Measuring the Historical Accuracy of Financial Modeling

Bryce Miller | Montpellier Business School 2021

Table of Contents

[Abstract 2](#_Toc85030399)

[Introduction (The Importance of the Financial Sector) 3](#_Toc85030400)

[The Research Question 7](#_Toc85030401)

[Efficient Market Hypothesis 8](#_Toc85030402)

[Companies Defending their Value 10](#_Toc85030403)

[Discounted Cash-Flow Valuation 14](#_Toc85030404)

[Robert Shiller 17](#_Toc85030405)

[Our Methodology 19](#_Toc85030406)

[Process of the Study 23](#_Toc85030407)

[Results of the Study 25](#_Toc85030408)

[A more advanced study 28](#_Toc85030409)

[Conclusion 31](#_Toc85030410)

[References 35](#_Toc85030411)

[Appendix 37](#_Toc85030412)

# Abstract

In this paper we will attempt to measure the accuracy of financial valuations of companies. Shares of a company represent portions of ownership, these shares are priced, in theory, based on the ability of the company to generate money. Investors can make assumptions about the future of a company and then price its shares according to prevailing market rates of return. In this paper I will discuss my study where I collected company financial statements to use for making valuations. I discounted cash-flows to get a historical price as if investors knew the future from a given historical date. Because in reality investors cannot predict the future they make assumptions about the future performance of a company. Therefore, for this study we will compare the historical valuation to what it would have been if the future was known to the actual existing market prices. A study similar to this was published in 2013 in a Nobel-prize-winning paper by the American financial economist Robert Shiller. The two goals of this paper are to provide some constructive comments on how to improve the study from Shiller, and then to implement the study with improved techniques.

# Introduction (The Importance of the Financial Sector)

The financial sector of an economy is often the focus point for modern economic news, analysis, and policies. It would seem that the financial sector is the most significant and yet the most abstracted part of the economy. When large economic development happens in a country, it is usually though forms of financing from large financial institutions. And when economic problems arise, it is often in the form of a financial crisis. It is not hard to see that the financial sector of an economy is important and worth understanding to have relevant information and ideas to navigate our increasingly modernizing global economy.

The financial sector develops like all other economic sectors, naturally, out of the desire for profit. Therefore, we find the financial sector present in all developed and developing economies worldwide. In the less developed countries, the financial sector is typically lacking in size, abilities, and regulations, while in advanced economies such as Europe and the United States, the financial sector is very large and critical. It is easy to draw a simple conclusion from this observable correlation that the finance industry is an economic asset that strengthens an economy and explains some of the success of the advanced countries. Multiple studies have shown that through various ways and measures, there is a positive relation between economic growth and a developed financial sector.[[1]](#footnote-1) In order to make a contribution to this field we should study the specific ways in which we can interpret and understand the roles played by the financial sector and how well it plays those roles.

By learning the details of the financial industry, we can attempt to explain the role it plays in economic development. From this understanding we can learn what impact it has, positive or negative, and where it could improve. This paper aims to make a contribution to the study of the financial sector in a specific way. While there are many components to the financial economy, we will limit our study to the accuracy of financial valuations, that is to say, the accuracy of pricing financial instruments which represent companies.

The financial industry is diverse but its main economic contribution can always be simplified by understanding that it invests idle money. This is the main strength it has to serve a nation’s economy. Idle money does not move into circulation, it does not buy goods and services, and it does not employee citizens. Whenever too much money is idle then an economy can begin to stagnate and shrink. When the financial sector is present and active it comes with armies of financial analysts looking for ways to invest and make money. Thus, these analysts and financial institutions are always looking for ways to make investments which involve purchasing goods and services which support businesses and employ citizens. Therefore, with an active financial industry, wealthy individuals and wealthy companies do not need to re-invest its profits directly, they can leave the idle money with financial specialists who will invest the money for them while giving a portion of the profits from investing; which of course incentivizes investing in the financial industry.

We know that many companies in the non-financial sector face competing interests and macro dis-coordination that impacts the smooth operation of business. For example, when a business deal doesn’t go the way it was expected, when things take longer than they should have, when costs are more expensive than originally planned, when customers and suppliers change their buying or selling habits and plans, etc., these can cause large troubles for important companies. However, when companies suffer from short-term problems and when their overall business model is still a successful but is experiencing some problems they can turn to the financial sector for help. When a company needs funding to implement a new competitive technology, when a struggling but profitable company needs some support, when a bankrupt company with jobs on the line is repurchased and restored it is the financial sector that can help. This is another strength that the financial sector gives to the economy, to overcome the problems of harmony, or to relieve friction when the market economy as a whole is based on many competing separate sectors and companies.

Therefore, with an active financial industry, circulation of money in the general economy is more easily facilitated. The investment sector even needs to keep investing idle money to survive and pay its workers. Additionally, the financial sector provides advanced information gathering with constant economic surveillance of the micro and macro components of the economy. Financial institutions and analysts need to gather information to make informed decisions. The information they require is down to the investment level on the individual company or asset, and also information on macro economic trends are important to know the overall economic environment. This information is provided on public exchanges for investors, politicians, economists, and citizens can get access to. Additionally, large financial institutions usually act on the information they gather. Therefore it is also possible to understand an economic situation based on observing the actions of investors. For example, if investors require higher interest rates on debt from a company, sector, or government, then this is a sign that there are some risks involved in these sectors. Thus there is both implicit and explicit information that provides insight into an economy. From these observations is easy to see how the financial sector can make a positive contribution to an economy. It provides movement of money and information that help countries and citizens develop and grow.

Yet at the same time, while the financial industry serves all these roles, it does not do so with intent. The financial industry is made up of many competing companies and parties where in which each are seeking to satisfy their own agenda and carry out their company policies according to their own economic outlooks and strategies. The benefits we get from finance are only an indirect result of the personal motivations of investors and investment institutions. The financial industry does not exist to provide investments and circulation, it only exists to pursue its own growth and profit, and then the positive impact we see is only a side-effect. It is not as if the many individual companies and persons in the industry are acting in harmony with the intent of creating economic growth. Actually, public opinion is generally negative towards the finance industry, seeing it as a sector riddled with fraud and overall rent-seeking, often seen as “not the real economy” and ultimately an unproductive sector. This public opinion is not such a surprising perspective after the public hears the stories about the excesses of high risk mortgage loans leading to the 2008 financial crisis, and when they hear about facts such as in 2012 to 2014 the finance industry in the United States paid $139 billion in various fines.[[2]](#footnote-2) Not surprisingly, trust in financial institutions was lowest after the 2008 financial crisis, and while it has grown back from that time, the financial sector still remains the least trusted industry.[[3]](#footnote-3)

Also, while it is true that investors and financial institutions are leading bodies that discover economic information, the existence of multiple bubbles and financial crashes over the economic history of the finance sector and financial institutions reveals many weaknesses in the sector’s ability to collect and disseminate company information. Actually, studies have shown that there are lacking incentives for investors to reveal negative information on forming bubbles and that they can actually benefit from letting false information spread. [[4]](#footnote-4)

We can see that the non-financial sector of the economy relies on finance for investments, liquidity, and information, and these factors help overcome friction and macro disorganization. However, if the financial sector is established in the same way as other businesses then it makes sense to see that the financial sector also suffers from friction and macro disorganization. We know that the financial sector steps-in to save and develop the larger economy, but who and what steps into solve the financial sector itself? Often we see that this intervention comes from governments around the world where they act as a financial institution that can borrow and invest large amounts of money. Bank bailouts can be traced as far back to 1890 where the Bank of England organized a rescue package after their banking giant, Baring Brothers & Co, was about to collapse, primarily due to bad loans made in Argentina; often called the first de-facto bailout in modern economic history.[[5]](#footnote-5) Moving forward in history the bailout strategy has been used many times in periods of crisis. Notably, during the Great Depression in the United States, in 1932 the Reconstruction Finance Corporation (RFC) was established to provided financial support to state and local governments as well as banks and other businesses. Another more recent example comes from the 2008 financial crisis where the American government approved of 700 billion to be used in rescue packages, ultimately using 416 billion; this is in addition to the investments made by the U.S. central bank.[[6]](#footnote-6) Symbolizing the growth and importance of the finance industry in our modern economy, less than half of the allocations of the 1932 RFC went to the financial sector, while the 2008 American bailouts had nearly 75% going to financial institutions and financial investments.[[7]](#footnote-7) These bailout strategies were also implemented in the COVID-19 crisis and seem to now be considered basic economic policy for all counties in our modern understanding of economic policies.

