.09

	TTM	2023	2024	2025	2026	2027	TV
Earnings	218.09	233.67	250.35	268.24	287.39	307.92	320.57
Expected Growth	7.14%	7.14%	7.14%	7.14%	7.14%	7.14%	7.14%
Cash to Earnings	85.25%	85.25%	85.25%	85.25%	85.25%	85.25%	85.25%
Dividends + Buybacks	171.87	199.20	213.43	228.67	245.00	262.50	273.29

Tables 5.4.1 Expected CF calculation

$$4508 = \frac{199.20}{(1+r)} + \frac{223.43}{(1+r)^2} + \frac{228.67}{(1+r)^3} + \frac{245.00}{(1+r)^4} + \frac{262.50}{(1+r)^5} + \frac{273.29}{(r-0.0411)(1+r)^5}$$

Solving for r yields, r = Implied Expected Rate of Return on Stocks = 9.017%

Implied Equity Risk Premium (1/9/23) = r – risk-free rate = 9.02 – 4.11 = 4.91%

5.5 Free Cash Flow to Firm Valuation

All metrics in millions of dollars unless otherwise stated. These inputs are extracted from the TTM devised and the 10-K 2022, 10-Q 2023 Q1 and 10-Q 2023 Q2 reports.

5.5.1 Inputs

5.5.1.1 Inputs from fundamentals

1. Revenues (TTM) = 67393.00
2. Operating Revenue/ EBIT = 8624.00
3. Interest Expense = 772.00
4. Book Value of Equity = 9240
5. Book Value of Debt = 17545 = Long term debt + current maturities of long term debt
6. Cash and marketable assets = 3673

Here, to understand the many cross holdings of Lockheed Martin, I looked into the total Book Value of the assets owned. However, to convert them to their price, I could not find information on the individual company holdings. Therefore, we are looking at a multi- industry average of Price to Book ratio and deriving the price from that. From Lockheed Martin website, their industries of focus for investments are:

- Artificial Intelligence
- Autonomy & Robotics
- Cybersecurity

- Human Potential
- Materials & Manufacturing
- NextGen Electronics
- Power & Propulsion
- Quantum Technologies
- Sensor Technologies
- Signals & Communication Tech
- Space Technologies
- Synthetic Biology

This can be categorised to the following industries with their average P/E ratios as:

- Aerospace/Défense – 4.93
- Electrical Equipment – 3.13
- Electronics – 3.06
- Engineering – 2.82
- Machinery – 4.06
- Metals and Mining – 2.75
- Software (system and applications) – 8.39
- Chemical (specialty) – 2.83

Average Price to Book ratio = 4.00

7. Price to Book ratio (no units) = 4.00
8. Book value of holdings = 587.00
9. Price Value = BV * P/B = 587*4 = 2348
10. Number of shares outstanding = 251.83 Million
11. Current Stock price (1/9/2023) (in unit US dollar) = $ 448.18
12. Effective Tax rate = Weighted Average Tax Rate weighted using income tax expense for past 3 years

Year	Effective yearly/semi annual Income Tax Rate	Income tax expense	Weighted value
2023 - 6 months	16.8	630	10584
2022	14.2	1403	19922.6
2021	16.4	1585	25994
2020	16.4	1729	28355.6
	Sum	5347	84856.2
	Weighted average effective tax rate =	15.86987096	

Tables 5.5.1.1.1 Weighted average tax rate calculation

13. Marginal Tax rate = t = 21%

14. Revenue growth rate next year = 5.98% (refer section 5.4.6)
15. Operating Margin for next year = 13.97% (most recent year)
16. Target pre-tax operating margin = 8.64% (Industry average US)
17. Compounded annual revenue growth rate – years 2-5 = 5.98% (refer section 5.4.6)
18. Years of convergence for margin = 30
19. Sales to capital ratio FY1-5 = 1.46
20. Sales to capital ratio FY6-10 = 1.89
21. Initial Cost of Capital = 9.95 % (refer section 5.4.2)

5.5.2 Cost of Capital

5.5.2.1 Cost of Debt

1. Book Value of straight debt = Total debt = net Long term debt + short term portion of long term debt = 17262+283 = 17545
2. Market value of debt = PV (debt, cost of debt, maturity) = 15046.70
    a. Cost of debt = 5.18% (we get this from the ratings.xls sheet)
        i. ICR = EBIT/ Interest expense (ratio) = 8624/772 = 11.17
        ii. The synthetic rating is AAA corresponding to a default spread of 0.74%
    b. The current 10 year US Treasury Bond is trading at 4.11% = risk-free rate (US$)
3. Therefore **COD = Default spread + risk-free rate = 4.85%**
4. Weighted average maturity = t =18 (from Table 5.2.1) (rounded)
    a. Total debt = $ 17545 Million
    b. Annuity = Average interest payments over last three years (2022 - 2017) = (772+623+569+591+653+668+651)/7 = $ 639.71 Million
5. Market Value of Debt = PV Annuity (Book Value of Debt, Average Interest payments, COD, Weighted average maturity) = PV (17545, 639.71, 4.85%, 18)

$$PV_{Annuity} = \left(\frac{Annuity}{r}\right)\left(1 - \frac{1}{(1+r)^t}\right) + \frac{Book\ Value\ of\ Debt}{(1+r)^t}$$

6. Market Value of Debt = 15046.70
7. Value of Debt from operating leases = 1292.68 (refer section 5.4.3)
8. Total Market Value of debt = 15046.70 + 1292.68 = 16339
9. Current Debt ratio = 16339.38 / (16339.38 +251.83*448.18) = 0.1217 = 12.65%

5.5.2.2 Cost of Equity

1. Market Value of Business = 251830684*448.18 = $ 112865.47 Million
2. Unlevered industry average US Beta = 1.23
3. Implied Equity Risk Premium = 4.91%

$$E(R) = R_f + \beta_L(IERP)$$

5.4.2.2.1 Levered Beta

$$\beta_L = \beta_U\left(1 + \left((1-t)D/E\right)\right)$$

$$\beta_L = 1.23\ (\ 1 + (1-0.21)(16339.38/112865.48) = 1.37$$

Cost of Equity = 4.11 + 1.37*4.91 = 10.84

$$Cost\ of\ Capital = Cost\ of\ Equity\frac{Market\ Value\ of\ Equity}{MarketValueof(Debt + Equity)} + Cost\ of\ Debt(1-t)\frac{Market\ Value\ of\ Debt}{MarketValueof(Debt + Equity)}$$