Then we know that the financial sector is helpful but is itself not immune from its own type of problems. And as we see the advanced economies grow and use leverage from the finance industry, they also become more reliant on it; where each subsequent financial failure threatens a forever-growing pool of global financial assets and industries which live off its value. It should then not be surprising that the financial industry tends to be the most regulated industry in the developed economies as its significance has not gone unnoticed.

# The Research Question

For this research paper I would l like to join the study of financial economics to help discover the strengths and weaknesses of the financial industry. I will do that by tracking the accuracy of the financial valuation of companies. This is a concept that has been studied directly and indirectly by various financial economists. I will be performing a literature review of existing materials to gather and centralize the ideas among professionals, to study the general concepts of financial valuation accuracy discovered by others. However, I will treat the definition of financial accuracy specifically and have a unique technique for processing the financial data.

The price paid for a stock is also the price of an individual part of a company. Financial assets are interesting because they are different than other goods or services created in the economy. When we look at the price for a consumption product, we will know the price of the good will be set in the competition of supply and demand. Therefore, the price of this type of good reflects many objective and subjective social interactions at a given time and place. However, a financial asset is quite different because a financial asset has a specific purpose measurable in money. The financial asset should be able to make an income and a profit for the purchaser and therefore it can be discounted to get a fair price according to a given required rate of return. For instance, if a financial asset could produce one year of income at $100 and a required rate of return is 5% then the price of this asset should be about $95.24. This way we know that the investment will grow at our rate of 5% and thus 95.24\*1.05 = $100 is satisfying that required rate. Therefore, we would think that prices paid for companies on the stock market would also be equal to buying any other asset and the price would match the future income. In this way a price is a more objective thing when the required rate of return is given, with this information we can say if the price is at, above, or below, what it theoretically should be. Once the future income is known and the required rate of return, the theoretical price can be calculated.

We do not need to assume that the financial industry has a magical sense into the future and can use that to accurately know future income and value companies perfectly. However, financial economists and investors have come to expect that the financial research done by analysts to be as accurate as possible and every financial company has nothing but a pure profit motive to get forecasts correct. Therefore, it seems that in some way we should expect the prices of companies to reflect something near to what actually occurs in the future.

While this research paper has a specific research question to focus on, we will also take time to consider other material on the same subject. Below we include resources and information on the efficient market hypothesis and its critics, which can be found in many books and papers.

# Efficient Market Hypothesis

The study of financial economics and the efficiency of the finance industry has been studied by academics and business professionals alike. The debate is categorized under the “efficient market hypothesis”. This idea suggests that asset prices reflect all available information from investors who are continuously allocating financial resources based on market research and by doing so change supply and demand conditions and therefore change prices. For example, if there was an asset can be purchased at a cheap price and then when sold it can get extra profit above what the market regularly realizes, then we would expect it to be a popular asset. However, the asset would then be so popular that when everyone seeks to buy it they bid the price up and therefore it is no longer sold at a discount. It is sometimes said that if you tell a hardened efficient market theorist that there is $100 laying on the ground behind them then they would not believe you because they would assume someone would have already picked it up!

When it comes to investing in companies we then assume that a hot new company with a promising future should eventually yield strong cash-flows and therefore can be given a high value. Efficient market theory suggests that investors would have this information and then bid the price of equity up to a fair market price. In our study we wish to understand how accurate prices reflet their “true” value based off the financial prospects and future of an asset. Efficient market theory does not specifically say that this is happening, but it suggests that investors are doing the research that would correctly price an asset to its perceived financial future; so we are interested in the accuracy of this phenomenon.

Regarding the efficient market hypothesis, many different theorists have different takes on if the market is “efficient” by its definition. However, the area of contest is less about if the markets are efficient or not, but more about how efficient they are. Be it “weak”, “mid-strength”, or “strong” market efficiency. Well-known financial economist, Burton G. Malkiel, concludes that: “As long as stock markets exist, the collective judgment of investors will sometimes make mistakes. Undoubtedly, some market participants are demonstrably less then rational.” [[8]](#footnote-8) Malkiel is remembered for commenting that a blindfolded chimpanzee can throw darts at a board to pick stocks and perform as well as professionals. Therefore, for a typical individual investor to beat the market and get above average risk adjusted returns is expecting them to find things that many others can’t;[[9]](#footnote-9) it means finding $100 on the ground that hasn’t already been picked up by someone else. Actually, as interesting as it might sound, professional investment managers have had lower long-term performance compared to overall market returns. Multiple studies have confirmed this, including Malkiel himself in his 1995 work: *Returns from Investing in Equity Mutual Funds 1971 to 1991*. Thus, we often say that the best investment advice for non-professionals and even professionals alike is to simply buy and hold broad market index funds for a long period of time instead of trying to pick individual companies to invest in.

The efficient market hypothesis is then quite relevant to our study for we too are interested in asset prices reflecting opportunities in the market. However, the efficient market hypothesis assumes that assets are being bought and sold reflecting real underlying circumstances and so therefore it is not possible to beat the market by finding investment opportunities that are better than the market average. Therefore, this theory admits that prices accurately reflect reality. Our topic of study on the other hand is to measure this accuracy.

While the performance of financial managers has not beaten the market and the incentives that drive the efficient market hypothesis are convincing, hedge funds have not decided to close-up shop and we still see plenty of erratic over reactions, under reactions, fads, and herd mentality in equity prices that represent erratic behavior of investors. In fact, efficient hypothesis theory has to admit the opposite, that markets are problematic enough that allow the financial institutions to exist that would make the market efficient in the first place. If the market is efficient then it has to be the actions of investors and institutions that drive this efficiency. So therefore it seems that this study, and how it relates to our study, reveals that various forces are moving prices and that at a given moment the price may or may not reflect the actual reality of a theoretical or “real” value and we should attempt to test this strength.

# Companies Defending their Value

The question over companies reflecting their performance and potential in their stock prices is not just an academic question but an actual practical and business question that weighs heavily on the minds of business managers, owners, and other important stakeholders. A company and its share price are two very related things. The owners of the company also own the stocks and wish that they are profitable. Therefore, the shareholders of a company would be very confused if their company was doing well but the stock prices does not reflect this reality; equally, the owners of a company would be confused if the opposite was true however they would be much happier in that circumstance! While we expect companies that are doing well to have good stock prices there is no magical force that will raise the price of a stock.

In order for the company’s equity price to rise then in the first instance there need to be other people willing to pay this risen price for the company. The study of finance and all of its numbers and theories have to stand against hordes of investors with varying amounts of financial knowledge who will make the ultimate decision on the price of the company buy buying and selling its shares.

While it is true that no magical force will control a company’s stock prices to reflect their performance, the company itself can defend its status by using its financial resources. Being that a company itself generates income, it can take this money and send it directly to the investors in the form of dividends and stock buybacks to reward them for owning a well-performing company. The extra dividend income should make the stock more valuable which can increase its price. Additionally, with buybacks, the company can go on the market and buy shares which can indirectly go to shareholders by buying directly from shareholders and by bidding up the price with extra demand.

Therefore, it would be wise to introduce a concept of “defending value”, where companies can use their financial resources to influence their own share price. This concept allows us to break free from the idea that all stock prices are always set by market activity regardless of the actual company performance. When the company directly intervenes, it can adjust supply and demand factors which also, in the act itself, can send a signal for all investors to see that the company is capable of defending its value. This is something a company can do to prove itself, but it needs to have something to prove as it needs to be financially strong enough to reward its owners and not simply rely on the market to continuously pay more and more for its stock. Financially weak companies are not able to support this kind of spending regardless of their valuation given to them by the market. So then a financially weak company with a high stock price would not be able to afford large stock buybacks to boost its price and the dividends it could pay would be small compared to the high stock price and would give a low dividend yield; as in an investor could buy a high stock price of $1,000 with a dividend of $10 which is a much lower yield than a company with a stock price of $100 and the same dividend of $10. So overall a financially weak company could not defend high equity prices.

Then, we are not alone when we search for something representing a company’s “real price” opposed to the chaotic market price, as the idea of flexing “real value” by company actions such as raising dividends and stock-buybacks is a common practice. The company that can back its bark with a bite and use its strength to influence its equity price is the force needed to realize financial theories. The use of stock buybacks has been very present in the American economy in recent years. Actually, from 2005 to 2014 companies in the S&P 500 spent around 52.7% of net income on buybacks and around 35.7% on dividends.[[10]](#footnote-10)

Now we actually can look at our original problem while considering some new perspectives. For one, the diverse and complicated form of markets and financial markets lead to constantly changing supply and demand, changing perspectives from different investors and financial institutions that does not require any real relation to actual company performance. At the same time we have efficient market hypothesis that identifies the behavior of investors and their tendency to price assets in a specific way. And finally, we have companies that can defend their values and have an interest to do so.