Cost of Capital = 9.95%

5.5.3 Capitalizing Operating Leases

Operating lease expense in the current year = 295.00

Year	Commitment
1	287.0
2	235.0
3	194.0
4	151.0
5	98.0
6 and beyond	605

Tables 5.5.3.1 Operating Lease Commitments from the Annual report

When converting operating leases to debt, the present value of each expense in the following years is discounted at the cost of debt = (here) r = 4.85% For years 6 and beyond, the commitment is converted to an annuity for Number of years embedded in 6 yr estimate.

$$Debt\ Value_{Operating\ leases} = \sum_{i=1}^{t_1}\frac{OL_i}{(1+r)^i} + \left\{\left(\frac{Annuity}{r}\right)\left(1 - \frac{1}{(1+r)^{t_2}}\right)\right\} * \frac{1}{(1+r)^{t_1}}$$

- Here, t1 = 5

- t2 = number of years embedded in 6 yr estimate

$$Annuity = OL(6 and beyond)/Number of years embedded in 6 yr estimate$$

$$Number\ of\ years\ embedded\ in\ 6\ yr\ estimate\ = \frac{OL_6}{AVG(OL_1 : OL_6)}$$

Number of years = 605 / 193 = 3 (rounded)

Annuity = 605/3 = 201.67

PV of OL 6 years and beyond at annuity 201.67 for 10 years = 434.61

PV of OL 1-5 = 858.07

Year	Commitment	Present Value
1	$ 287.00	$ 273.72
2	$ 235.00	$ 213.76
3	$ 194.00	$ 168.30
4	$ 151.00	$ 124.94
5	$ 98.00	$ 77.34
6 and beyond	$ 201.67	$ 434.61
Debt Value of leases =		$ 1,292.68

Tables 5.5.3.2 PV of each year/years of operating leases and the Debt value of operating leases

Value of Debt from operating leases = 1292.68

$$Depreciation\ on\ the\ counter\ asset\ = \frac{Total\ value\ of\ debt\ from\ operating\ leases}{t_1 + t_2}$$

Depreciation on the counter asset = 1292.68 / (5+3) = 161.58

Adjustment to the operating earnings is to add back OL for current year and subtract depreciation = Operating earnings + 295.00 – 161.58 = 133.42

Adjustment to Book Value of Debt = BV of Debt + debt value of leases = 17545 + 1292.68 = 18837.68

5.5.4 Capitalizing R&D expenses

R&D expenses can be extracted from the 10 K reports of the company. These expenses need to be Capitalised. The amortization period for R&D projects in this industry is roughly 10 years.

R&D expense in the current year = 1700, and this gets amortized from next year.

Year	R& D Expenses
-1	$1,500.00
-2	$1,300.00
-3	$1,300.00
-4	$1,300.00
-5	$1,200.00
-6	$988.00
-7	$839.00
-8	$751.00
-9	$697.00
-10	$616.00

Year	R&D Expense	Unamortized portion		Amortization this year
Current	$1,700.00	1.00	$1,700.00	
-1	$1,500.00	0.90	$1,350.00	$150.00
-2	$1,300.00	0.80	$1,040.00	$130.00
-3	$1,300.00	0.70	$910.00	$130.00
-4	$1,300.00	0.60	$780.00	$130.00
-5	$1,200.00	0.50	$600.00	$120.00
-6	$988.00	0.40	$395.20	$98.80
-7	$839.00	0.30	$251.70	$83.90
-8	$751.00	0.20	$150.20	$75.10
-9	$697.00	0.10	$69.70	$69.70
-10	$616.00	0.00	$0.00	$61.60
Value of Research Asset =			$7,246.80	$1,049.10

Amortization of asset for current year =	$1,049.10

Tables 5.5.4.1 a) R&D Expenses upto year (-10); b) Amortization and counter asset calculation

Amortization of an asset occurs at a (R&D Expense*1/amortizable period) rate per year till it is completely exhausted on year 10. Each year, the amortization of this asset is written off. Therefore, the amortization of each R&D expense in the last 10 years is added and the sum is considered the amortization for the current year. The unamortised portion of each is summed and is considered the R&D counter asset.

Adjustment to operating income = Operating income as stated in financials + Current year R&D expense – amortization for the current year = Operating income + 1700 – 1049.1 = Operating income + 650.90

Adjustment to Book Value of Equity = BV of Equity + Value of Research Asset = 9240 + 7246.80 = 16486.80

5.5.5 Adjustments to other Financial line items

Adjusted Operating Income = Operating Income + (Operating Lease for current year – depreciation of lease counter asset) + (R&D Expense for current year – amortization for current year) = 9408.32 = EBIT

Adjustment to Book Value of Equity = BV of Equity + Value of Research Asset = 9240 + 7246.80 = 16486.80

Adjustment to Book Value of Debt = BV of Debt + debt value of leases = 17545 + 1292.68 = 18837.68

5.5.6 Growth Rates

Reinvestment Rate -

$$Reinvestment\ Rate = \frac{(Net\ Cap\ Ex + Change\ in\ non\ cash\ WC)}{After\ Tax\ Operating\ Income}$$

$$After\ Tax\ Operating\ Income = EBIT(1 - t)$$

t= tax rate = 21%

EBIT (1-t) = 9408.32 (1-0.21) = 7432.5728 (since we are using a sustainable growth rate model, tax rate is marginal tax rate)

$$Net\ Cap\ Ex\ =\ Cap\ Ex\ -\ depreciation$$

Net Cap Ex = 1747-903 (from Yahoo Finance, subtracting amortization from intangible assets) = 844

$$\begin{aligned} Adjusted\ Net\ Capital\ Expenditures \\ &= Net\ Cap\ Ex + Current\ \ Year\ \ R\&D\ expenses \\ &- Amortization\ \ of\ \ Research\ \ Asset \end{aligned}$$

Adjusted Net Cap Ex = 844 + 650.90 = 1494.9

Reinvestment rate = 1494.9 / 7432.57 = 0.2011 = 20.11%

Return on Invested Capital or ROC or ROIC

$$Return\ on\ Invested\ Capital = \frac{After\ Tax\ -\ Operating\ Income}{Book\ Value\ of\ Equity\ +\ Book\ Value\ of\ Debt\ -\ Cash}$$

ROC = 9408.32 / (16486.80 + 18837.68 - 3673) = 0.2972 = 29.72%

Growth rate = Reinvestment Rate * ROC = 0.2011*0.2972 = 0.0598 = 5.98%

5.5.7 Valuation Output

	Base year	*1*	*2*	*3*	*4*
Revenue growth rate		5.98%	5.98%	5.98%	5.98%
Revenues	$ 67,393.00	$ 71,423.10	$ 75,694.20	$ 80,220.72	$ 85,017.92
EBIT (Operating) margin	13.96%	13.96%	13.61%	13.43%	13.25%
EBIT (Operating income)	$ 9,408.32	$ 9,970.66	$ 10,298.45	$ 10,772.04	$ 11,265.44
Tax rate	15.86%	15.86%	15.86%	15.86%	15.86%
EBIT(1-t)	$ 7,916.16	$ 8,389.32	$ 8,665.11	$ 9,063.59	$ 9,478.74
- Reinvestment		$ 2,005.21	$ 2,125.12	$ 2,252.21	$ 2,386.89
FCFF		$ 6,384.11	$ 6,539.99	$ 6,811.39	$ 7,091.85
NOL	$ -	$ -	$ -	$ -	$ -
Cost of capital		9.95%	9.95%	9.95%	9.95%
Cumulated discount factor		0.9095	0.8272	0.7523	0.6842
PV(FCFF)		$ 5,806.35	$ 5,409.84	$ 5,124.43	$ 4,852.59

5	*6*	*7*	*8*	*9*	*10*	Terminal year
5.98%	5.61%	5.23%	4.86%	4.48%	4.11%	4.11%
$ 90,101.99	$ 95,153.10	$ 1,00,131.51	$ 1,04,995.90	$ 1,09,703.92	$ 1,14,212.75	$ 1,18,906.89
13.07%	12.90%	12.72%	12.54%	12.36%	12.19%	12.19%
$ 11,779.33	$ 12,270.94	$ 12,735.39	$ 13,167.89	$ 13,563.79	$ 13,918.73	$ 14,490.79
15.86%	16.89%	17.92%	18.94%	19.97%	21.00%	21.00%

$ 9,911.13	$ 10,198.63	$ 10,453.72	$ 10,673.36	$ 10,854.83	$ 10,995.79	$ 11,447.72
$ 2,672.55	$ 2,634.08	$ 2,573.75	$ 2,491.01	$ 2,385.62	$ 2,483.67	$ 3,136.68
$ 7,238.58	$ 7,564.55	$ 7,879.97	$ 8,182.35	$ 8,469.21	$ 8,512.12	$ 8,311.05
$ -	$ -	$ -	$ -	$ -	$ -	$ -
9.95%	9.78%	9.61%	9.45%	9.28%	9.11%	9.11%
0.6223	0.5669	0.5172	0.4725	0.4324	0.3963	
$ 4,504.75	$ 4,288.13	$ 4,075.14	$ 3,866.30	$ 3,662.08	$ 3,373.32	

Terminal cash flow	$ 8,311.05
Terminal cost of capital	9.11%
Terminal value	$ 1,66,220.92
PV(Terminal value)	$ 65,872.78
PV (CF – 10 years)	$ 44,962.94
Total Present Value	$ 1,10,835.72
Probability of failure =	0.00%
Proceeds if firm fails =	$55,417.86
Value of operating assets =	$ 1,10,835.72
- Debt	$ 18,837.68
- Minority interests	$ -
+ Cash	$ 3,673.00
+ Non-operating assets	$ 2,348.00
Value of equity	$ 98,019.04
- Value of options	$0.00
Value of equity in common stock	$ 98,019.04
Number of shares currently outstanding	251.83
Estimated value per share	$ 389.23

Price	$ 448.18
Price / Value	115.15%

Tables 5.5.7.1 Valuation Output

	Base year	*1*	*2*	*3*	*4*
Implied variables					
Sales to capital ratio		2.13	2.13	2.13	2.13
Invested capital	$ 31,651	$ 33,657	$ 35,782	$ 38,034	$ 40,421
ROIC	25.01%	26.51%	25.75%	25.33%	24.92%

5	*6*	*7*	*8*	*9*	*10*	Terminal year
						After year 10
1.89	1.89	1.89	1.89	1.89	1.89	
$ 43,093	$ 45,728	$ 48,301	$ 50,792	$ 53,178	$ 55,662	
24.52%	23.67%	22.86%	22.10%	21.37%	20.68%	15.00%

Tables 5.5.7.2 Implied Variables

5.4.6.1 Formulas and considerations

Growth rate remains stable at the aforementioned rate up until year 5, but then reduces linearly from year 6 reaching the risk-free rate of 4.11%

$$Growth\ rate\ after\ year\ 5\ in\ year\ i = 5.98\ -\ \frac{5.98\ -\ 4.11}{5} * i$$

EBIT Margins start at current year value of 13.96% from year 1, but then reduces linearly from year 2 over a period of 30 years, reaching the target margin of 8.64% (industry average)

$$EBIT\ Margins\ at\ year\ i = 13.96\ -\ \frac{13.96 - 5.64}{30} * (i - 1)$$

EBIT or operating income = EBIT Margins * Revenues

Reinvestment = Forward-looking change in revenues divided by current year sales to capital ratio The inverse of sales to capital ratio nets us a capital to unit sale, which when multiplied with excess revenues, gives us reinvestment in terms of capital. This is because of the assumption that reinvestment is necessary to realize growth in revenues.

$$Reinvestment\ on\ year\ i = \frac{Revenues_{i+1} - Revenues_i}{Sales\ to\ Capital\ ratio_i}$$

FCFF is the remaining cash flow after all reinvestments done. The excess after-tax operating income is considered to be a cash flow to both investors and lenders.

$$FCFF\ = EBIT(1-t) - Reinvestment$$

Terminal Cash Flow = 8202.88

$$Terminal\ year\ cost\ of\ capital\ = IERP\ +\ risk\ free\ rate$$

Terminal year cost of capital = 4.91 + 4.11 = 9.02%

This is considered so, as companies reach maturity, their COC reduces to the total ERR on equity and debt of the country.

$$Terminal\ Value\ = \frac{FCFF_t(1+g)}{(r-g)}$$

r = Terminal year COC

g = Terminal year growth rate = risk-free rate

$FCFF_t = FCFF\ on\ the\ last\ year\ of\ high\ growth$

Through FCFF valuation, we have arrived at the value of $ 391.29 against the price, $ 448.18 and hence the stock is overpriced. The recommendation is to sell the stock.

5.5 Storytelling and Narrative

Lockheed Martin is one of the biggest players in the entire Aerospace/Defense industry with having a whopping market share of 33.44% as of Q2 2023 just behind the Boeing Company at 36.53%. Within the capital goods sector, Lockheed Martin owns 25.44% of the market share among its competitors. Lockheed Martin is an established brand in the areas of defense and research and is among the biggest defense contractors frequented by the US Government. We will look at 3 different avenues of metrics to understand the current situation of the company and its future.