Therefore, in combination with efficient market hypothesis, where we know the market is both efficient and not efficient, with institutions looking for investment opportunities that beat the market and having a degree of success in eliminating these options by finding them, and with companies that can flex their muscle and realize their value then this means that the investor’s theories and investigations would allow investors to be rewarded for their market research when a company can flex and realize its financial strength. Despite any random market fluctuations that would be below a company’s value, if the company is financially strong and active about its share price (which it has incentive to do) we could possibly expect an “intrinsic value reversion” where we would assume that prices have to be attracted to “real value” in some way.

Investors have been looking for these instances where they can purchase a company at a “discount” when its price is below its “true value”, which is often referred to as “value investing” and is a common investment strategy. Sometimes investors can measure this value by using ratios such as the price to earnings ratio and more, referred to as “multiples”. The price to earnings ratio has the stock price as the numerator to earnings per share as the denominator. The value investor with this approach looks at comparisons on historical ratios and to other companies and looks for a company that has a relatively low price compared to how much earnings it generates. Therefore, expecting an intrinsic value reversion, the investor can buy stock in the company when the price is down and wait for it to go back up. Moreover, this same approach can be done to short a company that may be overvalued. The techniques used by value investors have seen some success.[[11]](#footnote-11) Moreover this value investing strategy also stands to reveal and enforce “real value” in companies. That is, the value investors are looking at company ratios and financials and buying and selling based off these fundamentals. This action has an influence on supply and demand, where the value investors push prices up or down based on company performance; thus creating another force to regulate prices to performance which also acts as a self-fulfilling prophesy.

Therefore, in summary, it seems as if financial markets are many things, a chaotic mix of pricing with some degree of predictability to the behaviors of investors. We have the chaos of markets but at the same time we have the efficient market hypothesis, value investing, and companies defending their values. Therefore, we may expect some order to come from the market chaos and realize financial pricing theories. But then if there are components to harmonize and stabilize the financial markets then have we seen these the results of that? What interpretation of “success” is used to judge a company? What ratios are used, what valuation techniques, and what forecast periods are used? The financial economy indirectly helps against disorganization of resources in the “real economy”, and we may believe that financial theories and investor behavior helps against disorganization markets, but then what impact do they have? For this we must study the accuracy of valuations.

# Discounted Cash-Flow Valuation

We will spend a moment discussing the discounting cash flow (DCF) asset valuation technique. This is the most common technique used and taught in finance. The researcher, author, and former senior lecturer at Harvard Business School, Timothy A, Luehrman, stated that DCF models are “the heart of most corporate capital-budgeting systems”[[12]](#footnote-12). This paper will use this technique for carrying out its empirical study. We will say that the discounting cash flow method is the most basic and intuitive technique at valuation and is widely used because of this feature. Therefore, we will spend a moment discussing the discounting process.

Whenever an investor decides to invest they are typically doing so to make a profit. This profit is often measured by a rate of return, which is the rate of profitability measured as a ratio. The investor wants to invest a certain amount and have that amount of money generate income. They are interested in the ratio because they want to get the most out of their investment as possible. For example, an investor can yield $10,000 which is more than $100, however if the investment that yielded the ten thousand took an investment of nine thousand while the investment to get one-hundred took only fifty then we can see below in the profitability ratio that the $100 was actually the better investment.

Therefore, profitability is rather important to investors because in the long-run they will continue to invest and the best rate will win in the end. As an investor continues to have their wealth grow, they will make larger and larger investments, and the better rates of return will bring the largest profit returns and maximize how much overall profit is made from their investment.

We can recall from above that at the simplest form, our pricing model seeks to find a fair and objective price for a capital asset used to create profit. We discovered above that if a financial asset could produce one year of income at $100 and a required rate of return is 5% then the price of this asset should be about $95.24. We can express this more specifically in the simplified discounting formula below:

Above we discount the income by one plus the discount rate (i.e., 1 + 0.05 = 1.05). This then, of course we know, satisfies 95.24 \* 1.05 = 100 and therefore we know that investing 95.24 at a rate of 1.05 leads to the income, 100. We should manage to at least take this out of the simple form, where we have only one period of income, when usually a business investment has multiple periods of income forecasted in a short and long-term future. Below shows multiple years added together giving us our discounted value for two periods of cash-flows of 100:

Therefore, as seen above in this example, when two period cash-flows are discounted at 5% then the cost is 185.94. This means that 185.94 is a fair price for an investment that has two years of cash-flows where an investor requires a 5% compounded rate of return because that price will satisfy the return requirement.

Then using the DCF model we simply need to project the future income, discounted periodically by a compounded required rate of return, then added to get the price of the investment. The final component of a discounted cash-flow technique is to get the terminal value at the end of the forecast period. Most investors are not forecasting cash-flows of investments infinitely into the future, typically only 3-10 years of projections are made as an acceptable time-horizon for a financial forecast. This forecasting often then fits with investors who may only hold an asset for 3-10 years. But as the asset may continue to make profit into the future beyond the forecast timeline, investors use the terminal approach to get a future valuation. To get the terminal value an investor needs to get the last cash-flow of the forecast period and then make some assumptions about the future growth rate of the company, meaning the assumption that the cash-flows will continue to grow at a certain rate.

Once the investor gets the last cash-flow and makes the assumption on the future growth rate they can calculate the terminal value. The specific formula is to take the last-cash flow discounted by the growth rate minus the required discount rate, compounded to the last forecast period. Once this value is obtained it is added to the other discounted cash-flows to arrive at a present value figure which shows the price of the investment that would satisfy the investor’s required return. Thus the model is to get the discounted cash flows for the forecast period then add the terminal value at the end.

Typically, the DCF technique, as we have described, will discount a number of periods then add the terminal value. But also, some assets are simply valued at their terminal value from the start and assumed to grow at a constant rate forever. For our studies, as stated above, we will use the more common technique of forecast periods and then a terminal value.

While the DCF and terminal value technique are widely used, the assumptions and figures that go into the model can vary greatly. Our approach is to define a theoretical “real” price and study the correlation to actual historical prices. However, as we have seen so many parameters and variables we have to ask how “real” this “real” price can actually be. Our approach here is not to create some academic valuation model with arbitrary settings and impose it on actual market practices to judge them. The model we are using is designed to be rather simple at its basic nature and make logical sense to an investor, as well as conform to investment industry practices in addition to academic studies.

The model to discount cash-flows is simple and makes sense because the investor should expect that an investment asset should generate a return and therefore a more objective price can be calculated that meets its expectations. We are justified in using this price model because if the finance industry is logical it would consider asset pricing in this way.

Many variations are possible with this technique because the discounted methods can discount yearly cash-flows, quarterly, semi-annually etc. It can use various rate of return requirements to discount the cash-flows. It can have different forecast periods such as two, five, ten years, or any number of periods. And finally, the assumptions in the terminal value can differ greatly. Thus, while the discounted cash flow method is highly popular it can be complicated by many different requirements and techniques. Two educated and skilled investors can both be using the discounted cash flow technique on the same company at the same time but use different techniques and get two different answers. Which is correct or is any one correct? We will discuss more on this later.

# Robert Shiller

Robert Shiller is famous for making this similar study of the accuracy of financial valuations of companies. In 2013 he published the paper *Speculative Asset Prices* which won a Nobel prize in economics. Shiller takes a slightly different approach than will be taken here and we will take some time to comment on this approach.

Shiller used the S&P 500 index and uses a dividend discount model to make a valuation. This means that from the cash-flow created by the company, only what the company decides to pay out in dividends will make up the income discounted in his valuation model. Therefore, when a company pays a large dividend, it commands a large price, and as the dividends grow, assuming the company grows, then the result of the price model also grows. Shiller is able to use historical data to get the dividends and use that information to create a price that reflects the real future situation. He is then able to create a historical valuation that uses future financial information as if the future was known at the time. This hindsight price can then be compared to the real prices of the market index during the historical period of study; the same as the goal in this research paper.

If we take a look at Shiller’s findings the results we find indicate that the historical data on the real market was rather volatile and made large deviations from the actual future of the company. Below we show the results obtained where the actual valuation was relatively stable and growing over time as the actual prices fluctuate around sharply up and down.

Chart, line chart

Description automatically generated

Fig1. Correlation of discounted stock prices and actual prices (Shiller, Robert. 2013. *Speculative Asset Prices*. Nobel Prize. P.469)

From this result is seems that the actual prices only had a loose overall trend relationship with the accurate prices. That is to say that the actual prices correctly trend upward with the real dividend prices however at any given period they change radically and can deviate between overly-optimistic projections with high prices and then sudden crashes as this cycle of boom-and-bust repeats itself in an unpredictable pattern. Shiller makes the following comment after presenting his graph:

To see the problem for efficient markets here, imagine that the series labeled Pt\* is not price but air temperature, and that Pt is a weather forecaster’s forecast of the temperature for that day t. We might be inclined to label this weather forecaster as insane. Even though in the stock market there isn’t immediate feedback to the forecaster about forecast errors, still a forecaster should avoid adjusting forecasts up and down frequently, unless there is actual new information, and clearly there wasn’t, not information about something that actually happened in stock market history.[[13]](#footnote-13)

The study by Shiller is the dividend discount model applied to the market index, this occupies the majority of his work. However, Shiller spends a brief moment, barley longer than a page, citing two studies which may suggest that the observation of the relation of dividend modeling and real prices to individual companies may be different, and more closely correlated. First, by citing a 2002 paper *What Drive Firm-Level Stock Returns* by Tumo Vuolteenaho which uses an autoregressive model to changes in cash-flow expectations. The study claimed to find that individual stock returns are mainly related to cash-flow news. Additionally, Shiller cites one of his own papers where he attempted to study predicting dividend growth by the dividend-price ratio.[[14]](#footnote-14) The dividend price ratio has dividends as the numerator and price as denominator. It would make sense for investors to pay more for a stock if they expect future dividends to be high so the dividend payout ratio would be lower for a firm expected to have high payouts. Shiller and Jung found a relation that suggests that investors were able to identify and predict the future of dividends.

# Our Methodology

We will take some time here to summarize the differences of the approach of this study and that of Shiller. Schiller’s approach is useful and successful but with using advanced tools and access to large amounts of data we should be able to get more detailed results. In order to obtain these results more work needs to go into the study. It is easier with the Shiller approach because then only the index needs to be examined and the yearly data is more simplified. Doing more advanced studies will require computer programming and a large access to data. This paper intends to show how a more advanced study would be carried out.

Because Shiller studies an index it makes the process of obtaining financial data easier as it summarizes many companies. However, in this paper we will look at individual companies and perform an analysis of each one. This is much more difficult as it means getting information on each company, organizing it, and doing unique calculations. Using a study of individual companies should allow the results to be more relevant and also accurate.

Additionally, Shiller uses a dividend discount model while we will use an enterprise valuation. Not every company chooses to pay a portion of its cash-flow as dividends, but any company overall is still a cash-flow producing asset which can be priced with financial theory and market expectations. Therefore, instead of simply looking at dividends we will make a valuation of the company. We will take the free cash-flows from the cash-flow statement and use those as the basis to discount to get the value of the company; then the company value will be divided by the shares outstanding to get the theoretical share price. Therefore, our approach is more focused on company valuation while Shiller’s only indirectly approached this valuation via dividends which closely value an income producing investment, but not specifically the company itself.

Our approach to the discount rate will be much more detailed and company-specific. Shiller uses two approaches with the discount rate in his model, one constant and one varying. In contrast, the study in this paper will get a dynamic variable rate related to the condition of each company. The constant rate used by Shiller is 7.6% which he claims is the historical average real return since 1871. When Shiller uses the variable rate he uses a marginal rate of substitution between consumption in successive periods. When Shiller applies the variable the same result is produced where the actual price shows a loose and volatile relation to the model, shown below:

Diagram

Description automatically generated with medium confidence

Fig2. Correlation of discounted stock prices and actual prices with different discount rates (Shiller, Robert. 2013. *Speculative Asset Prices*. Nobel Prize. P.472)

Because our approach in this paper is to gather data for each firm individually, we will be able to use a unique variable rate fit for each firm. We will use the weighted average cost of capital (WACC) to value a specific company. The WACC aims to create a company-specific discount rate by looking at the company’s capital structure. A company’s capital structure represents the mix of debt and equity, for example if a company’s value is 100, and it is in debt by 50 then the company’s capital structure is 50% debt and 50% equity. The debt represents the lenders and their interest in the firm, they wish that the company remains profitable to make payments on debt, and the equity investors represent the owners of the firm who also expect to financially benefit from the company.

To satisfy the lenders, the company must get a rate of return on its investments that is enough to cover the interest rate. Therefore, if the company pays a rate of interest of 3% then it would need to make investments that generate more than a 3% return. The equity investors will also expect a rate of return so that the company can grow but here it is not so easy to find the rate they will expect. The lenders have negotiated the interest rate while the equity investors do not have a contract with the company that says they want a minimum return. To understand this it is necessary to study the behaviors of investors and know their motivations. All investors look at investments as opportunity costs. Therefore, any single investment can be compared to another investment. The general market return is typically used as a benchmark for comparing alternative investments and we will do the same. We will assume that the equity investors expect that their company will generate a rate of return equal to an historical market average, because why would they want to invest in their company when buying market indexes is more profitable? Thus the cot of equity is usually an opportunity cost where the equity owners of a company want their investments to match or do better than alternative investment options, while the cost of debt is simply the rate required by lenders.

The WACC calculates the required return based on the weight of the company’s capital structure. Let’s assume that investors want an 8% return and debtholders require 3%. Our firm with 50%-50% capital structure would need to get 8% on the equity investment (so a return of 8% on the invested value of 50) and also we need 3% on the debt and thus, if we simply the WACC formula a bit we have: 8% \* 50% + 3% \* 50% = 5.5%. Here we say that the company must get an overall return on its assets of 5.5% to satisfy its debt and equity investors. This is the rate we would be using to make our discount at the variable rate. To make the formula complete the WACC needs the tax shield added to reduce the debt cost, (being that interest expenses are tax-deductible, the WACC is adjusted when the tax rate is known) this has been included in the calculations for our study.

In the study of this paper, the capital structure of each firm for each moment in its history was collected, its rate of interest to debt holders, and the historical market average required by investors. Compared to Shiller’s simple discount rate, using a company-specific rate is another aspect that renders the study in this paper to be more specific and tailored to the analysis. Things like capital structure, taxes, and interest rates change from year to year for a firm making a unique WACC for many time periods. For each period that we discount we will use the relevant WACC with the relevant details pulled form the company financials.

# Process of the Study

The study that was carried out for this research paper was completed by a Python script which has been included in the appendix. The information on the companies comes from making numerous API calls to the database hosted by the Financial Modeling Prep website: https://financialmodelingprep.com.

Each company on the website had its data gathered one-by one with their historical cash-flow statement, balance sheet, and net income statements transferred on a JSON file by an API call. Because we have access to a wealth of data on each company, it was possible to get the figures and organize and apply them to each individual case. To do these calculations by hand would be a monumental task for a number of years and companies so using programming with access to large amounts of data is essential.

Our weighted average cost of capital figures use the unique debt to equity capital structure for each given year to calculate the required return. When it comes to the cost of debt, we can simply find the average interest rate by getting the interest expense from the income statement divided by the amount of debt found on the balance sheet for the given year. For the opportunity cost in the cost of equity we have simplified this to be 10%, based on historical averages to date.[[15]](#footnote-15) To move on to another more advanced level we should suggest that it would be better to use the average market returns for some past few years, meaning that in 1995 the cost of equity could be the market returns from 1990 to 1995, and in 1996 using the past returns from 1991 to 1996, or any other range of time etc. Therefore our approach to the cost of equity was simplified. Lastly, when we calculate the weighted average cost of capital, we need to acquire the effective tax rate paid by the company in a given year. This is also found from making API calls and has been included in the calculations.

Then unlike Shiller's broad approach, the technique used here is to make valuation assessments that apply to the specific conditions of the individual firm at a specific date. The code to gather information also pulls the cash-flows for the company from the free cash-flow statements stored on the financial modeling database. We discount four years’ worth of cash flows, and the fifth year being the final cash flow at the terminal value.

The terminal value projects the past rate of growth forward in the future to assume the company will continue growing at its past rate; or at least this is the basic technique. In order to get the growth rate, cash-flow growth figures were pulled from the financial modeling database and the last five years were averaged. Getting the discounted cash flows and terminal value has some challenges when companies have negative cash. Plenty of companies have periods where they have negative cash-flows as they focus on investing and expanding. However, this yields negative average growth rates with negative terminal values and then will result in negative stock prices when getting a discounted value. This obviously makes no sense and represents a limit in the discounting method. It is often recommended in these cases for investors to use other techniques to value a company. In our case then, there are many moments where the model used here generated negative prices and these periods are to be overlooked until a new model can establish a way of working with these figures. Different investors will have different techniques to approach this question, so our basic approach will not consider these instances although the data will still be collected.