5.6.1 Cash Flows

Aeronautics business segment is by far the highest grossing segment for the company, with the F-35 program bringing in 27% of total consolidated sales. Programs like these are often won as contracts from the US government where the cash flows come directly from them. However, the government has autonomy over terminating these contracts if the quality of work is deemed unfit by them. The F-35 program is currently delayed by over 10 years and has overbudgeted by more than 80%. This program is fast becoming one of the biggest investments by the US government in terms of financial and political relevance. The F-35 is an engineering marvel that can change the course of aerial surveillance and combat:

- Advanced sensor systems and increased range allow for quick detection of targets and engaging in long distance combat which is highly favored towards the aircraft.
- Next generation stealth capabilities that are essential for surveillance and covert missions
- 3 different variants to reduce costs when serving the 3 wings of the armed forces
- Decreasing cost of operation

However, in the last 2 decades, there has been much controversy regarding the program:

- Immense costs way over budget
- Dysfunctional systems and software capabilities
- Non functional promised advanced combat systems
- Bulky fighter jet with limited maneuverability

In recent times, however, the F-35 has seen favorable views and has enjoyed attention, especially from the European Union. Despite a temporary halt of F-35 deliveries, the number of successful deliveries, albeit in a backlog, is steadily increasing. Advanced weapons programs often take decades of research and performance tests that it is indeed expected of Lockheed martin to face harsh delays.

The increased interest for the aircraft has been increasing over the past couple years and the US has been strongly advocating for the same. This is only bound to increase with several orders pending that need to be fulfilled. Therefore, much of cash flows are locked behind these deliveries, which, once fast-tracked, can open up avenues for high return on invested capital in the future. There is much speculation in how these aircrafts will fair in sales with the rest of the world, and so far, its favorable.

5.6.2 Macroeconomic concerns

While the defense industry is highly competitive in nature, especially when it comes to bidding for US DoD contracts, the industry often tends to a collaborative method of sustenance. The master company of the contract usually subcontracts the contracts to its competition for efficiency and this can lead to higher returns.

With growing geopolitical tensions comes the increased demand for the products of the company. However, government sanctions and security concerns can severely disrupt the supply chain for materials and production. Such an incident was with China imposing sanctions on LMT which has hindered their procurement of raw materials from Taiwan.

Ther Aerospace and Defense industry is highly scrutinized and is subject to heavy procurement laws and regulations which can increase fixed costs and the occurrences of delays and even failure to deliver a service. This, coupled with the contracts and programs, the performance of LMT becomes a crucial metric for sustained cash flows.

5.6.3 Risks

5.6.3.1 Heavy Reliance on US defense contracts

While the US government is required to pay penalties upon termination of contracts, this is still a massive risk in terms of lost potential cash flows that can still massively affect LMT. Heavy competition means that bidding for these contracts becomes tedious and extremely risky with the growing trend of shrinking margins.

5.6.3.2 Subcontractors and suppliers

Default and non-performance by these entities can directly lead to non-compliance with US defense contracts, which can lead to immediate termination with little to no compensation. Therefore, the supply chain for the same needs to be secure and thus risk runs in both the macro and micro economic sense for the same.

5.6.3.3 International sales can pose economic, regulatory, competitive and other risks

Non familiarity with companies in the international market place and geopolitical relations between countries can heavily influence sales in LMT. Much of LMT's revenues are dependent on timely delivery of their products which can get delayed due to supply chain changes in short notice due to changing diplomatic climate in the world.'

5.6.4 Growth

5.6.4.1 F-35 Program

Much of the programs cash flows are contingent on its success and in the future. The ROIC can shoot up massively through a thorough service of the US DoD and even international clients in the EU. However, there is still time to go and therefore, speculations are high. The fact that the government still supports the program after all of it's logistical costs and delays is a positive sign pointing to its journey to success.

5.6.5 Narrative to numbers

Lockheed Martin will continue to be one of the biggest players in the Aerospace and Defense industries. Given their historic contributions to the US armed forces arsenal and the long-standing relations, their weapons program can be considered – "Too big to fail". Therefore, I believe that Lockheed Martin will find success in its most important venture, that is the F-35 program, which has already received favorable updates from the government, news outlets and enthusiasts alike. The cash flow seems to be a bit further in the future and the risk is relatively lower. Growth is also subject on the contingent that is the F-35 program.

The current rate of investment is high, and this investment can bear fruit in the future. A sustainable growth rate yielded 5.98% for years 2-5. After year 10, the assumption of the growth rate equating to the risk-free rate is valid – LMT is a mature company and cannot sustain growth of more than the risk-free rate in the economy. While the company is not small to have such high numbers of growth compared to its average, its unique customers in the international market and its capabilities to completely reimagine the US landscape of arsenal with rising defense budgets and geopolitical tensions can sustain this growth a bit longer.

The revenues of LMT are substantially higher than that of its peers and the market is heavily dominated by the giants that are Lockheed Martin and The Boeing company. I expect for the market share to grow by year 10. Moreover, the operating margins are assumed to coincide with the industry average by year 30. Jet and aircraft servicing can provide extremely high amount of revenue, which in the net decade or so can bring in very high cash flows, Therefore, the rate of convergence is considerably low.

Sales to capital is expected to fall back to the industry averages, once the upfront Cash Flows of the F 35 program are exhausted by deliveries. The stable return on capital is still to be higher than the cost of capital for the firm, given the competitive advantages and potential for cash flows in the future. The Cost of Capital is assumed to converge to a stable growth number given the characteristics of the mature company and through ease of financing. The total outstanding shares were decreased massively, with massive buybacks up until recently, and I doubt that this move would have led to a higher COC.

Failure rate is zero for reasons as discussed above.

5.6.6 Conclusive Remarks

LMT has seen a gradual but a steady increase in price despite the many backlogs, backlash and the controversies surrounding their biggest contracts. Moreover, they are on a upward trend. The numbers are justified to the extent that we can understand the immediate future, but to accurately predict the outcome of their biggest contracts is only up for speculation. LMT is a mature company with consistent dividend payouts and solid management. The industry is heavily scrutinized and therefore is kept in check by their own standards and that of the government.

The FCFE valuation yields an extremely off result due to not considering the inclusion of the R&D counter asset in the Book Value of Equity which would have reduced the Equity Reinvestment Rate and thus given us a different answer. Plugging in this gives us a value of:

1. Non Cash ROE (ROE)

$$Non - cash\ Return\ on\ Equity = \frac{Net\ Income\ from\ non - cash\ assets}{[Lastyear]Book\ Value\ of\ Equity - Cash}$$

Non Cash ROE = (7510.72)/(9266-2547+7246.8) = 0.5377 = 53.77%

2. Equity Reinvestment rate

$$Equity\ reinvestment\ rate = \frac{(Net\ Cap\ Ex + Change\ in\ non\ cash\ WC - Change\ in\ Debt)}{Net\ Income\ from\ non\ cash\ assets}$$

Net Cap Ex = Cap Ex – Depreciation + R&D - Amortization

Equity Reinvestment rate = (1747-902 + 1700 – 1049.1 + 2993 – 2000)/ (7510.72) =

0.3313 = 33.13%

3. Growth rate

Growth Rate = Equity Reinvestment Rate * Non-cash ROE = 0.5377*0.3313 = 0.1781

Growth Rate = 17.81%

Value per share = $ 409.65

These differences can be attributed the difference in dates of valuation and other minor factors.