The last steps in the valuation technique is to sum the discounted cash flows and the terminal value, then we subtract net debt. Net debt is calculated by getting the amount of debt on the balance sheet and subtracting the value of cash and cash equivalents. This arrives at the net enterprise value which is what the value of the company is for shareholders. From here we pull the amount of shares outstanding from the company's balance sheet for a given date and divide the enterprise value per share to arrive at the theoretical discounted share price. Then finally it is necessary to make the API calls to get the actual share price that existed at the time of the valuation to compare the deviation from the model to what existed in reality.

# Results of the Study

In total 124 companies have been studied. These companies were selected from the S&P500 index when the company had a sufficient history of data. Of these companies, we found that our valuations and the existing real stock prices often deviated quite drastically. We know that from Shiller's study this was to be expected to a degree. However, the deviation even seems to bear no relation to the stock movement. When the actual prices rise we should expect he discounted value to also rise, and when the actual prices fall the discounted fall, but this was seldom the case. The best match between the discount price and actual price is displayed below for the Intel Corporation (INTC).

Table

Description automatically generated

For INTC, I performed valuations on four separate dates from 2012 to 2015 when they published their yearly financial figures. The real\_price column holds the historical actual price, the discounted\_price column holds the calculated discount price. In this example above, the movement of the discounted values are in-line with the price movements, despite the different prices. In this case we see the movement was correlated and the price deviation was not as large as other examples.

To measure the deviation from discounted theoretical prices to real prices I took the absolute value of the deviation, then averaging the deviation amount gives us a raw average on how much the prices deviated in dollars. Finally, we take the average deviation divided by the average of the prices over the historical period to measure the relative strength of the deviations to their specific prices. For example, if the average stock price from 2012 to 2015 was $100 and the average deviation was $30 then the deviations on average represent 30% of the average price. This way we get a relative representation on how much the deviation is to the price.

For our example of INTC, the average deviation from the discounted prices and the real prices is about $5.86. The average deviation amount of $5.86 represents 20% of the average price over the four-year period, here the deviation is somewhat low compared to others. Another interesting note of INTC is the upward and downward movements are in harmony. Even when the discounted price and the actual price are not correlated, when the actual price goes up the discounted price also went up meaning that investors saw a more promising future for the company and that more promising future realized itself in a higher discounted price. Then later, for the period ending in 2015, there was a fall in the real price and a fall in the discount price. For INTC the up and down movements were correlated. Another example, below we have Nike (NKE) where the discounted price movements do not exactly follow actual movements, and therefore this correlation is not present.

Table

Description automatically generated

We see that the discounted price goes up when the real price goes down etc. The deviation for NKE was much larger, at 84% of the average actual prices for the periods. Other more extreme cases were found such as Apple (AAPL) where the deviations represent 539% of the prices over the period.

Table

Description automatically generated

Looking at total of all companies and if we exclude the instances where we have negative cash-flows, there are 64 companies with 3-5 unique yearly valuations (based on the availability of data and the dates the companies publish their yearly reports) that gives us an overall average deviation of 118%, meaning that in total with this sample set, the fluctuations are slightly larger than the average prices.

There are three reasons to account for these discrepancies. First, we know from Shiller's report, from our assessment of investor behavior, and from understanding the historical stock market booms and busts, that we should expect investors to not be the most accurate at predicting values and more to fall prey to emotions, hype, and trends that distort a more “true” picture of the prospects of a company discounted to a fair value. Secondly, our approach with negative cash-flows and negative growth rates impacting the terminal value was simply a generalized approach and this was accepted into our models. Negative values occasionally made the stock prices negative, which is not logical. In other cases when the overall valuation is positive negative values would simply lower the enterprise value which can be logical, provided it does not bring the whole stock price negative and only simply lowers it. At other moments when dealing with negative values an investor might handle these cases uniquely and adjust the discount factor or growth rate to more accurately predict a company's future after maybe just a few negative periods. An investor might approach the negative growth problem by seeing that a company might be heavily investing and that accounts for a negative cash-flow growth rate; thus it is not necessarily a negative indication for the future of a company. If the investor believes that negative cash flows are investments that will lead to future growth they may wish to adjust this figure or use a different growth rate such as growth in assets. Perhaps a longer forecast horizon would lower the impact of negative cash flow periods. Lastly, the assumptions made in the study used only one technique to discount for a certain time period with given rates and our fixed cost of equity. We used only one historical cost of equity rate (although the overall discount rate, the WACC, varied from period to period and was a variable rate), and we used simply a 4-year horizon where the 5th year was the terminal value. We know that multiple options, inputs, and iterations are possible to generate different values from discounting, yet the scope and time constraints of this particular study limited us to just one approach of many. Robert Shiller also uses a limited approach and still carries a Nobel prize, this is because to undergo the massive technicalities of all valuation techniques requires a great deal of effort. In this study we have made an additional advancement on Shiller’s study by performing company-specific valuations, and I argue that this is a more correct approach. However, in the next section we will comment on how to grow this study to include a more robust number of discounting techniques.

# A more advanced study

In 2013 Robert Shiller received a Nobel prize for carrying out a similar study to this paper with and index fund and a dividend discount model. This paper has attempted to suggest a more advanced technique is possible to replicate this study using modern programming tools and data. Moreover, we have created the techniques and code to prove that a more advanced study is certainly possible because to a limited degree it was accomplished here. The approach from Shiller is a great step in measuring the accuracy of financial models and is one of the first of its kind. However, the accuracy is limited in that he uses an index rather than looking at companies uniquely with time-specific figures.

The index approach is broad as it takes into consideration many companies, where the would-be accuracies of some financial models for some companies may be offset by the inaccuracies of other companies in the index and vise-versa, so the index is more of a mix between different results comingled together. Moreover, the discount rate used by Shiller, both variable and the constant rate is itself again too broad as it does not take into consideration the situation of the firms and the firms as a whole. The proper discount rate used in models uses costs of capital and the weighted proportions necessary to satisfy investors. To obtain this rate a study of the capital composition is required. Shiller would have been better finding the capital structure of the whole index if he could or if it was even possible. Getting the capital structure for the index is a demanding task so we understand how this maybe was not possible or if Shiller did not possess the right tools and knowledge to mine all this data en masse.

Therefore, while we should continue to respect the 2013 work from Shiller it should be a foundation for us to continue the research to try to produce a more accurate model. The unique parameters used are available on databases that are open today and track company financials which go back many decades. Moreover, today the programming tools are available to build the processes that calculate and sort all the data if the analyst has the skill to write a program capable of handling all of it. With our study here we have proven that these techniques are possible to implement, even if our study was limited in some ways, which we will discuss below.

We can make some suggestions for a future study of this kind. Two key approaches would be to firstly establish a way to handle the negative growth rates in a consistent way. In real life there are techniques used and the best can be applied to another study. Secondly, there can be more simulations that use different discounting techniques to find the ones that had the most accurate results. Here we simply used one technique, one fixed cost of equity and one fixed time frame to discount with our 5-year horizons. However, in real life there are plenty of different ways to discount. Each technique can be applied to each company and the success of each model compared. We may find that, historically 10-year horizons have been more accurate with costs of equity that use the past 5-years of market returns, or any other combinations. Below are a few combinations that can be used:

|  |  |  |
| --- | --- | --- |
| **Cost of Equity Rate** | **Forecast Period** | **Growth Rate** |
| Variable rate at past 5 years average annual market return | Five years then terminal value | GDP Last 5 years |
| Variable rate at past 10 years average annual market return | Ten years then terminal value | GDP Last 10 years |
| Variable rate at past 15 years average annual market return | Etc.… | GDP Last 15 years |
| Constant Rate | Infinite growth model | Company average growth last 5, 10, and 15 years, etc. |

Therefore, a new approach should be able to calculate many iterations with various inputs. The program can run the same calculations numerous times and output the different results of each technique. Then for each result we can take the best correlation. This way we do two things, we can for one, select the model that has the best accuracy to use as the best-case comparison, and also potentially find that a certain modeling technique is best. Because there are many input possibilities, we would be making a more serious study if the inputs are logical, as opposed to a disingenuous study which used faulty inputs and then came to a wrong conclusion, we can run simulations to use the best possible comparison between theoretical prices and actual prices. If we find the best rate of success for various models then investors would find that information useful for making new models.

Another suggestion is to not look only at the discounted price deviation to the actual price, but also the correlation between the discounted price and the actual price. Because our discounted cash-flow price is retrospective with actual historical data we will expect the discounted price to go up or down based on positive or negative company performance. This up or down movement would possibly be correlated to up or down movements in the actual price. Above we briefly alluded to this by looking at our data by eye but a more advanced measurement would be necessary. Measuring the correlation between movements would also be important for our understanding of the accuracy of the models, not just in the sense that the discounted prices match exactly with the actual prices, but it would be useful to measure the strength of the moment correlation. This simply indicates not just if investors value companies exactly to a theoretical discount price, but it would test if investors can identify if a company will have a positive or negative future. In that the prices would go up when the company is set to get a larger future income and conversely the prices would go down on companies with a worse future. Then the same formulation can be used in that we compare the actual up and down model movements to the actual up and down price movements, we test the overall correlation as well as the strength of the correlation.

While testing the correlation of movements, due to the issue of relative scale of the discount rates it should be suggested to standardize the changes based on simple feature scaling. This would be necessary to examine a relatable comparison between the two changes in the market and in our model. When we use the simple feature scaling we will divide each number in a set by its largest value. This way, when the values change we look at them relative to their own size in the same set. Below we show the same change in the income from 100 to 150 including the 5% and 10% rates and their differences in the amount of change. However, also included is the scaled value for each discount method. The result with the scaled values is here comparable so that the change from 100 to 150 is reflected in an equal change of 0.33 no matter if the 5% or 10% rate is used.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Income** | **5% Discount** | **5% Discount Scaled** | **10% Discount** | **10% Discount Scaled** |
| $ 100.00 | $ 95.24 | 0.667 | $ 90.91 | 0.667 |
| $ 150.00 | $ 142.86 | 1 | $ 136.36 | 1 |
| Difference | $ 47.62 | 0.333 | $ 45.45 | 0.333 |

Therefore, now we can come closer to a comparable difference between the changes between our fixed rate model and the market. When the market moves, we will look at that change in magnitude in the context of the existing market prices and we will do the same for our model. Yet we may also recall back to the cost of capital and discount rate selection and know that any real rate used in the market must change as any given rate exists in an already existing and changing marketplace with already existing and changing expectations.

Therefore, while the study conducted in this paper has added some, what we refer to as missing details to the Shiller approach, still a more advanced approach is required that simply takes time, skill, and effort in writing the programming code. Our results that showed discounted prices that greatly deviated from the actual prices, as was expected, but with multiple iterations and different models it should be possible to find a better fitting model. And moreover, as we just described above, a correlation of movements in the discount price and actual price should also be tracked.

# Conclusion

From our study of 124 companies, we found that historical valuations did not match the actual future cash-flows. This means that our results show that investors did not properly price the company based on our 5-year horizon and techniques. When an investor does not price an asset correctly this means that the future prediction of cash-flows was not accurate. Our study also compliments the study of Robert Shiller, which we are quite interested in due to its similar nature to our goals and its popularity and recognition.

While we can say that our study was limited because the technique was simplified among the many techniques available to discount, we actually make another admission in this statement. We know that there are many techniques and forecasts periods choices involved in discounting so we must admit that while we found that our tools lead to notable deviations from actual prices, the tools and methods themselves are widely varying and there is no “correct” approach. Therefore, as we can say that our discounting technique found that investors had inconsistent theoretical prices compared to actual prices, this statement is restricted in that even the methods and tools themselves are not consistent. Therefore, we can ask, does a theoretical “real” price even exist?

Despite the problems of finding the “real” technique we know that discounting is very logical according to the notion of rate of return and investor desires. Therefore, the technique itself is very “real” but the varying number of approaches make it impossible to actual arrive at an objective theoretical price. Therefore, our suggestion, as stated in a previous section, is that we should stick to the discounting method but run multiple iterations implementing various techniques and then choose to take the closest match for an analysis like this. Moreover, for professionals in the industry the common practice is to use a valuation technique that makes sense for the investor which is logical because each investor has their own investment objectives and criteria, without much concern for the functioning of the larger economy if it comes at an expense to their revenue.

We have discussed how the finance industry makes significant contributions to a well-functioning economy by supporting business to overcome problems in market coordination, timing, and support. However, as the financial sector acts as a provider of forecast information we may still have some room for improvement. While we know that no “true” approach exists to valuation, multiple financial crises, fraud, and volatility show that the finance industry can still undergo development. Many professional investors are taken as experts in predicting market trends, successes and failures, and other business opportunities. Investment experts are highly trained, highly skilled, and should possess an intuitive understating of business and consumer behavior. Yet, despite this expertise and all the resources that support the financial industry, it seems their actual ability to forecast marked by upward and downward volatility that lessens a smooth and accurate equity markets. Inaccurate forecasting holds back the potential for the finance industry to support new and innovative opportunities and reveals a danger of supporting unsustainable outlets that can lead to economic problems and crisis.

When it comes to reproducing this study with the most advanced programming, if we discount a given company and find that a 10-year forecast period and a cost of equity based off the last 5-years of S&P 500 returns has the closest match then we should select this method to determine the accuracy of discounted prices compare to real prices. This may be seen to be a charitable approach however it seems appropriate in this circumstance. Because there are different possibilities it seems appropriate to pick the one that is the best match and use that to evaluate the strength of the modeling technique in general. Yet also this again expands the complexity of the study where the data analyst needs an increasingly more complicated code to process all this additional information.

Despite any study that reveals the lacking accuracy of financial forecasting the finance industry will continue to play its role as a part in a larger economy. This is true even while the finance industry does not exist to support economic growth but only to benefit itself. The purpose of our study into the accuracy of financial forecasting, and the numerous other studies of the finance industry will have no impact unless it has some kind of policy suggestion or discovery that will alter the behavior of financial institutions. This topic study may actually continue to grow in importance as the finance industry grows in importance to the global economy. A recent research article published by the Federal Reserve Bank of St. Louis states that in Q4 of 2020 U.S. private debt (of individuals and business) was 160% of GDP, and this figure has been on the rise; at the start of 1990 private debt was 120% of GDP and in 1980 was 97%.[[16]](#footnote-16) Therefore, the financial sector of the economy is becoming larger and larger as the rest of the economy is becoming more reliant on it. This means that external financing is often key to shaping the growth and direction of an economy. Therefore our understanding and studies of the finance industry are becoming increasingly more and more important. So more than ever, the finance industry must be making accurate and positive contributions through accurate forecasting, accurate identification of opportunities, and a continued role in supporting an economy. Instead of making bad investments and sparingly supporting business, we should expect good investments and a sufficient level of spending that frees up idle money and gets it buying goods, services, and employees.

# References

Athanassakos, G. (2012). Value Investing Vs. Modern Portfolio Theory. *Research Gate*

Retrieved from: https://www.researchgate.net/publication/269548838\_Value\_Investing\_Vs\_Modern\_Portfolio\_Theory

Banerjee, A. (2017). The First Modern Bailout: The Barings Crisis of 1890 and the Bank of England. *Columbia University – Department of History, (Undergraduate Thesis)*

Retrieved from: https://history.columbia.edu/wpcontent/uploads/sites/20/2016/06/Banerjee\_Thesis.pdf

Beck, T. (2011). The Role of Finance in Economic Development*.* *European Banking Center Discussion Paper*, No. 2011-038.

Retrieved from:

https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=1974471

Carin, van der Cruijsen, Jakob de Haan, and Roerink, Ria . (2020). Trust in Financial Institutions: A Survey. *DeNederlandscheBank DNB Working Paper,* No. 693.

Retrieved from:

https://www.dnb.nl/en/publications/research-publications/working-papers-2020/693-trust-in-financial-institutions-a-survey/

Daglish, T, and Moore, L. (2018). Railroad Bailouts in the Great Depression.