	1	2	3	4	5
Expected Growth Rate	17.78%	17.78%	15.11%	9.78%	4.44%
Net Income	$8,079.72	$9,516.55	$10,954.93	$12,026.03	$12,559.98
Equity Reinvestment Rate	33.14%	33.14%	35.39%	39.90%	44.40%
FCFE	$5,402.26	$6,362.96	$7,077.94	$7,228.22	$6,983.35
Cost of Equity	10.38%	10.38%	10.38%	10.38%	10.38%
Cumulative Cost of Equity	110.38%	121.83%	134.48%	148.43%	163.83%

Present Value	$4,894.35	$5,222.73	$5,263.38	$4,869.78	$4,262.46

Growth Rate in Stable Phase =	4.44%
Equity Reinvestment rate inn st	44.40%
Cost of Equity in Stable Phase =	10.38%
Price at the end of growth phase =	**$1,22,836.00**

Present Value of FCFEs in high growth phase =	$24,512.71
Present Value of Terminal Equity Value =	$74,976.04
Value of equity in operating assets =	$99,488.75
Value of Cash and Marketable Securities =	$3,673.00
Value of equity in firm =	$1,03,161.75
Value per share =	$409.65

Tables 5.6.6.1 Valuation Output FCFE Updated

5.7 Dynamic Implied Equity Risk Premium

The Dynamic Implied Equity Risk Premium can be calculated for the US on a daily basis to keep our valuations updated. This will further help us in understanding the IERP for other countries. For the context of this project, I will be focusing on developing a program for US only.

```
import yfinance as yf
import requests
import re
from datetime import date
from bs4 import BeautifulSoup
import sympy as sp
x = sp.symbols('x')

print("IMPLIED EQUITY RISK PREMIUM calculation for the US at", date.today())
#This prints the price of the S&P500 Index
SP500 = yf.Ticker('^GSPC')
price = SP500.info['regularMarketPreviousClose']
print("Current price= $", price)

url_div = "https://www.gurufocus.com/economic_indicators/150/sp-500-dividend-
yield"
url_eps = "https://www.gurufocus.com/economic_indicators/58/sp-500-earnings-
```

```
per-share"
url_buy = "https://www.gurufocus.com/economic_indicators/100/sp-500-
quarterly-buybacks-b"

#Getting TTM Earnings per share number
eps = requests.get(url_eps)
soup1 = BeautifulSoup(eps.text.strip(), "html.parser")

eps_val = soup1.find("font", class_="fs-24 fw-bolder color-primary-color")
txt1 = [element1.text for element1 in eps_val]
eps_txt = re.findall('\d+\.\d+', txt1[0])
eps_num = float(eps_txt[0])
print("Earnings per share: $", eps_num)

#Getting TTM Dividends Yield
div = requests.get(url_div)
soup2 = BeautifulSoup(div.text.strip(), "html.parser")

div_val = soup2.find("font", class_="fs-24 fw-bolder color-primary-color")
txt2 = [element2.text for element2 in div_val]
div_txt = re.findall('\d+\.\d+', txt2[0])
div_num = float(div_txt[0])
print("Dividend yield percentage:", div_num," %")

#Getting TTM Buyback
buy = requests.get(url_buy)
soup3 = BeautifulSoup(buy.text, "html.parser")

buy_val = soup3.find_all("span", style = "color: ")
txt3 = [element3.text for element3 in buy_val]

i=0
buyback = 0
for x in txt3:
    buy_txt = re.findall('\d+\.\d+', x)[0]
    buy_num = float(buy_txt)
    buyback = buyback+buy_num
    if i == 3:
        break
    i = i+1
print("Buyback = $", buyback, "Billion")

# Market Capitalization input
cap_val = float(input("What is the current Market Capitalization: in
trillions? Check slickcharts\n"))
buy_share = buyback * price / (cap_val*1000.00)

# per share outputs
print("Buyback per share = $", buy_share)
CF_share = buy_share + div_num*price/100.00
print("Dividends per share = $", div_num*price/100.00)
print("Total cash flows per share in base year = $", CF_share)
CF_revenues = CF_share / eps_num

#rates
growth = float(input("What is the average analyst projection growth estimates
of the earnings of the index as a pecentage?\n"))
```

```
rf = float(input("What is the risk-free rate you are using?? (suggestion: use
the 10 year Treasury Bond rate of US)\n"))
tgrowth = float(1.00+growth/100.00)
rf = rf/100.00

# final variables: price, eps_num, growth, CF_share, x (discount rate), rf
x = sp.symbols('x', positive = True)

PV_CF = sum([eps_num*CF_revenues*pow((tgrowth/(1.00+x)),(n+1)) for n in
range(5)])
PV_TV = eps_num*CF_revenues*((pow(tgrowth,6)) / (pow((1.00+x),5)*(x-rf)))

equation = PV_CF + PV_TV - price

a = sp.solve(equation, x)
print("------------------IMPLIED EQUITY RISK PREMIUM------------------")
print("S&P 500 on ",date.today())
print("Expected Rate of Return = ",a[0]," = ",a[0]*100,"%")
print("IERP = ERR - Rf",a[0]-rf," = ",a[0]*100-rf*100,"%")
print("---------------------------------------------------------------")
```

5.7.1 I/O

```
C:\Users\SHIVAM\PycharmProjects\IERP_US\venv\Scripts\python.exe C:\Users\SHIVAM\PycharmProjects\IERP_US\main.py
IMPLIED EQUITY RISK PREMIUM calculation for the US at 2023-09-29
Current price= $ 4274.51
Earnings per share: $ 175.17
Dividend yield percentage: 1.6  %
Buyback = $ 1005.39 Billion
What is the current Market Capitalization: in trillions? Check slickcharts
35.708
Buyback per share = $ 120.3525711017139
Dividends per share = $ 68.39216
Total cash flows per share in base year = $ 188.7447311017139
What is the average analyst projection growth estimates of the earnings of the index as a pecentage?
7.14
What is the risk free rate you are using?? (suggestion: use the 10 year Treasury Bond rate of US)
4.59
-----------------IMPLIED EQUITY RISK PREMIUM-----------------
S&P 500 on  2023-09-29
Expected Rate of Return =  0.0984361626377997  =  9.84361626377997 %
IERP = ERR - Rf 0.0525361626377997  =  5.25361626377997 %
---------------------------------------------------------------

Process finished with exit code 0
```

Figure 5.7.1.1 Pictorial I/O

5.7.2 I/O Text Format

C:\Users\SHIVAM\PycharmProjects\IERP_US\venv\Scripts\python.exe
C:\Users\SHIVAM\PycharmProjects\IERP_US\main.py

IMPLIED EQUITY RISK PREMIUM calculation for the US at 2023-09-29

Current price= $ 4274.51

Earnings per share: $ 175.17

Dividend yield percentage: 1.6 %

Buyback = $ 1005.39 Billion

What is the current Market Capitalization: in trillions? Check slickcharts

35.708

Buyback per share = $ 120.3525711017139

Dividends per share = $ 68.39216

Total cash flows per share in base year = $ 188.7447311017139

What is the average analyst projection growth estimates of the earnings of the index as a pecentage?

7.14

What is the risk-free rate you are using?? (suggestion: use the 10 year Treasury Bond rate of US)

4.59

----------IMPLIED EQUITY RISK PREMIUM----------

S&P 500 on 2023-09-29

Expected Rate of Return = 0.0984361626377997 = 9.84361626377997 %

IERP = ERR - Rf 0.0525361626377997 = 5.25361626377997 %

Process finished with exit code 0

5.7.3 Discussion

Through the writing of this code, it has come to realization that data is very scarce on the internet, even for US's biggest indices. More often than not, it has been seen that valuation, and

data gathering has been made intentionally hard to relay people to much more stringent and expensive environments which is detrimental to health of Finance as an industry.

5.7. Data procurement and recommendations

The biggest bottleneck in writing this program was to web scrape credible sources as most of the tickers are either not functioning, have limited information or are inaccessible, often behind a paywall. This program utilizes the yfinance module under python to get preliminary data regarding the S&P 500 index. Further information is gathered by scraping other websites that have credible sources. It is highly recommended to not abuse this program, even though it is designed to send as many less requests to the website as possible. Moreover, there is a need for occasional maintenance as HTML codes and websites are bound to change. It is also recommended to use this data for personal uses only, even though it is available in the public domain.

6 CONCLUSION AND FUTURE WORK

6.1 Conclusive Remarks

The project started with understanding the basics of Finance and the Industry, but quickly plunged to depths of critique, abstract concepts, and fascinating narratives. Finance is not a science, neither is it art. It sits comfortably in between being able to find value and price assets and liabilities alike. This nature of Finance means that while optimization of models using algorithms and AI will always have scope for improvement, there is also good footing for the average investor who is willing to take this a step further.

The initial phases of the project investigated the ongoing classes and exercises of Dr. Aswath Damodaran's MBA classes on Valuation in New York University Stern School of Business. These times were spent in exceptional review of literature and learning to understand, in detail, the various concepts and the antitheses of the same, in valuation. As we moved forward, our attention was drawn to Intrinsic Valuation and the many considerations that come along with it. This took us through a journey of assumptions, critique and most importantly learning the first steps in DCF valuation and the many considerations regarding the same. We did our best to value the companies chosen and to understand better the necessary tools and data to improve.

As we moved further, intrinsic valuation became a daunting task, with many considerations, and the necessity to justify numbers. This was especially important, as even the smallest of tweaks in the many metrics of input can drastically change the course of the valuation. On top of this, we investigated storytelling, where the bulk of the time had to be spent. Through this exercise, I have been able to familiarise myself with 10 K and 10 Q reports and now have a meagre proficiency in identifying relevant data and credible data sources.

As we finished our final FCFF valuations, we delved deeper into media platforms and financial reports of multiple years to better understand the historic relevance and the current scenario of the company. Lockheed Martin, especially proved to be challenging, with many differing opinions on their work and the course of action within the pentagon as per press releases. These opinions, especially in an extremely well connected and online platform can sway opinions, often bringing political agendas and other such noise. The idea is to look past this and understand relative performances, improvements, and future course of actions for these companies. This has been especially hard since much of it is part of the narrative, we create to justify our numbers.

The project concluded with a small exercise of coding in python to understand availability of data which quickly took a bad turn with facing bad data, unavailability, etc. Therefore, this took more time than usual and is based on many assumptions to do what we can best with the available resources. Overall, this project has had a paramount impact on our understanding of finance and the principles involved and the ethics we need to follow in pursuing such trade.

6.2 Future Work

The internship is far from over and I am currently involved in student and research assistant activities in TAPMI. I would like to take this further and delve into this beautiful world of crunching numbers and telling stories and I am glad that I took this project. My immediate future is to look into proficient mastery of navigating the Bloomberg Terminal and to learn relevant skills for employment. However, through this time, I would also be involved in research of more, softer aspects of Finance and how these can affect our lives.

Through my work at TAPMI, I am planning to investigate Valuation Diagnostics, Relative and Option Pricing models and efficient data collection. Relative and option pricing models have been a major bottleneck in terms of understanding their different means and methodologies. Moreover, data collection proved to be a massive hassle with having to rewrite the code 10s of times to arrive at credible sources and making calculations to fill the gap created. The scope of work is to automate data transference from Bloomberg terminal which would form the basis for further coding and finer aspects of optimizing and making efficient the initial pricing models so that more emphasis can be put on storytelling.

Lastly, but most importantly, I want to take this moment to thank my professor at T.A. Pai Management Institute, Dr. Nandan Prabhu sir, for considering a MIT student and trusting in giving this opportunity to me. I am eternally grateful, and I am sure that he has impacted me in a manner that will be supremely drastic in the future.

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Department of Mechanical and Industrial Engineering

Annexure 1

PO &PSO Mapping

Student Name: Shivam Subramanian Register no: 190909050

Note: use a tick mark if you have addressed that PO in your report

PO	✓ Tick	Pg. No	Section No	Guides Observation
PO1	✓	11-49	2.1-2.16	
PO2	✓	11-49	2.1-2.16	
PO3	✓	53-73	5.1-5.4	
PO4	✓	51-53	4.1-4.2	
PO5	✓	53-81	5.1-5.7	
PO6	✓	1-10	1.1-1.5	
PO7				
PO8	✓	1-10	1.1-1.5	
PO9	✓	53-81	5.1-5.7	
PO10	✓	53-81	5.1-5.7	
PO11	✓	58-81	5.3-5.7	
PO12	✓	84	6.02	

PSO	✓ Tick	Pg. No	Section No	Guides Observation
PSO1				
PSO2				
PSO3				

Signature of Student: Name and Signature of Guide:

Date: 30/09/2023

Department of Mechanical and Industrial Engineering

Annexure 2

LO Mapping

Student Name: Shivam Subramanian Register no: 190909050

Note: use a tick mark if you have addressed that LO in your report

Sl No	LO	✓ Tick	Pg. No	Section No	Guides Observation
1	C1.	✓	16-20	2.4	
2	C2.	✓	11-49		
3	C3.	✓	63-72	5.5	
4	C4.	✓	11-49		
5	C5.	✓	63-72	5.5	
6	C6.				
7	C7.	✓	1-10	1.1-1.5	
8	C8.	✓	1	1.1	
9	C9.	✓	16-20	2.4-2.5	
10	C10.				
11	C11.				
12	C12.	✓	51-52	4.1-4.2	
13	C13.	✓	53-82	5.1-5.7	
14	C14.	✓	16-33	2.4-2.8	
15	C15.				
16	C16.				
17	C17.	✓	63-77	5.5-5.6	
18	C18.	✓	51-51	4.1-4.2	

Signature of Student: Name and Signature of Guide:

Date:

Department of Mechanical and Industrial Engineering

Annexure 3

Mapping of IET learning outcomes during project period

Answer the following questions relevant to your Practice School work.