Retrieved from:

http://pseweb.eu/ydepot/seance/512888\_DM2\_1\_Tables.pdf

Dyck, A and Zingales, L. (2002). The Bubble and the Media. *Research Gate/Corporate Governance and Capital Flows in a Global Economy*

Retrieved from:

https://www.researchgate.net/publication/248649185\_The\_Bubble\_and\_the\_Media

Lazonick, W. (2016). How Stock Buybacks Make Americans Vulnerable to Globalization. *The Academic Industry Research Network*

Retrieved from:

https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=2745387

Luehrman, T. (1998). Investment Opportunities as Real Options: Getting Started on the Number*. Harvard Business Review*

Retrieved from:

https://hbr.org/1998/07/investment-opportunities-as-real-options-getting-started-on-the-numbers

Malkiel, B. (1995). Returns from Investing in Equity Mutual Funds 1971 to 1991. *Journal of Finance*, Vol L, No.2, Jstor

Retrieved from:

https://www.jstor.org/stable/2329419

Malkiel, B. (2003). The Efficient Market Hypothesis and Its Critics. *Journal of Economic Perspectives*, Volume 17, Number 1, pg.59-82

Retrieved from:

https://eml.berkeley.edu/~craine/EconH195/Fall\_16/webpage/Malkiel\_Efficient%20Mkts.pdf

Maverick, J.B. (2021). What Is the Average Annual Return for the S&P 500? *Investopedia.*

Retrieved from:

https://www.investopedia.com/ask/answers/042415/what-average-annual-return-sp-500.asp

Perkis, D. (2020). Making Sense of Private Debt. *Federal Reserve Bank of St.Louis Economic Research*

Retrieved from:

https://research.stlouisfed.org/publications/page1-econ/2020/03/02/making-sense-of-private-debt

Shiller, R and Jung, J. (2006). Samuelson’s Dictum and the Stock Market. *Cowles Foundation for Research in Economics, Yale University*. No.1183

Retrieved from:

http://www.econ.yale.edu//~shiller/pubs/p1183.pdf

Shiller, R. (2013). Speculative Asset Prices. *Nobel Prize*

Retrieved from:

https://www.nobelprize.org/uploads/2018/06/shiller-lecture.pdf

Vuolteenaho, T. (2002). What Drive Firm-Level Stock Returns. *Wiley Online Library*

Retrieved from:

https://onlinelibrary.wiley.com/doi/10.1111/1540-6261.00421

Zingales, L. (2015). Does Finance Benefit Society. *National Bureau of Economic Research. Working Paper 20894*

Retrieved from:

https://www.nber.org/system/files/working\_papers/w20894/w20894.pdf

# Appendix

Below I have placed my Python code that was used to gather and process the financial data. There are two sections, the first section is the file that imports and engages the second section which is the get\_data file containing most of the processing.

File to Run get\_data File:

pip install openpyxl

import get\_data

import json

import pandas as pd

import openpyxl

list\_of\_stocks =["MO", "AEP", "BA", "BMY", "CPB", "CVX", "KO", "CL", "COP", "CVS", "DE", "EIX", "ETR", "XOM", "HAL", "HIG", "HSY", "IBM", "KR", "MRK", "NSC", "PFE", "PG", "PEG", "SEE", "UNP", "XEL", "ABT", "SHW", "CMI", "EMR", "CLX", "GIS", "NEM", "MCD", "LLY", "BAX", "JNJ", "GPC", "HPQ", "WMB", "JPM", "BAC", "DUK", "TAP", "NEE", "DIS", "WFC", "MMM", "INTC", "TGT", "TXT", "WBA", "AIG", "FDX", "PCAR", "ADP", "GWW", "MAS", "SNA", "AAPL", "OXY", "CAG", "BBWI", "VZ", "LOW", "HES", "HAS", "BLL", "APD", "NUE", "PKI", "NOC", "TJX", "DOV", "PH", "ITW", "GPS", "MDT", "SYY","AVY", "HD", "NKE", "ECL", "GL", "NWL", "ORCL", "ADSK", "MRO", "AEE", "AMGN", "LIN", "COST", "CSCO", "KEY", "UNM", "MSFT", "LUV", "UNH", "MU", "BSX", "ALL", "CMA", "AON", "AZO", "ADBE", "CAH", "SCHW", "EFX", "APA", "PGR", "YUM", "TFC", "CINF", "RF", "AES", "LUMN", "CMS","NTAP", "VMC", "ADI", "LEG", "XLNX", "CTXS"]

ticker\_names = []

real\_price = []

discounted\_price = []

date = []

api\_key = ‘INSERT KEY HERE’

for i in list\_of\_stocks:

ticker = i

print(i)

results = get\_data.get\_data(ticker, api\_key)

for i in range(len(results['ticker'])):

ticker\_names.append(results['ticker'][i])

real\_price.append(results['real price'][i])

discounted\_price.append(results['discount price'][i])

date.append(results['date'][i])

df = pd.DataFrame(list(zip(ticker\_names, real\_price, discounted\_price, date)),

columns =['ticker\_names', 'real\_price', 'discounted\_price', 'date' ])

file\_name = 'data\_file.xlsx'

df.to\_excel(file\_name)

File get\_data:

from urllib.request import urlopen

import json

def get\_data(ticker, api\_key):

def get\_WACCs(ticker, api\_key):

def get\_ratios(ticker, api\_key):

url = 'https://financialmodelingprep.com/api/v3/ratios/' + ticker + '?limit=40&apikey=' + api\_key

response = urlopen(url)

data = response.read().decode("utf-8")

data = (json.loads(data))

debt\_to\_assets\_list = []

equity\_to\_assets\_list = []

effective\_tax\_rate\_list = []

date\_list = []

for i in range(len(data)-1):

debt\_to\_assets = data[i]['debtRatio']

equity\_to\_assets = 1-debt\_to\_assets

effective\_tax\_rate = data[i]['effectiveTaxRate']

debt\_to\_assets = round(debt\_to\_assets,4)

equity\_to\_assets = round(equity\_to\_assets,4)

if effective\_tax\_rate == None:

effective\_tax\_rate = 0

effective\_tax\_rate = round(effective\_tax\_rate,4)

date = data[i]['date']

debt\_to\_assets\_list.append(debt\_to\_assets)

equity\_to\_assets\_list.append(equity\_to\_assets)

effective\_tax\_rate\_list.append(effective\_tax\_rate)

date\_list.append(date)

ratios\_dict = {

'D/A': debt\_to\_assets\_list,

'E/A': equity\_to\_assets\_list,

'effective tax': effective\_tax\_rate\_list,

'dates': date\_list

}

return ratios\_dict

def get\_cost\_of\_debt(ticker, api\_key):

url = 'https://financialmodelingprep.com/api/v3/income-statement/' + ticker + '?limit=120&apikey=' + api\_key

response = urlopen(url)

data = response.read().decode("utf-8")

data = (json.loads(data))

interest\_expenses = []

date\_list = []

for i in range(len(data)-1):

interest\_expenses.append(data[i]['interestExpense'])

date\_list.append(data[i]['date'])

url = 'https://financialmodelingprep.com/api/v3/balance-sheet-statement/' + ticker + '?limit=120&apikey=' + api\_key

response = urlopen(url)

data = response.read().decode("utf-8")

data = (json.loads(data))

total\_debt = []

for i in range(len(data)-1):

total\_debt.append(data[i]['totalDebt'])

costs\_of\_debt = []

for i in range(len(total\_debt)):

if not total\_debt[i] == 0:

costs\_of\_debt.append(interest\_expenses[i]/total\_debt[i])

else:

costs\_of\_debt.append(0)

cost\_of\_debt\_dict = {

'cost of debt' : costs\_of\_debt,

'dates' : date\_list

}

return cost\_of\_debt\_dict

def sync\_dates(ratios\_dict, cost\_of\_debt\_dict):

min\_length = min(len(ratios\_dict['dates']) , len(cost\_of\_debt\_dict['dates']))

cost\_of\_debt\_dict['cost of debt'] = cost\_of\_debt\_dict['cost of debt'][0:min\_length]

cost\_of\_debt\_dict['dates'] = cost\_of\_debt\_dict['dates'][0:min\_length]

ratios\_dict['D/A'] = ratios\_dict['D/A'][0:min\_length]

ratios\_dict['E/A'] = ratios\_dict['E/A'][0:min\_length]

ratios\_dict['effective tax'] = ratios\_dict['effective tax'][0:min\_length]

ratios\_dict['dates'] = ratios\_dict['dates'][0:min\_length]

for i in range(min\_length):

if not cost\_of\_debt\_dict['dates'][i] == ratios\_dict['dates'][i]:

cost\_of\_debt\_dict['cost of debt'] = cost\_of\_debt\_dict['cost of debt'][0:i-1]

cost\_of\_debt\_dict['dates'] = cost\_of\_debt\_dict['dates'][0:i-1]

ratios\_dict['D/A'] = ratios\_dict['D/A'][0:i-1]

ratios\_dict['E/A'] = ratios\_dict['E/A'][0:i-1]

ratios\_dict['effective tax'] = ratios\_dict['effective tax'][0:i-1]

ratios\_dict['dates'] = ratios\_dict['dates'][0:i-1]

break

return ratios\_dict, cost\_of\_debt\_dict

def get\_WACCs(ratios\_dict, cost\_of\_debt\_dict):

WACC\_list = []

date\_list = []

min\_length = min(len(ratios\_dict['E/A']), len(ratios\_dict['D/A']), len(cost\_of\_debt\_dict['cost of debt']), len(ratios\_dict['effective tax']))

for i in range(min\_length):