1. Explain the steps you followed to Investigate and define the problem in your project work (C4, evaluate level)

I investigated the problem by first reviewing relevant literature and then defining the problem by identifying the key challenges and objectives of the project. The literature itself is a study on the many complications that arise due to the use of industry practices in valuation and steps were taken in terms of analytical analysis and plotting results against the history to arrive ata a methodology to understand what is best suited for valuation going forward.

2. What is the science, mathematics, statistics, engineering principles and other basic technology you identified for design (Mechanical, Electronic, Physics, Chemistry, Automation) in your project work? (C1, C2, C3, Application, Analysis, Evaluation of Science and Mathematics in the project).

Mathematics and statistics played a crucial role in designing and validating the quantitative aspects of the project, while engineering principles were essential for the technical design. Application of statistical analysis to understand limitations and to arrive at better solutions to the problems faced has been crucial to land where we are right now. Moreover, automation has been used to derive the IERP value.

3. Have you considered the Environmental and sustainability limitations in your project work? (C7, evaluate)

Sustainability in terms of carrying forward the work for use of others has been considered.

4. Have you considered ethical dilemma, health, safety, security, and risk issues; intellectual property; codes of practice and standards? Did you address any of these issues in your project work? If so, Explain in detail. (C5, create)

Ethical dilemmas, health, safety, and security issues were evaluated and addressed by following industry standards, safety protocols, and ethical guidelines. Ethical concerns when it comes to the distrust and disingenuity of the financial sector has ballooned in recent times. There is an amazing

use case in understanding the involvement of finance in valuation and in doing so, I have opted for fair judgement. Valuation analysts often overstate valuations to secure their oen relationships and connections and these valuations are blindly followed in the industry.

5. What were the esthetical issues faced and how it is addressed in your project in the design phase? (C5, analysis)

No.

6. Were there any health issues considered during design process. How it is addressed in your project in the design phase? (C5, create)

No major health issue faced.

7. What were the safety, security and risk issues needed to be taken care of in the design stage? (C10, create)

Strict protocols were in place to secure the relay of data from the Bloomberg terminal and to prevent misuse of the same. Data from Bloomberg is extracted in a spreadsheet and can only be mailed through the Bloomberg login details which provides details on these mails to admins.

8. Were there any intellectual property issues needed to be taken care off? Have you come across IP issues in the project phase? (C5, create)

No IP issues came, and all the work done is original work ref is given wherever necessary.

9. What are the codes of conduct and standards you needed to use in design phase and in other phases of your project as well? (It may include codes of practice and standards for safety, security, health, risk) Explain the legal issues, ISO standards, IEC standards, etc. (C8, evaluate)

Standards of GAAP were used. Data privacy standards help to handle privileged information and data and the same were used to handle data from the Bloomberg labs.

10. What is the general safety measure regulated in the industry where you did the project work? (C8, evaluate)

Firefighting measures were taken and emergency exits were cleverly designed.

11. What were the professional ethics needed to be followed in general while you are doing the project? (C8, evaluate)

Professional ethics were adhered to throughout the project, including honesty, integrity, and respect for colleagues and stakeholders. Moreover, ethics regarding genuine stock recommendations by removing personal biases were done to ensure that our recommendations come from a place of reason.

12. Do you think ethics and professionalism needs to be paid attention by students during study? If, yes, explain how it can be inculcated/introduced/implemented? (C8, evaluate)

Yes, ethics and professionalism are essential in student education. To instill these values:

Absolutely, ethics and professionalism are paramount in student education. To instill these values, integrate ethics discussions into the curriculum, have faculty serve as ethical role models, establish clear conduct policies, offer mandatory ethics courses, and promote mentorship and student groups focused on ethics. Practical experience, ethical assessments, open dialogues, and community engagement activities complete this comprehensive approach. These measures prepare students for ethical and professional success in their future careers and societal contributions.

13. Do you think environmental and sustainability limitations; ethical, health, safety, security, and risk issues; intellectual property; codes of practice and standards are sufficiently covered in the courses you have studied in your curriculum? (C8, evaluate)

The coverage of environmental and sustainability limitations, ethical considerations, health, safety, and legal issues were of high standards and while, there is always scope for reinforcement, I believe they well served their purpose.

14. Have you gone through online classes, or a crash course in which you are familiarized with intellectual property rights as well as risk issues in professional environment? (C8, evaluate)

Not as such.

15. In the beginning of your project did you evaluate environmental effects and sustainability factors in your work? (C7, evaluate)

No I did not.

16. During your stay in the industry, have you realized the need for professional and ethical conduct? Quote the context and explain. (C8, evaluate)

During my industry experience, I observed the significance of professional ethics in maintaining trust and credibility. Through a certain miscommunication in handling data, the data ended up in the hands of another professor and strict actions were taken. Moreover, further fact checks in the process of data handling were introduced, till we familiarized with the process thoroughly.

17. What are the professional codes of conduct you needed to imbibe during your stay in the industry? (C8, evaluate)

Professional codes of conduct in the industry that we need are: empathy, professionalism, SOP and documentation, ethical and friendly workplace, sportsmanship, competitiveness and collaborative mindset.

18. Did you address any of limitations of your project work and have you improved the results through continuous improvements in your project work? (C5, create)

Yes, limitations in the project were addressed, and continuous improvements were made to enhance results. The results were improved by deciding on using public data for dynamic IERP automation to make sure that this code is able to help those who do not have access to data sources like the Bloomberg Terminal.

19. How did you plan your project, deadlines, maintaining dairy of each stage and improved the quality of the project (C14, understand)

Project planning involved setting deadlines, maintaining a diary of each stage, and continuous quality improvement through feedback and adjustments from Dr. Nandan Prabhu. Maintaining a notion work place to document all the work and deadlines was crucial in the entire stage of the internship.