WACC = (ratios\_dict['E/A'][i] \* 0.10) + (ratios\_dict['D/A'][i] \* cost\_of\_debt\_dict['cost of debt'][i] \* (1-ratios\_dict['effective tax'][i]))

WACC\_list.append(round(WACC,4))

date\_list.append(ratios\_dict['dates'][i])

WACC\_dict = {

'WACC' : WACC\_list,

'dates' : date\_list

}

return WACC\_dict

ratios\_dict = get\_ratios(ticker, api\_key)

cost\_of\_debt\_dict = get\_cost\_of\_debt(ticker, api\_key)

ratios\_dict, cost\_of\_debt\_dict = sync\_dates(ratios\_dict, cost\_of\_debt\_dict)

WACC\_dict = get\_WACCs(ratios\_dict, cost\_of\_debt\_dict)

return WACC\_dict

def get\_cash\_flows(ticker, api\_key):

url = 'https://financialmodelingprep.com/api/v3/cash-flow-statement/' + ticker + '?limit=120&apikey=' + api\_key

response = urlopen(url)

data = response.read().decode("utf-8")

data = (json.loads(data))

free\_cash\_flow\_list = []

dates = []

for i in range(len(data)-1):

cash\_flow = data[i]['freeCashFlow']

# if cash\_flow < 0:

# cash\_flow = 0

free\_cash\_flow\_list.append(cash\_flow)

dates.append(data[i]['date'])

free\_cash\_flows = {

'cash-flows': free\_cash\_flow\_list,

'dates' : dates

}

return free\_cash\_flows

def get\_revenue\_growth(ticker, api\_key):

url = 'https://financialmodelingprep.com/api/v3/cash-flow-statement-growth/' + ticker + '?limit=40&apikey=' + api\_key

response = urlopen(url)

data = response.read().decode("utf-8")

data = (json.loads(data))

rev\_growth = []

dates = []

for i in range(len(data)-1):

growth\_rate = data[i]['growthFreeCashFlow']

if growth\_rate < 0:

growth\_rate = 0

rev\_growth.append(growth\_rate)

dates.append(data[i]['date'])

average\_growths = []

average\_growth\_dates = []

for i in range(4,len(rev\_growth)):

average\_growth = (rev\_growth[i] + rev\_growth[i-1] + rev\_growth[i-2] + rev\_growth[i-3] + rev\_growth[i-4])/5

average\_growth = round(average\_growth,4)

if average\_growth < 0:

average\_growth = 0

average\_growths.append(average\_growth)

average\_growth\_dates.append(dates[i])

growth\_dict = {

'growth rate': average\_growths,

'date' : average\_growth\_dates

}

return growth\_dict

def discount\_cash\_flows(WACC\_dict, free\_cash\_flows, growth\_dict):

discounted\_cash\_flows\_list = []

date\_list = []

for i in range(len(free\_cash\_flows['dates'])-5,0,-1):

c = 0

k = 0

for ii in range(len(WACC\_dict['dates'])):

if WACC\_dict['dates'][ii] == free\_cash\_flows['dates'][i]:

c = ii

for ii in range(len(growth\_dict['date'])):

if growth\_dict['date'][ii] == free\_cash\_flows['dates'][i]:

k = ii

if c != 0 and k != 0:

sum\_discounted\_cash\_flows = 0

for iii in range(1,5):

sum\_discounted\_cash\_flows = sum\_discounted\_cash\_flows + free\_cash\_flows['cash-flows'][i+iii-1]/pow(1+WACC\_dict['WACC'][c],iii)

terminal\_value = free\_cash\_flows['cash-flows'][i+4]/(growth\_dict['growth rate'][k]-WACC\_dict['WACC'][c])

sum\_discounted\_cash\_flows = sum\_discounted\_cash\_flows + terminal\_value

discounted\_cash\_flows\_list.append(sum\_discounted\_cash\_flows)

date\_list.append(free\_cash\_flows['dates'][i])

discounted\_cash\_flows = {

'cash-flows': discounted\_cash\_flows\_list,

'date' : date\_list

}

return discounted\_cash\_flows

def get\_share\_price(ticker, api\_key, discounted\_cash\_flows):

url = 'https://financialmodelingprep.com/api/v3/balance-sheet-statement-as-reported/' + ticker + '?limit=10&apikey=' + api\_key

response = urlopen(url)

data = response.read().decode("utf-8")

data = (json.loads(data))

stock\_price\_list = []

date\_list = []

possible\_debt\_names = ['longtermdebtandcapitalleaseobligations', 'longtermdebtnoncurrent', 'longtermdebtandcapitalleaseobligationscurrent', 'longtermdebt', 'otherliabilitiesnoncurrent',

'longtermdebtfairvalue', 'otherlongtermdebtnoncurrent', 'unsecuredlongtermdebt']

possible\_cash\_names = ['cashandcashequivalentsatcarryingvalue', 'cashandduefrombanks', 'cash', 'cashcashequivalentsandshortterminvestments']

for i in range(len(discounted\_cash\_flows['date'])):

for ii in range(len(data)-1):

if data[ii]['date'] == discounted\_cash\_flows['date'][i]:

for iii in possible\_debt\_names:

try:

long\_term\_debt = data[ii][iii]

break

except:

pass

for iii in possible\_cash\_names:

try:

cash\_and\_equivalants = data[ii][iii]

break

except:

pass

net\_debt = long\_term\_debt - cash\_and\_equivalants

EV = discounted\_cash\_flows['cash-flows'][i] - net\_debt

try:

stock\_price = EV/data[ii]['commonstocksharesoutstanding']

except:

stock\_price = EV/data[ii]['commonstocksharesissued']

stock\_price\_list.append(stock\_price)

date\_list.append(data[ii]['date'])

share\_price\_dict = {

'stock price': stock\_price\_list,

'date' : date\_list

}

return share\_price\_dict

def get\_historical\_stock\_price(ticker, api\_key, share\_price\_dict):

url = 'https://financialmodelingprep.com/api/v3/historical-price-full/' + ticker + '?serietype=line&apikey=' + api\_key

response = urlopen(url)

data = response.read().decode("utf-8")

data = (json.loads(data))

data = data['historical']

real\_stock\_price\_list = []

discont\_price\_list = []

date\_list = []

ticker\_list = []

for i in range(len(share\_price\_dict['date'])):

for ii in data:

if ii['date'][:7] == share\_price\_dict['date'][i][:7] :

real\_price = ii['close']

date = share\_price\_dict['date'][i]

discounted\_price = share\_price\_dict['stock price'][i]

break

real\_stock\_price\_list.append(real\_price)

discont\_price\_list.append(discounted\_price)

date\_list.append(date)

ticker\_list.append(ticker)

final\_dict = {

'ticker': ticker\_list,

'real price': real\_stock\_price\_list,

'discount price': discont\_price\_list,

'date': date\_list

}

return final\_dict

WACC\_dict = get\_WACCs(ticker, api\_key)

free\_cash\_flows = get\_cash\_flows(ticker, api\_key)

growth\_dict = get\_revenue\_growth(ticker, api\_key)

discounted\_cash\_flows = discount\_cash\_flows(WACC\_dict, free\_cash\_flows, growth\_dict)

share\_price\_dict = get\_share\_price(ticker, api\_key, discounted\_cash\_flows)

final\_dict =get\_historical\_stock\_price(ticker, api\_key, share\_price\_dict)

return final\_dict

1. Beck, 2011 [↑](#footnote-ref-1)
2. Zingales. 2015 [↑](#footnote-ref-2)
3. van der Cruijsen, de Haan, and Roerink. 2020 [↑](#footnote-ref-3)
4. Dyck and Zingales, 2002 [↑](#footnote-ref-4)
5. Banerjee, 2017 [↑](#footnote-ref-5)
6. https://en.wikipedia.org/wiki/Troubled\_Asset\_Relief\_Program [↑](#footnote-ref-6)
7. Daglish and Moore, 2018 [↑](#footnote-ref-7)
8. Malkiel, 2003, p.22 [↑](#footnote-ref-8)
9. Comparing not just rates of return but also factoring in the risk of the investment, because according to efficient market theory, an investor should be able to get returns higher than the market if they accept additional risk. [↑](#footnote-ref-9)
10. Lazonick 2016 [↑](#footnote-ref-10)
11. Athanassakos, 2012 [↑](#footnote-ref-11)
12. Luehrman, Timothy, 1998 [↑](#footnote-ref-12)
13. Shiller, 2013, p.469 [↑](#footnote-ref-13)
14. Jung, and Shiller, 2006 [↑](#footnote-ref-14)
15. Maverick, 2021 [↑](#footnote-ref-15)
16. Perkis 2020 [↑](#footnote-ref-16)