20. While having Industrial training/ internship, what were the college practices which helped you to abide by the professional ethics of the company environment? (C8, evaluate)

College practices like note taking, adherence to deadlines, and documentation of lab work.

21. During your stay in the industry, did you observe how the teamwork plays a role in engineering process? (C16, apply)

Teamwork is integral, and I observed how collaboration enhances efficiency and creativity.

22. Are you aware of the ethical clearance when you work in the field of health/medical applications.? (C8, evaluate)

No such issues faced.

23. During your stay in industry, are you able to observe and understand certain management techniques practiced in that industry. Explain in detail. (C14, understand)

No, as we did not delve into such topics.

24. Could you understand how they tackle project management and what tools, techniques is adopted? (C14, understand)

Project management tools and techniques, including Gantt charts and agile boards, were employed to manage tasks and timelines effectively. Work break down structures were done to keep in mind the extensive literature review required and time to absorb content.

25. During your stay in the industry, did you observe any engineering activity implemented to promote sustainable development? (C7, evaluate)

Yes, Solar power was used for power supply.

26. Did you adopt any quantitative technique for any engineering activity related to your project? (C3, evaluate)

Quantitative techniques were applied to analyze project-related data, assess risks, and make informed decisions.

27. What are the elements of your project work which addresses sustainable development and were you able to apply quantitative techniques to analyze and achieve your project goals? (C7, evaluate)

The dynamic IERP code section addresses this.

28. How the company takes green initiative, environment related factors. (C7, evaluate)

The company embraced green initiatives, including waste reduction, solar energy and energy efficiency programs.

29. During your stay in the industry, have you observed/sensitized about legal requirements governing such activities in that industry? Explain. (C8, evaluate)

Compliance to data privacy and data protection when it came to handling data from the Bloomberg terminal.

30. Did your project need the understanding of relevant legal requirements governing engineering activities you carried out as a part of your project work? Explain in detail. (C8, evaluate)

Compliance to data privacy and data protection when it came to handling data from the Bloomberg terminal.

31. What are the legal, ethical practices you followed while working on project? (C8, evaluate)

Compliance to data privacy and data protection when it came to handling data from the Bloomberg terminal and following justified and truthful valuation methodology.

32. Are you sure that you abide IPR/copy right issues? (C15, apply)

Yes.

33. Have you observed any national/international standards in the workplace? How many are relevant to your project work? List them. (C8, evaluate)

GAAP standards were followed and broken down for various assets of the project and data collection.

34. What online course you attended to improve your communication skills. Report writing, Oral presentation, Software used for writing report. (c17, apply)

MBA valuation course by Aswath Damodaran.

Statistics 101 by Aswath Damodaran.

Accounting 101 by Aswath Damodaran.

Bloomberg terminal certification.

35. In your project, was it needed to tackle risk issues, including health & safety, environmental and commercial risk, and of risk assessment and risk management techniques? Explain in detail. (C5, create)

Yes, macro and micro economical risks were considered, and bias in the industry was considered.

36. What are the cyber safety rules and precaution you were sensitized with, when you started practice school, or started industrial training? (C9, evaluate)

Compliance to data privacy and data protection when it came to handling data from the Bloomberg terminal.

37. How is an organization addressing a fire accident/human safety when working with machines? (C9, evaluate)

The organization had fire safety protocols and equipment in place to address fire accidents and ensure human safety.

38. Process of teamwork. How each of you are involved in the team? What part the work is addressed by you.? (C16, evaluate)

Not Applicable.

39. Have you filed patent, IPR, or published your work? Give more details. (C17, evaluate)

No.

40. How you documented the literature review, your analysis on their results, discussion with the guide and team members, provide the documents on weekly basis. Put as one chapter in final report. (C4, evaluate).

Literature review, analysis, and discussions with the team and guide were documented weekly, forming a chapter in the final report.

Extensive notes were made based on the courses taken that were paramount in understanding the concepts elaborated in the lit review. Moreover, these reports are being used by IPM students for their own studies.

41. Have you sensitized about inclusion and diversity in the team? If yes, what are the diversification in the team in terms of religion, gender, ethnicity, etc. What challenges you

come across in the team. (C11, apply). Indian constitution and acts related to caste, gender, race discrimination.

Not Applicable within team however the relations with the external guide have been of respect and mutual understanding.

42. How were you able to keep yourself updated with the technology? How you incorporated advanced technology in your project. (C18, lifelong learning)

Used Python to create a program for calculating IERP for commoners who do not have access to information readily.

43. Which are the laboratory skill you found applicable to your project. Explain. (C12, apply)

Working on Bloomberg terminal and various python modules were part of this.

Department of Mechanical and Industrial Engineering

Annexure 4

Project/practice school classification

Student Name: Register no:

Note: Use a tick mark to specify under which domain your practice school work falls into.
Table 1: classification based on project domain classification

Domain	✓ **Tick**
Product	
Application	
Review	
Research	✓
Management	✓

Note: Use a tick mark to specify Societal impacts you considered during your practice school.
Table 2: classification based on societal consideration

Societal Impact	✓ **Tick**
ethics	✓
safety	✓
environmental	
commercial	✓
economic	✓
social	✓

Signature of Student: Name and Signature of Guide:

Date:

Department of Mechanical and Industrial Engineering

Annexure 5

Company Details

Student Details			
Student Name	**Shivam Subramanian**		
Register Number	190909050	Section / Roll No:	C
Email Address	shivam.s@learner.manipal.edu	Phone No (M)	8754424981
Practice School Details			
Title			
Practice School start Date	9th of March, 2023	Practice School End Date	9th of Sept, 2023
Organization (Company) Details			
Organization Name	**T.A Pai Management Institute**		
Type of Organization (Public Listed, Private, PSU, Govt, cooperative)	**Private**		
Full postal address with **pin code**	Badagabettu Road, Manipal, Karnataka 576104		
Website address	Top Management Institutes in India, Best Business Colleges in India for Management Courses (tapmi.edu.in)		

Department of Mechanical and Industrial Engineering

Name of the CEO of the Organization	Professor (Dr.) Madhu Veeraraghavan		
Supervisor Details			
Supervisor Name	Dr. Nandan Prabhu		
Designation	Associate Professor		
Full contact address with pin code	Badagabettu Road, Manipal, Karnataka 576104		
Email address	nandan.prabhu@manipal.edu	Phone No (M)	+91 78298 49240
Internal Guide Details			
Faculty Name	**Dr. Ananda Hegde**		
Full contact address with pin code	Dept. of Mechanical and Industrial Engineering, Manipal Institute of Technology, Manipal – 576 104 (Karnataka State), INDIA		
Email address	Ananda.hegde@manipal.edu		

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